AN ASSESSMENT OF PROCEDURES FOR DETERMINING CIVIL WORKS RESEARCH AND DEVELOPMENT NEEDS AND PRIORITIES

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PREFACE

I. Purpose and Recommendations

On 13 August 1980 the Deputy Director of Civil Works requested that the Institute for Water Resources (IWR) investigate the procedures for developing priorities for the Civil Works Research and Development Program (R&D). The resulting Report is a working paper that details IWR's assessment, findings and conclusions. This preface overviews and supplements our principle findings. IWR's charge was to make a preliminary diagnosis of the current Civil Works R&D prioritization system and to suggest options for improvement. These suggestions are directed toward facilitating dialogue among R&D participants on various issues of research prioritization. By focusing debate on the issue of R&D prioritization, we anticipate that review of the Report will provide impetus for a better definition of the system, its problems and related issues. All those reviewing, critiquing and discussing the prioritization problem are encouraged to generate new solutions and fresh ideas.

The Report presents 15 improvement actions and describes what the general impacts of selected groups of them would be. As directed, the Report does not contain detailed data such as manpower calculations, Laboratory capital investment data, or percentage of research done inhouse or by contract. Thus, we have described the system, synthesized a number of problems, and developed suggestions for improvement.

As the study progressed and our awareness of major structural problems emerged, it became clear that a more detailed analysis of certain aspects of the overall R&D prioritization system is warranted. In this regard the preface goes beyond the Report and briefly indicates approaches that would more radically address the major structural problems in the R&D prioritization system.

At this time, we recommend that a process be initiated to restructure certain aspects of the Research Needs System and the priority setting process. Such a restructuring should distinguish between long term, intermediate and short-term research. Long-term and intermediate research priorities should be tied primarily to strategic goals expressed at OCE through the Civil Works R&D Review Committee and should reflect emerging policy and long-term plans. Field advisory committees should assist, but not be the primary focus in prioritizing such research. To be meaningful, short-term research must be accomplished quickly, by reducing the number of the actors in the game. OCE should provide guidance to field laboratories on goals for percentage of long-term intermediate, and short-term research.

If OCE decides not to restructure R&D prioritization or, pending further studies, not to significantly disturb the existing procedures, our recommendations are to adopt at least the package of seven high priority options included in the Report (Chapter V). That package includes options to:

- o Increase MPS Quality Control;
- o Improve general understanding of the processes involved in developing R&D needs and priorities;
- o Clarify Technical Monitor roles;
- o Institute basic changes in the MPS rating process;
- o Institute basic changes in the MPS analysis process;
- o Reinforce the Civil Works R&D Review Committee function; and,
- o Institute a long-range investment budget/priority system.

II. Defining Prioritization and R&D

Perceptions of both prioritization and research vary significantly among Civil Works R&D personnel. Of the roughly $70 million Civil Works research effort, almost one-half is accomplished through direct reimbursable agreements between laboratories and other Corps elements, while the remaining $35 million is subject to the Civil Works research prioritization system. However, it is not apparent that a substantial percentage of this $35 million is distributed according to any specific set of priorities in any one year. Given the continuing requirements of laboratory staff salaries and overhead, revolving fund repayments for investments in physical plant, and the inertia of ongoing programs, only a limited increment of this $35 million is available for allocation each fiscal year.

In this sense, prioritization means the annual distribution of a limited discretionary percentage of the $35 million research budget across six Research Areas and 29 Research Programs conducted by five Research Laboratories (WES, CERC, CRREL, CERL, ETL) and two Research Performing Offices (HEC and IWR).

For some, prioritization (or distribution of these discretionary dollars) means statistical analysis of Mission Problem Statements (MPS) which are presumed to reflect field priorities for research. For others, prioritization means statistical weighting by the Civil Works Research Committee. While both MPS analysis and the Committee weighting are critical, they tell only part of the prioritization story. Together they constitute a formalized process of assessing and prioritizing research needs and budgets which many Corps personnel often call the "Civil Works Research Prioritization Process."

Some Corps personnel feel that prioritization should address the total $35 million Civil Works research budget. This view of prioritization could result in a drastic redistribution of the $35 million budget with forced major and/or minor disruptions to the among Corps laboratory community. It is within this context, that the need for a long-term research investment strategy becomes apparent. If either research budgets or manpower significantly decrease, this redistributive perspective of prioritization will become clearer.

In a larger sense, prioritization refers to the percentage of the Civil Works budget devoted to R&D. In the last several years the R&D budget has remained at roughly one percent of the total Civil Works Budget. Whether one percent is too large or too small, depends on a more general view of the utility of the Corps research program by Corps management. The Directorate of Research and Development, Civil Works Directorate (including Programs Division), OMB and Congress play roles in establishing and maintaining such a percentage. The degree of influence each exercises in this setting is unclear. However, prioritization as a percentage of the Civil Works budget, is likely to surface under the conflicting trends of budget and manpower cuts and an increased need to find and adapt to new missions.

Regardless of perspective, one theme filters throughout the Corporate R&D sector and the research management literature. That is, that R&D prioritization should be directly tied to strategic organization goals. In the Corps Civil Works functions, R&D prioritization attempts to balance among short- and long term goals, but operates from a research needs system that is strongly biased toward short-term field needs. There is little apparent link between prioritization and long-term strategic (or other macro-organizational) and future goals.

The lack of a commonly held definition of Research and Development -- which is really the object of the prioritizing process -- is striking. How one defines R&D greatly influences one's expectations of the appropriate prioritization process. For example, we found that Corps personnel hold three broad purposes of R&D: to increase the efficiency in meeting current planning, engineering, operating and regulatory missions; to anticipate trends and project future events; and to create and to innovate new possibilities, options and missions for the Corps. Essentially, R&D is viewed as helping our organization to transcend its current circumstances, to adapt to changing circumstances, and to lead its evolution into new circumstances.

More practically, Corps R&D capability is viewed as increasing the Corps' capacity to: maintain its large public capital investment, complete ongoing and plan new useful projects, manage and reduce the conflict surrounding projects, find new missions, find new ways to do old missions, and to help transform field needs into field guidance.

Clearly the different views target different types of research goals: short, medium and long-term as well as applied and basic research. Priorities for each of these research categories are likely to differ, yet over the last several years, the Civil Works research system has been striving to institute one prioritization system to collectively service all of these types. We suspect that much of the frustration underlying debate over prioritization mechanics stems from this attempt.

III. The Existing System

The Report provides a detailed description of the current system. Achieving this description was surprisingly difficult, because there are considerable differences in perception of the system operations. Essentially, the system is activated through four decision processes: Mission Problem Statement (MPS) generation and ranking, Work Unit development, Research Program Reviews, and the Civil Works R&D Review Committee review. Compared with other major water resources agencies, the Corps has a more formally developed system of prioritizing research, which, over the last few years has been actively evolving. The major flaws and positive points of the system decision process are briefly highlighted in the following paragraphs.

The system's evolution has generated frustration, in part, because frequent rule changes reduce the traceability of prioritization decisions and, thus, the utility of formalization. Additionally, major new programs appear to first emerge outside the system and are then legitimized inside the formal process procedures. In addition, there is no readily apparent mechanism for terminating or de-emphasizing major on-going programs.

Within the RNS, the purpose of MPS generation and ranking is to solicit field needs and develop field priorities for researching them. In actuality most MPS are generated directly or indirectly by the laboratories. Work units are developed solely by laboratories and represent laboratory views concerning the appropriate reaction to field problems. The connection between MPS and Work Units is not rigidly monitored and consequently the laboratory research programs are frequently viewed by the field as not strongly relevant to field problems. While the key to the process is the Technical Monitor's interest, advocacy, and professional monitoring, the degree to which an active monitor can influence the content and priority of Research Programs is highly uneven. The job descriptions of Technical Monitors carries little formal recognition and/or reward for research management duties. The Research Needs System then, does not clearly service a primary customer, the Corps field offices. Despite these problems it does facilitate active dialogue among Technical Monitors, the laboratories, and OCE during Program Review and development.

The Civil Works R&D Review Committee's decision process is difficult to discern. In a formal systematic sense, the Committee members are the right actors for deliberating Research Program budget allocations, yet because of the process and information used to develop their priorities, it is not clear whether they can make the right decision at the right time. We found a range of opinion and disagreement as to what the Committee's actual role is, what it was intended to be, and what it should be. It is apparent that certain improvements could be made to aid the Committee in accomplishing its work. Beyond this, there is the question of how much impact the Committee should have in prioritizing research dollars across Research Programs.

There are several flaws in the techniques used to decide on the distribution of research dollars across and within Research Programs. Basically, two separate statistically based priority systems exist: one to identify the priority of MPS, and another to establish priorities between

programs. The Report evaluates the statistical viability of both these systems. Overall, they are cumbersome, often irrelevant, operate to imply rating scores not warranted by the level of data available, are subject to manipulation by analysts, and create a false sense of objectivity.

Finally, little formal consideration is given to decisions regarding long-term research investment strategies. Basically, this involves balancing the distribution of money, basic laboratory survival needs, field and OCE research needs, and overall Corps goals. Currently the decisions affecting priorities for this balance appear good at maintaining the relative proportions of R&D plant and personnel; however, they do not clearly cope with questions concerning the current distribution and capacity of R&D plant to adequately execute research on future Corps mission needs. In balancing short-term versus long-term needs, the system rationalizes itself according to short-term needs expressed through the MPS ratings from the field, while the actual longer-term execution cycle is clearly more appropriate to intermediate or long-term research.

VI. Concepts for Improvement

In dealing with the priority-setting problems in the R&D system, there are essentially three choices: do nothing; adjust the current system; or restructure the system. The major arguments to do nothing are: that the R&D prioritization system works as well as could be expected; that the system is relatively new and should be given a chance; that while imperfect it is better than what existed in the past; and, that the Corps has a better system than other agencies. We reject these arguments because the frustration level among R&D personnel is high, and as manpower and budget constraints increase, that frustration will probably grow.

The defense for adjusting the current system is that basically the broad framework of decision processes is correct and that therefore the costs for major changes would outweigh possible benefits of change. Essentially, then, the RNS and Civil Works R&D Review Committee process would need only minor adjustments in numerical calculations, personnel, and preparation for and conduct of the Committee meetings.

The major arguments for restructuring the total R&D decision process relate to the imbalance of time and effort given to priority setting activities: that too much time is spent prioritizing a small part of the $35 million research budget which is roughly one-half of the approximated $70 million Corps Civil Works research program; that most major research is identified outside the RNS; that the slowness of the RNS makes it difficult, if not unlikely, that research products will impact short-term field problems; and finally, that the existing prioritization system cannot effectively incorporate long-term investment decisions. The important reason for concern over research priorities is not with money, as only about one percent of the total Civil Works budget is devoted to research, but because of the fact that almost 10 percent of the Corps work force is involved in the research program.

In view of the study purpose, our report focuses primarily on adjusting the current system. However, the more we study and debate the current system, the more we realize that these are only bandages which will not overcome major problems.

The Report outlines 15 options and categorizes them by relative degree of need for improving the system and by anticipated extent of alteration to the system's decision processes. These options center on four areas: techniques for improved technology transfer and R&D coordination; the RNS (MPS generation, rating and ranking); operations of the Civil Works R&D Review Committee; and long-term planning strategies. In order to describe the potential improvement that could be realized, three groups of options representing likely combinations for minimal, moderate, and major levels of improvement are analyzed in the Report.

Options for improved technology transfer and R&D Coordination include: audio-visual tapes to describe the RNS and its role in the overall system, R&D Coordinator Conferences, and an R&D Bulletin. These measures would also encourage field participation in the RNS. Options for long-range planning strategies include five-year plans for Research Programs and the development of a long-range investment budget and priority system. Because those options which have potential for improving the RNS and the Civil Works R&D Review Committee operation impact most directly on priority setting problems in the existing system they are highlighted in this preface.

1. Improvements to the Research Needs System

Increased attention has been given to the quantification problem of the RNS, yet attempts to correct the problems have not been effective. This study developed three options that would not only preserve the traceability of the numbers, but would also simplify their generation. These options are called: procedures for MPS quality control, change in the MPS rating process, and change in the MPS analysis process.

Through these measures, the constraints imposed by the existing MPS classisification method would be removed by formal mechanisms for MPS review, appeal of rejected MPS, MPS categorization, accommodation of multiple research program MPS, and a system for logging in, tracking, and controlling the life-span of MPS. To improve the rating process, the Corps could adapt a simplified nominal scale of one to five (that is, great importance to little importance). Raters would be given four or five basic criteria determined by OCE and would rate each MPS by the one to five scale. After rating, the district should record the position and number of people within the district who rated the MPS. The rating process could be further improved and the effort reduced if the work were disaggregated, with the major concerned functional organizational element assuming lead responsibility for reviewing and rating appropriate Research Programs. During rating analysis, the degree of consensus among ratings would be indicated as high, medium, or low for each MPS. As a result, each MPS would actually have two ratings: one, an average rating (which should be computed with all Districts as the base); and two, the degree of consensus on that rating. This would give more meaning to the average rating and would enrich the decisionmaker's capacity to deal with field need priorities.

While these three options would improve the mechanisms within the RNS, it is possible to imagine a more extensive change that would minimize the tremendous effort required to produce MPS field ratings. This could be done by eliminating MPS ratings and instead soliciting field priorities directly at the Research Program and Research Area levels. Because this action would involve a considerable change to the existing structure and because the details of its implementation and impact have not been developed, it is only described here as a concept and is not included in the Report.

By this measure, OCE would continue to: solicit MPS, organize them by Research Program and Area, and provide the compilation to laboratories and Technical Monitors. The MPS would continue to be used primarily to develop the content of Research Programs but not through priorities inferred from field rating. This measure would obtain field review of Research Programs; DE's would receive descriptions of each Program, including Work Unit agendas, and would be asked to indicate their priorities.

2. Improvement to the Civil Works R&D Review Committee Operation

Currently the Committee performs three primary functions: to confirm the priorities in each Research Program developed during Annual Program Reviews, to approve the FY+1 budget, and to provide general guidance for the distribution of research dollars between Research Programs in the FY+2 budget. Committee function would be more effective if these two objectives were accomplished at separate meetings. In addition, it would be beneficial to have the Committee consider what new Research Programs and Areas should be added and what old ones should be de-emphasized or phased out.

Recent Committee attempts at prioritizing have emphasized quantitative methods. That emphasis should be moderated but not necessarily abandoned. Assuming that the members are interested in impacting the Civil Works R&D budget two methodological issues arise: what is the best means to prioritize 29 Research Programs across six Research Areas, and how six people can best engage in trade-off of research dollars within a defined budget in a limited time. While the problem is more one of group process than statistical weighting; the statistical weighting does provide traceability. We recommend a process that would: encourage meaningful pre-meeting preparation, separate actual rating from group interactions, simplify the analysis of field ratings, and restrict use of RNS results from Committee deliberation.

For the meeting to develop the FY+2 budget priority recommendations, we recommend a five step process. The first three steps would be accomplished prior to the meeting.

Step 1: Prepare information package: OCE policy would assemble a briefing book for each member with the significant information on the goals and content of each Research Program and Area (no more than one or two pages for each).

Step 2: Rating Programs: Members would receive the briefing book at least one-week prior to the meeting. They would also be given the four to five OCE-generated R&D criteria and would individually rate each Research Program on a one to five scale (great importance to little importance).

Additionally, each member would review the previous year's Research Program budget distribution and would adjust that distribution to indicate his preference for the FY+2 budget. This would simplify the current process, since each of the 29 Programs would have one rating per member and the ratings would be completed before the meeting.

Step 3: Pre-meeting Analysis. OCE policy would collect this information and display the clustering of ratings by Research Program. The degree of agreement and disagreement across the Programs could be visually displayed on one chart and distributed to the Committee members the day before the meeting. This would be accompanied by an explanation of the meeting objectives and an agenda. The analysis would highlight areas of disagreement and provide focus for the meeting, and thereby increase the efficient use of members' time.

Step 4: Hold the Meeting. The meeting would focus on: (1) establishing relative priorities among Research Programs; (2) recognizing what the impacts of possible budget allocations would mean to the objectives of each Research Program before the Committee budget recommendations go forward; and (3) deliberating long-term trends for funding requirements. Voting, rating and other scaling techniques should be done at the meeting at the discretion of the members. In event of failure to reach cloture on any of the agenda points, the Committee would chose to delegate or hold another meeting.

Step 5: Post-meeting Documentation: Once completed, a summary and minutes of the meeting should be distributed to each of the members as well as other interested Corps personnel.

V. Concepts for Restructuring a New System

Since this study concentrated on the objective to adjust the current system, we did little conceptualizing of a new prioritization system. However, as the study progressed, we became aware of certain structural deficiences and the advantages that a new, restructured system could offer. Our ideas for the structural foundation for such a system are summarized in this section.

Any new system should classify that which is to be prioritized (i.e., short, medium or long-term research), and should develop prioritization systems appropriate to each. For example, short-term research should be done with minimal OCE administrative involvement and could be undertaken on a direct reimbursable or willingness-to-pay basis. Medium and long-term research should be tied primarily to strategic OCE thinking, and should be supported by some form of field input. Rather than the current OCE-lab-field trilateral arena, direct relations between OCE and laboratories, and laboratories and field, based on the type of research, should be stressed. Laboratories should balance the maintenance of current R&D capability against possible new future R&D capability requirements and short-term consitituency

constituency service against long-term OCE generated research. Further, a new prioritization system should include an explicit divestiture policy as well as a long-term R&D investment process. Manpower to administer the program should be reduced and their roles and responsibilities should be explicitly stated.

VI. Concepts for Immediate Consideration

This preface has highlighted the basic issues and a few options surrounding those areas of primary interest to OCE. As the Report is circulated, we encourage reviewers to provide solutions and fresh ideas. Discussion should focus on the following questions:

1. In addition to the options developed in this study, what other solutions can be generated to retain but improve the existing system?

2. Which, if any, of the improvement options should be implemented.

3. This effort found evidence for a need for a new Civil Works R&D prioritization system, Should the Corps initiate a study to develop recommendations for completely restructuring the system?

We suggest that a formal workshop, or series of workshops, be held following the review of this Report. If such workshops were held among a broader audience than that participating in this short effort, they would provide the information for a firm basis for eventual recommendations to the Director of Civil Works.

AN ASSESSMENT OF PROCEDURES FOR DETERMINING CIVIL WORKS RESEARCH AND DEVELOPMENT NEEDS AND PRIORITIES

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Staff Report

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I. INTRODUCTION

A. Purpose of Study

The objective of the Corps Civil Works R&D Program is to provide information, data, methods and concepts that will improve the capability of the Corps to execute its assigned missions in planning, engineering, and operations related to the nation's water resources. Providing users with the products they need requires continuous program orchestration to ascertain short and long-term needs, to establish priorities among those needs across a broad range of problem areas, to distribute budget allocations in a manner consistent with these needs, and to insure that appropriate R&D products are produced on time. An extensive set of institutional mechanisms have been established to direct and manage the Civil Works R&D program. While these mechanisms are working, it has become increasingly clear that improvements could be made which would increase the efficiency and effectiveness of the processes for determining research needs and for establishing priorities and budgets for meeting these needs.

Recognizing these problems, the Deputy Director of Civil Works, in a memo on 13 August 1980 to the Divisions in Civil Works, the Research and Development Office, and the Water Resources Support Center, directed an assessment of current procedures for determining Civil Works R&D needs and priorities and requested the development and evaluation of options for improving these procedures. The OCE Office of Policy (CWR-W) and the Institute for Water Resources (IWR) were assigned the responsibilities for conducting the study.

B. Overview of Study Organization

Subsequent to the assignment, IWR assembled a small task force to describe the existing system for establishing needs and priorities, to determine what the problems are, to gain a general understanding of how other organizations develop research priorities, and to formulate options for improvement of Corps procedures. The major information sources used in this study included: proposed and current R&D Engineering Regulations, documentation from the August 1980 meeting of the Enviromental Advisory Board (EAB), interviews with attendees at the 1980 Civil Works R&D Review Committee meetings, interviews with principal OCE participants in the research and development program, and a one-day workshop of RDO staff, OCE R&D Technical Monitors and other interested persons.

The investigation of procedures utilized in research programs of other organizations included interviews with key personnel in three agencies (WPRS, TVA, and OWRT) and a brief review of academic literature on research prioritization. Although the establishment of priorities and the development of budget allocations is the most visible and perhaps most significant product of the R&D management process, the complexity of the problems discerned in

this study clearly indicated a need to avoid simply focusing this study on the mechanics of need assessment and priority setting. Accordingly, this report deals with these issues in a broader context -- that of the relationship of these activities to the overall program management functions.

C. Description of Report

This paper discusses the study results. Section II, "Overview of Existing Procedures" provides background information for understanding the remainder of the paper. The final three sections present the analytical evaluation of Corps needs assessment and priority setting and is organized by discussion of problems, options for improvement, and impacts of alternative options. The paper is followed by six appendices that describe and display detailed information and options compiled during the study. The appended material includes:

1. A description of the existing R&D system.
2. A synthesis of the one-day workshop.
3. A summary of the EAB's comments.
4. A summary of interviews with attendees of the recent Civil Works R&D Committee meetings.
5. A summary of the interviews with other agencies.
6. A review of literature on research prioritization.

II OVERVIEW OF EXISTING PROCEDURES

A. Description of the Current System

1. Major Components and Participants

The key element of the Corps' prioritization system is the Research Needs System (RNS). However, the regulations that specify this system do not contain a definition and there are differences of opinion as to the scope of the RNS. For the purposes of this study, the RNS is defined as the process that: (1) discerns problems facing the field offices of the Corps; and (2) develops priorities for researching them. The basic ingredient to the RNS is researchable problems as identified by field elements, OCE and Corps' labs. When such a need is submitted and accepted into the RNS it becomes a Mission Problem Statement (MPS). Mission Problem Statements are the lowest level component of the R&D hierarchical structure.

The Corps R&D Program consists of three budget areas: Military Programs, Operations and Maintenance, and Civil Works. Civil Works R&D is structured into six functional Research Areas (e.g. Environmental Quality) and 29 Research Programs (e.g. Aquatic Plant Control). A listing of the Research Areas and Programs is included in Figure A5 of Appendix A. Within each Research Program there are one or more research efforts or Work Units. Work Units are developed by the performing elements (or laboratories) in response to MPS. However, there is not an exact correspondence between Work Units and MPS since there are now about 500 MPS and 200 Work Units. Also, while some Work Units address more than on MPS, some Work Units do not address any.

There are four major participant groups in the R&D Program:

a. Non-Corps, consisting of Congress, the Office of Management and Budget (OMB), and various advisory groups.

b. Corps, consisting of OCE, including the Directorate of Civil Works (an R&D user) and RDO.

c. The Performing Elements.

d. The field, (i.e., the District and Division Offices who are also the primary users of R&D products).

2. Role of the RNS within the R&D Program

In order to understand the RNS there must be some understanding of the overall program. Essentially, the program is accomplished through five phases, although at any one time there are three fiscal years under consideration so that the Program never truly has a beginning or an end. The three years of concern reflect different aspects of program planning and management:

a. The current fiscal year (FY), in which research on approved Work Units is executed.

b. The budget year (FY +1), for which Work Units are planned

c. The new budget year (FY + 2), during which priorities for Research Program content and budget are planned.

The five phases (presented more fully in Appendix A) may be described as follows:

a. Development of General Guidance for the Total Corps R&D Program. The primary focus of this Phase, which coincides approximately with the first quarter of the year, is the Research and Development Review Board Meeting which provides guidance on long and short-term R&D within each of the three major budgetary areas.

b. Identification of Civil Works Research and Budget Needs. This Phase encompasses the Program Review System conducted each spring by RDO. Reviews are held in each Research Program area to determine the program content (Work Units) proposed at alternative funding levels by the Performing Elements.

c. Establishment of Civil Works Research and Budget Priorities. During this Phase (late spring and summer) the final planning and approval for the FY + 1 budget is done, primarily through the interactions of the Civil Works R&D Review Committee, the Director of Civil Works, and RDO. The Committee also meets to recommend priorities and tentative budget targets for FY + 2 program planning.

d. Development of Program Appropriate to Research Needs and Budget Allocations. Prior to the end ofthe FY, the Performing Elements complete final planning and documentation of Work Units to be undertaken during the next FY. Also, the RDO submits the budget package and justification for FY + 2 to OMB and Congress.

e. Execution of Program. Early in the new fiscal year, Congress appropriates funds and research on new Work Units can begin.

These five phases make up the budget and management cycles of the R&D Program. The RNS, is which overlain through all the phases is the mechanism for problem solicitation and fits into the overall Program by: (1) providing information on field needs and field priorities; and (2) by influencing decisions made during the Program Reviews (Phase II) as well as recommendations made by the Committee for FY + 2 priorities (Phase III).

3. Implementation of the RNS

The annual RNS cycle involves three activities, i.e. the identification, rating, and ranking of RPS; and three participants, i.e. the field offices (through their R&D coordinators) the Office of Policy (CWR) and the Performing Elements.

a. MPS Identification. The sequence begins when mission problem statements are written and submitted to CWR. Anyone may submit a mission problem at anytime. There is a format for the write-up and there have been suggestions for its improvement. Traditionally the laboratories have been the major source of new mission problem statements, but during FY 80 an equal number was submitted by field offices and laboratories.

The Office of Policy reviews all mission problems and rejects those which address research that has already been done, is in progress, or is project specific. Originators are not notified of rejection. Those MPS which are acceptable are subject to revision and are assigned to one Research Program. Multidisciplinary mission problems present a problem as these logically could be assigned to more than one Research Program. Each year the Office of Policy also reviews old MPS. Those that have been in the RNS for several years and have consistently received low ratings may be deleted, however this decision is subjective since there is no specified MPS life span.

b. MPS Rating. Mission problems received by mid-May comprise the group that will be rated in the fall by the 47 field offices (Districts and Divisions). The Office of Policy compiles the accepted MPS by volumes (corresponding to Research Areas) and chapters (corresponding to Research programs). The FY 80 compilation for the first time, cross-referenced multidisciplinary MPS to the other potential Research Programs. In each field office, the R&D coordinator is responsible to see that the MPS are rated; the DE approves the ratings prior to their submission to CWR. Since the volume of MPS has presented a problem, in 1980 CWR required that the field rate only the new MPS; ratings submitted the previous year were allowed to stand. The circumstances under which the MPS are rated in each field office varies as to length of time invested, number of raters, job level, and whether by individual or group consensus.

The regulations specify that each MPS will be rated against the following four criterion each of which is worth up to 10 points on a scale of 1 to 10: safety, urgency of need, potential dollar savings, and intangible benefits. A field office can assign a zero rating to an MPS to indicate that it has no interest in this problem. The criteria have been subjected to much criticism as the rationale is not well understood, are subject to various interpretations, and do not intuitively represent a balance among various factors that could collectively describe Corps research priorities.

c. MPS Ranking. Ratings are submitted to CWR by mid-November. The arithmetic to compile and rank the ratings does not take into account the different processes used by the field offices. The following values are calculated:

(1) Average MPS ratings, which are then ranked to indicate field priorities.

(2) Average MPS rating by Research Program.

(3) Average MPS rating by Division.

The Office of Policy sends the results of these calculations to RDO and to the Technical Monitor of each Research Program. In turn, RDO sends the average MPS ratings and their ranking to the Performing Elements. The field offices also receive a copy so that each may compare how its perception of needs compares with others. The calculation and distribution of RNS results marks the end of the cycle (i.e., field needs and field priorities have been identified).

4. Application of RNS Results

Details on the use of MPS ratings and rankings are difficult to describe because the use varies each year and is subjective. However, the following points should be made:

a. The RNS does have input to other portions of the overall R&D Program.

b. The RNS does provide a gauge of field needs and priorities.

c. Although the results are available to those who make decisions, they are not critical to or always used for those decisions.

Currently, the results are used primarily in the Program Review System and in the allocation of the Research Program budget.

a. Program Review. Prior to the Program Reviews, the Technical Monitors and Performing Elements review the RNS results, paying particular attention to those MPS in the upper 50%. This gives the Performing Elements some guidance in developing the Work Unit agenda and Work Unit content that will be proposed within a particular Research Program. It also gives the Technical Monitors an indication of the field's perception of what a particular Research Program should emphasize. Thus, during the Program Review of each Research Program, response to the RNS can be seen in new Work Units developed, old Work Units redirected, and the priority listing of Work Units proposed.

b. Research Program Budget Deliberation. As mentioned in the description of the third phase of the R&D Program, the Civil Works R&D Review Committee develops recommendations for funding targets for the FY + 2 budget. These recommendations go to RDO as guidance in preparing the budget and budget justification for OMB. The results of the RNS are generally an important input to the prioritization process. The process used in 1980 was perhaps the most mechanistic and formal that the Committee has ever used.

The 1980 method consisted of the development of numerical scores for each Research Program by aggregating ratings on eight items. The first two (or 25 percent) were taken directly from the RNS:

a. The total number of MPS in the top 50 percent of each Research Program, scaled on an index of 1 to 5.

b. The average MPS rating within each Research Program scaled on an index of 1 to 5.

The remaining six items were subjectively scored criteria; five were taken from the CW Budget Circular on Mission Areas:

c. Commercial Navigation.

d. Municipal and Urban Water Supply.

e. Urban Flood Control.

f. Environmental Preservation.

g. Hydropower.

h. The final item, selected to be reflective of future needs, was called Command Interest.

For the six subjective criteria, each of the Committee attendees evaluated, on a scale of 0 - 5, the contribution of each Research Program made to the criteria. Then an average score per criteria was calculated for each Research Program by simply averaging the responses of each participant. The total score for a Research Program was equal to the sum of the values of the 8 items (thus, maximum score = 40). Research Programs were then ranked by their total scores. The ranking of the Research Program was important because that determined whether it fell in the top, mid, or lower third of the total program and that determined the percent increase or decrease relative to FY 81 that would be applied to derive the FY 82 proposed funding for each budget level for each program. The percentages that would be applied to each third at each budget level had been formulated by the CWR prior to the Committee Meeting and took into account the FY 81 allocations, research program substance, and MPS rating.

B. Types of Decisions

The processes of program planning, management, and problem solicitation, which are describable in terms of five operational phases and the Research Needs System, provide the methods for accomplishing the Corps Civil Works research objectives. The mechanisms that force these processes are decisions. Although decisions manipulate the direction and emphasis of the R&D Program, they generally represent a compromise with the ideal: decisions are driven by research needs and capabilities and must be made within the monetary bounds of Congressional and OMB guidance and within the functional bounds of the Corps' purpose (Figure 1).

Basically, there are two types of decisions: those concerned with program goals (research objectives) and those concerned with acquiring and arranging elements (money, facilities, manpower) to achieve these goals. Decisions also have a temporal dimension, since they must give consideration to what goals and which elements should be targeted for both the short term and the long term. Within the Civil Works R&D program, the basic decision types may be more specifically defined in relation to the program structure (Figure 1):

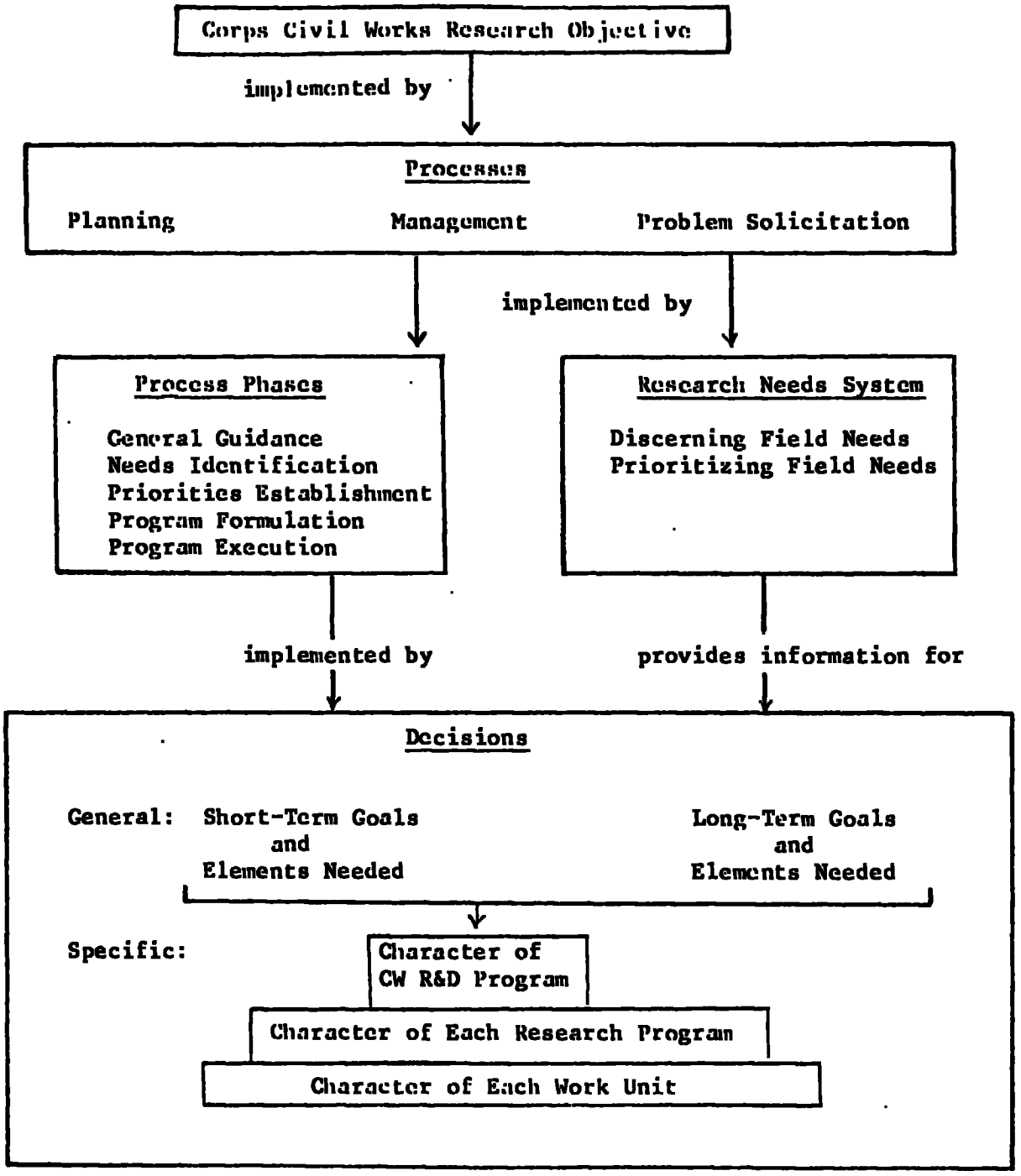

Figure 1. Understanding the types of decisions

1. Decisions as to the size, character, and goals of the overall Civil Works R&D Program,

2. Decisions as to the size, character, and goals of the six functional Research Areas and 29 Research Programs, and

3. Decisions as to which researchable problems should be studied, i.e. be addressed by Work Units.

C. Major Types of Problems

When viewed in the abstract, the five phases that exist as the framework for the formulation of the Civil Works Program appear to provide an appropriate and logically structured sequence for program development. However, when the processes, and in turn the decisions, which link and implement these phases are examined, problems become evident. For example, some major problem areas quickly emerged at the one-day workshop on prioritization procedures (details are in Appendix B). Although the purpose of the workshop was to aid in identifying problems, successes, and possible solutions to problems in setting R&D priorities, it was clear that the participants could not discuss prioritization issues without discussing the relationship of those issues to the overall system.

As identified by the workshop and substantiated by other tasks of this study, the major problems in the existing R&D system relate to five areas as described in the following paragraphs:

1. Lack of Understanding.

   In general, and at all levels, system participants understand their own roles and responsibilities, but do not always understand the significance of their function. Thus, while activities may be completed on time, there is little appreciation of how they might best be done so as to be properly integrated in succeeding activities. For example, for lack of understanding of numerical and statistical techniques, the numbers generated through the Research Needs System are unreliable.

2. Weaknesses in Coordination.

   Coordination problems could probably be identified down to the smallest details in the system and could not be completely prevented, yet there are some key points that require attention. The primary weak points are:

   a. External coordination with non-Corps agencies. Although there are both formal and informal contacts with other agencies, several of the workshop participants indicated that this was a problem. This may be because of possible gaps in the Research Areas coordinated or because of difficulties in informing all interested persons.

b. Internal coordination of system elements including participants, decision information needs, field and OCE-perceived research needs, long-term and short-term goals, and deployment of facilities to support research needs and goals.

3. Inertia and Momentum.

It must be recognized that the system is necessarily constrained by lapse of time between decision and realization and by the direction imposed by existing conditions. The object then is to promote efficiency by minimizing that lapse of time; this requires decisions that are solidly founded on good coordination and understanding of the system elements and are constructed with a comprehensive view of system performance design.

An example of a problem in this area is the seemingly overly long time passage before research responds to user needs. Factors in this delay include loose accountability between Work Unit products and MPS addressed, and also the momentum of ongoing research which makes it difficult to accommodate new problems. The system is also constrained by the existing physical plant; this delimits the capabilities of the performing elements and puts a priority on resources so as to ensure that these investments are maintained and managed.

4. Decision on Goals and Priorities.

Problems in decisionmaking relate to:

a. Whether or not the level at which a decision is made is appropriate to the scale of the decision;

b. Whether or not the information used in arriving at the decision was suitable for that decision;

c. Whether or not the information was reliable;

d. Whether or not the mechanisms for the use of the information were valid.

Effective decisions require understanding of roles, responsibilities, and processes; coordination of participants, needs, goals, and facilities; and a sense of the decision's function within the overall system.

5. Lack of Comprehensive Perspective.

This problem has already been mentioned as a contributing factor to problems in the areas of inertia and momentum and of decisions on goals and priorities. It refers to a deficiency in regarding overall system operation as an integrated, purposeful design of performance. This goes beyond the understanding of what the various roles and responsibilities are and how the budget, planning, and needs processes work. Lack of comprehensive perspective is the lack of recognition of

system operations; that while each of the separate functions contributes to program development, that the accomplishment of the system depends more on how the functions interrelate.

As indicated, these five broad problem areas overlap and reinforce each other. Probably the greatest overlap occurs in Decisions on Goals and Priorities, where each of the other four areas clearly add complications to the tasks of decisionmaking or prioritization.

III. SPECIFIC PROBLEMS IN DECISIONS ON GOALS AND PRIORITIES

As shown in Figure 1, decisions are required to implement the planning and management processes and the RNS provides information for use in making certain decisions. For this reason an examination of issues in the three specific decision types (Figure 1), and the RNS can enable the identification of specific problems as well as positive aspects of the Civil Works R&D system. Then, having identified the major problem areas, the specific problems, the positive aspects, and the location of all of these in the system, it should be possible to develop ideas with potential for improving decisionmaking and priority setting.

Collectively, the three decision levels which correspond to three structural levels of R&D components (i.e., overall program, Research Programs, and Work Units) involve a complexity of elements. These include:

-- The participants involved and their roles;

-- The mechanisms for participant interaction (e.g., meetings, advisory groups, responsibilities, etc.);

-- The information used to make a decision (e.g., OMB guidance, Program Reviews, RNS; etc.);

-- The constraints to decisions (e.g., the realities of prior decisions);

-- The purpose(s) of the decision (e.g., recommendations, guidance, directives, etc.);

-- The time-frame addressed (e.g., short-term, long-term, which FY, etc.);

-- The means for assessment evaluation or mechanisms for decision (e.g., review of capabilities, review of needs and budget, mechanisms for setting priorities including strategic judgement and quantitative ranking).

While such elements are common to all decision levels, the actual set of elements associated with each decision level varies. Consideration of the three decision levels in terms of the elements simplified this study's determination of which aspects of the program work successfully and which work with difficulty in setting priorities; these results are given on Table 1. Similarly, the mechanisms of the RNS and the elements of its role in the Program Review System and in the allocation of Research Program budget were examined; these results, which complement the decision dissection, are given in Table 2.

TABLE 1

Results of Examination of Specific Decision Types within the Civil Works R&D System

Aspect	Decisions, Civil Works R&D Program	Decision, Research Programs	Decisions, Work Units
Positive Features of Decision Process	• Scale of decision appropriate to level at which decision is made. • Coordination between RDO and Civil Works Directorate. • Field interests represented by rotational RDRB members • Flexibility to accomodate new programs and capacity to be responsive • Rudiments of traceability of decisions	• Forum for discussion of Research Programs • Means for bringing issues to attention of higher authority. • Complement to the field expression of need since it can identify or emphasize issues field cannot perceive. • Recommendations represent the consensus of the committee • Flexibility to accommodate new programs and capacity to be responsive • Rudiments of traceability of decisions • System for money allocation involves iterative interaction between RDO and Civil Works.	• Constructive interaction RDO Technical Monitors, User Representative, and performing elements. • Field needs addressed • General long-term goals of Research Program considered • Flexibility to accommodate new programs and capacity to be responsive • Rudiments of traceability of decisions • Labs consider feasibility of addressing NPS including preliminary estimates of time and costs required • RDO assess lab proposals and introduces larger Corps considerations • Competition among labs for R&D funds encourages performance.
Apparent Problems	• Major investment commitments sometimes disjointed • Maintenance and management of existing facilities present constraints • Strategic planning limited by failure to coordinate with Corps Corporate Planning and Command Goals processes • Strategic planning limited by inadequate interaction of commanders, field offices, and laboratories.	• Statistical and R&D significance of ranking of Programs not understood by Civil Works R&D Review Committee • Committee impassive to items it finds uninteresting • Information Not (1) available far enough in advance; (2) not uniform for each research program; (3) frequently inappropriate (either not needed or else lacking). • Concept of significance in NPS rating and in research program prioritization different; therefore, use of NPS in this decision is inappropriate. • Use of RNS results as scaled index values is inappropriate. • Committee unsure of how to use information on field needs, not sure if RNS truly reflects field needs. • Process for ranking research programs varies each year, so no basis for evaluating how well this process functions. • No attempt to periodically determine how goals of R&D relate to research program prioritization. • Committee members often delegate uninformed substitutes just prior to meetings. • Impact of recommendations on long-term goal of research programs not deliberated; i.e. current and anticipated technical content of research programs not considered important in establishing program priorities and recommending program budgets. • Timing of committee meeting is not appropriate with respect to budget planning cycle. • Long-term research programming weak. • Individual committee members and particularly their substitutes, make decisions without appreciation of their significance. • Impact of committee recommendations unclear. • System for money allocation not generally understood. • No program review at level at which program decisions are made.	• Inertia—problem in length of time it takes for an NPS to be addressed by a Work Unit. • Momentum of past research makes it difficult to make significant changes in the program • Unclear relationship of NPS to Work Units, i.e. how well a Work Unit responds to NPS(s) • Long-term research planning weak. • RNS biased to short-term perspective of field. • Emphasis on top 50% of NPS means that a significant, though not widely required need may not get the attention it deserves. • Establishment of work unit priority based on NPS ratings is invalid. • Use of average ratings biases priorities towards problems which appeal to a few districts (e.g. coastal or noxious plant problems) and against widespread problems (e.g. flood control or water supply)

TABLE 2

Examination of Mechanisms Within the Phases of the Research Needs System

Phase	Positive Features	Problems
Identification of NPS	• Prescribed format and procedure for proposing NPS.	• Prescribed format inconsistently used. Prescribed format inadequate; greater quality control and additional features needed.
	• Anyone may propose NPS.	• Originator not notified as to whether their proposed NPS are accepted or rejected.
	• Proposed NPS may be submitted at anytime.	
	• Proposed NPS are reviewed and evaluated in Civil Works.	• Review of proposed NPS and existing NPS inadequate: - System contains duplicates - System contains NPS that are being addressed by Work Units - Guidelines for deletion of old NPS are not clear.
	• Accepted NPS are consolidated in relation to research themes.	• Categorization of multidisciplinary NPS is difficult; 1980 cross-referencing system is confusing.
Rating of NPS	• Criteria for rating are specified in regulations.	• Criteria for rating are not well understood, are subject to misinterpretation. Criteria do not represent a balance among factors that could collectively describe Corps priorities. Careful and complete specification of concept of R&D significance not undertaken. Not resultant from process of debate--criteria have serious validation problems.
	• Users (field offices) do the rating.	• Fields do not recognize the significance of their ratings. No specific guidance on the rating process is given. Circumstances of rating and process of rating vary widely by field office. Meaning of the zero score not uniformly understood. Because of these reasons, the scores are not reliable.
	• Variety of NPS are provided for rating.	• Sheer volume of NPS requires considerable effort if done conscientiously. 1980 technique of allowing old ratings to stand and requiring only new ones to be rated is not valid.
Ranking of NPS	• Does provide a gauge of field needs and priorities.	• System of field input too complex; needs simplification.
	• NPS scores averaged by NPS, field office, and research program.	• Categorization of NPS adds element of bias to NPS average rating by research program. Constant change in method reduces field confidence in use of results.
Use of RNS Results - Program Reviews	• Does give technical monitors and performing elements guidance as to which problems the field is in greatest need of.	• Field need priorities are for field as a whole, a need that is critical but only to a few field offices receives a low overall priority. • Significance of urgency and intangible benefit cannot be uniformly evaluated.
- Research Program Budget Deliberation	None - RNS results not appropriate for this level of decision.	• Use of information in 1980 neither valid nor appropriate since values from two different sources (including the RNS) were integrated into the composite index for ranking. The concept of significance for NPS rating is not the same as for research program prioritization, yet the two were mixed. Further, the validity of the 8 criteria used in 1980 is suspect. They were not derived through consideration of their significance and a process of legitimation. • Different process is used every year; there is then, no basis for judging how consistent the results would be.

Based on the analysis of the elements within each decision level and within the RNS, and in consideration of findings of the study tasks, specific categories of problems could be identified within each of the five broad problem areas. These categories are listed on Table 3. As shown on the table, this study discerned five specific types of problems that relate to decisionmaking and prioritization. It is clear, however that these problems cannot be treated in isolation from others in the system. Options for alleviating these difficulties must take into account the fact that there is a network of interrelated problems pervading the system. There is a particularly strong concentration of the problem network in the area of Decisions on Goals and Priorities. Table 4 indicates how the five problem types in this area are reinforced by difficulties in other major problem areas. The following section briefly discusses the five problem types and their relationship to the overall R&D Program. These relationships will be useful in understanding the options for improvement which are presented in Part IV.

A. Discussion of Problems

1. Long-term investment priorities.

Prior investment decisions inevitably control the Performing Elements' capability to respond to needs identified at a later date. Since the Research Needs System is oriented to current problems, they are a source of frustration for long-run research resource allocation. Generally, long-term investment decisions are made so as to maintain a breadth of research capabilities. This broad base of civil engineering capability enables the Corps to provide quick and competent response to national needs (generated outside the Corps). If the Corps is to continue its historic and thus far very successful strategy of maintaining responsive capabilities, the long-range program formulation process must shift from short-run specific needs (the NPS) to a more general assessment of emerging national priorities. This process lacks linkage to the Corps Corporate Planning process lead by the Resource Management Office. It also overlooks the possible advantages of a long-range budget approach. There is a need to balance research capabilities with emerging needs and to keep a diverse but up-to-date base of capability. A long-range budget approach would facilitate setting priorities for these needs and would reduce the fragmented investment decisions which have characterized the past. The difficulties which augment problems in long-term investment priorities are indicated on Table 4.

2. Long-term Planning of Research Goals

Each of the three decision levels addresses long-term, five-year research goals, but in general, the planning is done either too broadly or too superficially to provide a well-expressed description of real goals. As a consequence, most goal planning focuses on FY +1 and FY +2. As indicated in the discussion of investment priorities, long-term budget planning and goal

TABLE 3

Categories of Specific Problems Within the R&D System

Problem Area	Specific Problem Categories
Lack of Understanding	• Differentiation of R&D vs. operation, planning, design. • Budget and management processes. • Roles and responsibilities. • R&D structural component relationships (e.g., MPS and Work Units) • Use of numerical and statistical methods.
Weaknesses in Coordination	• Between and within R&D participant groups ((1) field; (2) performing elements; (3) OCE's CW and RDO; (4) non-Corps). • Balancing of research needs. • Coordinating research in progress. • Balancing of research goals.
Inertia and Momentum	• Responsiveness of performing elements to users. • Vector of existing research capabilities (facilities and manpower).
Lack of Comprehensive Perspective	• Weak perception of relationship of priority establishment to overall R&D system. • Lack of clear R&D advocates.
Decisions on Goals and Priorities	• Long-term investment priorities. • Long-term planning of research goals. • Appropriateness of information used in decision deliberation. • Timeliness of decisions. • Processing of field needs.

TABLE 4

Specific Problem Categories Within the Broader Problem Areas of Decisions on Goals and Priorities, Indicating Their Relationship to Other Broad Problem Areas

Decisions on Goals and Priorities: Problem Category	Nature of the Problem	Contribution from Difficulties in Other Broad Problem Areas: Broad Problem Area	Sources of Associated Difficulty
1. Long-term Investment Priorities	• Disjointed decisions	Lack of Understanding	Decisions are made without an appreciation of their impacts on other portions of the R&D system.
	• Failure to clarify probable consequences	Weakness in Coordination	Overlook benefits of non-Corps external review or consultation.
	• Strategic decisions poorly formulated		Strategic prioritization limited by failure to connect these decisions to Corps corporate planning and Command Goals processes.
			Problems in balancing long-term and short-term research goals.
			Inadequate interaction of commanders, field offices, and laboratories in long-range budgeting.
			Problems in allocating budgets to accomplish research goals.
			Competition and overlap in R&D between performing elements.
			Technology Transfer
		Inertia and Momentum	Prior decisions on facilities and manpower inevitably constrain later decisions and affect ability to achieve research goals.
		Lack of Comprehensive Perspective	Corporate concerns overlooked.
			Few key participants in CW with full-time responsibility/concern for R&D: too little preparation for meetings.
			RDRS takes issue - specific approach to investment decisions; cumulative impact on other issues and over time not considered.
2. Long-term Planning of Research Goals	• Weakly expressed for overall R&D program	Lack of Understanding	Budget determination not clear.
			Decisions are made without an appreciation of their impact on other portions of the R&D system.
	• Weakly expressed among the research programs		Role of CW R&D committee not clear.
			Technical monitors input is variable.
	• Weakly expressed within the research programs and performing elements		Roles of responsibilities and interactions generally not well understood.
			Confusion about relationships of research areas, research programs, work units, MPS.
		Weakness in Coordination	Field and performing elements: communication of needs and tailoring products to meet needs.
			Civil Works: too many persons whose R&D attention is fragmented by other job responsibilities; too little preparation for meetings.
			Civil Works and RDU: coordination unbalanced since CW is less motivated.
			Corps and non-Corps: overlook benefits of external review and consultation.
			Problems in balancing field and OCE needs.
			Technology transfer.
			Competition and overlap in R&D between performing elements.
			Problems in balancing long-term and short-term research goals.
			Problems in allocating budgets to accomplish research goals.
			Problems in effecting R&D program goals in research programs and ultimately in work units.
			Strategic prioritization limited by failure to connect such decisions to Corps corporate planning and Command Goals processes.
			Inadequate interaction of commanders, field offices, and laboratories in long-range planning.
		Inertia and Momentum	Time lapse between identification of MPS and its address by a work unit.
			Time lapse between identification of MPS and delivery of work unit product.
			Momentum of past research makes it difficult to make significant changes in performing element's program.
			Prior decisions on facilities and manpower inevitably constrain later decisions and affect ability to achieve research goals.
		Lack of Comprehensive Perspective	RDRS takes issue-specific approach to investment decisions; cumulative impact on other issues and over time not considered.
			Few key participants in Civil Works with full-time responsibility/concern for R&D.
			CW R&D committee has limited concept of and concern for purpose of research program prioritization.

Decisions on Goals and Priorities: Problem	Category	Nature of the Problem	Contribution from Difficulties in Other Broad Problem Areas: Broad Problem Area	Sources of Associated Difficulty
3. Appropriateness of Information Used in Decision Deliberation		• CW R&D committee's use of research needs system results	Lack of Understanding	Confusion as to fiscal year affected by decision. Budget determination not clear. Decisions are made without an appreciation of their impact on the R&D system.
		• CW R&D Committee's consideration of objectives of the research program		Role of CW R&D committee not clear. Technical monitors input variable. Confusion about relationships of research areas, research programs, work units, MPS. Invalid criteria used for numerical scoring in both the research needs system and the CW R&D committee mechanisms for priority establishment. Invalid scaling techniques used by CW R&D committee. Numerical and statistical methods not understood as they are not appropriate to purpose. Numerical and statistical results unreliable since based on invalidation.
			Weakness in Coordination	Civil Works: too many persons whose R&D attention is fragmented by other job responsibilities; too little preparation for meetings. Civil Works and RDO: coordination unbalanced since Civil Works less motivated. Problem in balancing of field and OCE needs. Problems in allocating budgets to accomplish research goals. Problems in affecting R&D program goals in research programs and ultimately in work units.
			Lack of Comprehensive Perspective	Few key participants in CW with full-time responsibility/concern for R&D. CW R&D committee has limited concept of and concern for purpose of research program prioritization.
4. Timeliness of Decisions		CW R&D Committee Meeting on FY81 Budget	Lack of Understanding	Role of CW R&D committee unclear. Technical monitors input variable.
			Weakness in Coordination	Civil Works: too many persons whose R&D attention is fragmented by other job responsibilities; too little preparation for meetings. Civil Works and RDO: coordination unbalanced since less motivated. Problems in allocating budgets to accomplish research goals. Problems in affecting R&D program goals in research programs and ultimately in work units.
			Lack of Comprehensive Perspective	CW R&D committee has limited concept of and concern for purpose of research program prioritization. Few key participants in Civil Works with full-time responsibility/concern for R&D.
5. Processing of Field Needs		• Cumbersome - too much effort relative to influence.	Lack of Understanding	Decisions are made without an appreciation of their impact on other portions of the R&D system. Confusion about relationships of research areas, research programs, work units, MPS. Invalid criteria used for numerical scoring in the research needs system and the CW R&D committee mechanisms for priority establishment. Invalid scoring techniques used by CW R&D committee. Numerical and statistical methods not understood as they are not appropriate to purpose. Numerical and statistical results unreliable since based on invalidation.
		• Generation of MPS - quality control lacking		
		• Review of MPS by CWR - inadequate, results and methods not clear.		
		• Categorization of MPS into research programs.		
		• Rating of MPS - criteria not valid, process not uniform, results not reliable, too many MPS.	Weakness in Coordination	CWR and field: regarding MPS acceptability and rating process - leads to reduced field confidence and initiative. Field: R&D coordinator and field personnel regarding MPS generation and rating. Civil Works: too many persons whose R&D attention is fragmented by other job responsibilities. Problems in affecting R&D program goals in research programs and ultimately in work units.
		• Analysis of ratings - results not valid because of prior steps, more information could be extracted and could be better displayed.	Inertia and Momentum	Time lapse between identification of MPS and its address by a work unit.
			Lack of Comprehensive Perspective	CW R&D committee has limited concept of and concern for purpose of research program prioritization. Few key participants in Civil Works with full-time responsibility/concern for R&D.

planning are not only not well-coordinated, they are also fairly short-sighted. Of the difficulties which aggravate long-term planning (Table 4), weaknesses in coordination are key; a particular handicap is the inadequate interaction of Commanders, field offices, and laboratories.

3. Appropriateness of Information Used in Decision Deliberation

This problem focuses on the decision level concerned with the size, character, and goals of the 29 Research Programs. The primary decisionmaker is the Civil Works R&D Review Committee; the RDO, the Civil Works User Representative, and the technical monitor of each of the Research Programs provide input. The key issues here are:

a. That the Committee is making use of the MPS ratings that result from the RNS. As listed on Tables 1 and 2, there are a number of problems in using RNS data to deliberate Research Program priorities; chiefly that the concept of significance for MPS rating is not the same as that for Research Program rating and that therefore the RNS data should not be used by the Committee. Furthermore, even if the RNS data were appropriate for use at this decision level, the mechanisms by which it has been used are statistically invalid (Table 1).

b. That the Committee is not taking into account Research Program level information, (i.e., the goals of each program and the progress, plans, and technical substance relative to the goals). As a consequence the Committee is not aware of what the impact of their recommendations would be on either the individual Research Programs or the overall Civil Works Program

There are a number of problems which confound the prioritization problems of the Civil Works R&D Review Committee (Table 4); the general sense of them is that the Committee lacks a good understanding of its role and how to fulfill it.

4. Timeliness of Decisions

Again the problem focuses on the Civil Works R&D Committee, and particularly on its meeting on the FY +1 budget. Currently, Committee validation of the FY +1 budget is done concurrently with priority establishment for the FY +2 budget. The meeting takes place in mid-summer after the Program Reviews and the RDO budget planning; by that time the FY +1 budget is fairly well set and changes of any significance would be difficult. The mid-summer meeting is important because the Committee should have a role in budget validation; ideally, however, the Committee should also have a more timely role in budget formulation, and should be able to refine its summer-recommended priorities before Program Review. Appendix D provides a more in-depth discussion of this problem and Table 4 indicates its relationship to other problem areas.

5. Process of Field Needs

This problem probably receives more criticism and judgement than any other single issue. The comments raise questions as to whether or not field needs should be solicited and whether or not the RNS provides a true picture of field needs, but the comments always agree that the current means for implementation and the application of the RNS are unsatisfactory. Although the entire process is burdened with problems (Tables 2 and 4), the issues focus on the invalidity of the numbers, particularly since considerable effort is expended to produce those numbers.

B. Problem Clusters

In reviewing, analyzing, and identifying sources of the range of problems in the existing Civil Works R&D System, it is apparent that problem clusters exist. Their identification makes it easier to develop ideas for options having some predictable potential for problem alleviation. The findings of this study indicate that the problem clusters which act as major deterrents to efficient and effective processes for determing research needs and priorities are:

1. Weaknesses in coordinating and planning research goals.

2. Lack of understanding in both acquiring and using appropriate information.

3. Lack of a comprehensive perspective in establishing long-term priorities and goals.

4. Weaknesses in coordination within and between participant groups in accomplishing Program development tasks.

IV. OPTIONS FOR IMPROVEMENT

A. General Strategy

In considering the network and clustering of problems in the Civil Works R&D Program, a general strategy for developing options is apparent. First, to determine a set of criteria against which possible improvement actions could be aligned. Second, to generate and describe a set of options. Third, to identify different categories of options graded by their extent of alteration to the existing system; and finally, to indicate how crucial each of the options would be in improving the system.

The following criteria were used to generate possible actions for improving R&D Program development. They are oriented to the major problem areas yet guide the proposed actions to build on positive aspects of the current system.

a. Possible actions should attempt to integrate field "bottom up" views although they should recognize that field views are only one of many decision criteria for resource allocation.

b. Possible actions should encourage a "pro-active" OCE to integrate a strategic "top down" view.

c. Possible actions must rely on part-time people and personnel.

d. Possible actions should increase the validity of numbers used in the system.

e. Possible actions should increase the accountability, visibility and traceability of R&D decisions.

f. Possible actions should help to simplify the system and make it understandable.

g. Possible actions should build on that which is in place, namely the Research Needs System.

B. Description of Options

The study identified 15 improvement actions (Table 5) that, like the problems they address, range from fairly simple to complex and interlocking. The objectives of each of these actions are briefly described in the text that follows. Tables 6 through 20 provide a more detailed profile of each. Table 21 gives an estimate of the effort required to implement and maintain each option. The brief descriptions below group the actions by the portion of the R&D System they would impact; although some would affect more than one portion, they are grouped by the portion on which they would have primary impact.

TABLE 5

Listing of Improvement Actions Identified

1. Procedures for MPS Quality Control
2. R&D Coordinator Conference
3. R&D Bulletin
4. Audio-visual Tapes Describing the Research Needs System
5. Field Advisory Committee Recommendations
6. Reinforcement, Function of the Civil Works R&D Review Committee
7. Change in Composition of the Civil Works R&D Review Committee
8. Funding for Field Participation in the Research Needs System
9. Clarification of Work Unit/MPS Relationships
10. Clarification of Job Descriptions for Technical Monitors and R&D Coordinators
11. Change MPS Rating Process
12. Change MPS Rating Analysis Process
13. Index File of Field Office Project Studies
14. Five-Year Plans for Research Programs
15. Long-range Investment Budget and Priority System

1. Mechanical Improvements

a. Procedures for MPS Quality Control:

To improve accountability to originators by changing the process by which MPS are accepted, reviewed, revised, and classified in OCE; to set up a formal system for information on Work Unit response and for controlling MPS life span.

b. Funding for Field Participation:

To set up an account, supported by OCE transfer funds, against which field offices would charge the time required to rate MPS, so as to encourage more concientious participation in the MPS rating process.

c. Change in the MPS Rating Process:

To improve the field rating of MPS by: (1) developing criteria indicative of significance of field needs; and (2) by encouraging widespread application of a uniform rating process and documentation of its accomplishment.

2. Improvements to Cause Better Generation and Application of RNS Results

a. R&D Coordinator Conference:

To be held at least yearly to aid coordinators in their understanding of the R&D System and in their participation in the RNS, to encourage uniformity in MPS rating, and to promote a community concerned with expression of field needs.

b. R&D Bulletin:

To be issued at least quarterly to update R&D Coordinators on issues of interest in the R&D System, to provide information on the use and impact of MPS ratings, to encourage and explain participation in the RNS, and to provide a means of enchanging information on research products.

c. Audio-visual Tape Describing the RNS:

To develop a short film describing the RNS and its application which R&D coordinators could show to demonstrate how the field can affect the R&D System, to encourage submission of MPS, and to encourage uniformity in the MPS rating process.

d. Clarified Job Description for Technical Monitors and R&D Coordinators:

To review and rewrite job description of these participants so as to describe the R&D duties and extent of effort they would be expected to perform; the purpose is to clarify these responsibilities and draw attention to their importance.

c. Change in the MPS Rating Analysis Process:

To aid those who use RNS results in making decisions by providing them with an indication of the distribution of MPS ratings as well as with an average rating and number of reporting offices; the rating distribution would be conveyed by indicating a high, medium, or low degree of consensus.

3. Improvements for Decisions Affecting Character of Work Units

a. Clarification of Work Unit/MPS Relationship:

To have Performing Elements provide a short description of the extent to which the anticipated products of each Work Unit respond to MPS; this accounting would be presented at Program Reviews and included in Work unit documentation and would improve response to field needs.

b. Index File of Field Office Project Studies:

To maintain a file of studies conducted or contracted by field offices in order to: (1) identify results having potential for application in other field offices; and (2) to overview field effort for topics which may be potential problems for research.

4. Improvements for Decisions Affecting Character of Research Programs

a. Field Advisory Committee Recommendations for Research Program Budget Priorities:

To establish a Field Advisory Committee in each of the six Research Areas that would serve to complement and expand the RNS results by expressing budget recommendations and research priorities within Research Programs; the recommendations would be useful to both RDO and the Civil Works R&D Committee in formulating their decisions.

b. Reinforce Function of the Civil Works R&D Review Committee:

To improve the Committee's ability to accomplish its duties by: (1) emphasizing staff preparation for Committee decisions meetings including an agenda, background information on pertinent issues, brief information sheets on each Research Program; (2) providing such information to Committee members well in advance of meeting; (3) developing criteria of significance of R&D priorities at the Research Program level; and (4) having the Committee meet just prior to the Program Reviews in order to express timely recommendations on FY +1 Research Program budgets and goals (these recommendations may or may not refine those made towards the close of the fiscal year).

c. Composition of Civil Works R&D Review Committee:

To expand the Committee's appreciation of field needs and non-Corps views by adding up to three year-long rotational positions for a Division Engineer, District Engineer, and an R&D management expert from outside of the Corps.

d. Five Year Plans for Research Programs:

To have the Performing Elements, RDO, and the Technical Monitors develop five-year plans for each Research Program that would be reviewed by the Civil Works R&D Review Committee and the futures group of the Resource Management Office and that would provide a means for balancing short and long-term goals and provide a link between research goal priorities and strategic resource capabilities.

5. Improvements for Decisions Affecting the Overall Civil Works Program

a. Long range Investment Budget and Priority System:

To institute a system for generating five to ten year investment budgets and budget priorities for physical plant research capabilities that would facilitate long-run research resource allocation by providing a means of balancing capabilites required for specific research goals with the need to maintain a broad base of research capabilities.

C. Detailed Descriptions of Options

Each of the options is presented in the narrative tabulations of Tables 6-21 according to a profile which provides information on: (a) the portion of the R&D system directly affected; (b) the problem categories addressed; (c) the description of the option; (d) the decisions necessary for implementation; and (e) positive features of the option. For some of the more complex options, an implementation strategy is also included.

It should be noted that the presentations are cast more as a description of an idea than as a description of a mechanism. The profiles do not provide detailed descriptions partly because for any particular option, certain decisions would need to be made which would affect the actual working of that option; furthermore, the details of how an implemented option would operate would be somewhat dependent on what other options were adopted. Thus, each of the profiles provides the basic information on an idea for a possible action, which if selected for implementation, would need to be expanded or reduced in scope to fit with the array of other improvement measures.

TABLE 6

Procedures for MPS Quality Control

a. Portion of R&D System Directly Affected:

Research Needs System (Phase concerned with identification of MPS)

b. Problem Categories Addressed:

Processing of field needs

c. Description:

- Submitted mission problems would be carefully reviewed prior to acceptance as an MPS. Those known to duplicate existing MPS, to address problems that have or are, being researched, or to be too project specific would not be accepted and their originators would be notified. Originators would have an opportunity to appeal.

- Acceptable but incomplete mission problems would be returned to originators for completion of all format items. The existing format should be examined for adequacy, for example, the date of preparation might be added or the keywords revised.

- Accepted MPS would be logged in by assigning them a number and a three year expiration date. If an MPS has not been undertaken in research by that time it would be reviewed and either eliminated or reintroduced.

- Accepted MPS will also eventually be assigned either to a Research Program, to all relevant Research Programs, to a Research Area, or perhaps even to a Functional Area (e.g. Engineering, Planning, Con-Ops, etc.). Because of the difficulties that have occurred with assignment of multidisciplinary MPS to one Research Program, it is recommended that assignment be by Research Area. Assignment to all relevant Research Programs would be preferred over the existing system.

- The log could be set up so as to retrieve MPS on any desired basis: e.g. by year of origin, by office of origin, by Research Program, by Research Area.

  The log could also be maintained so as to contain information on any MPS even after it has been picked up by a Work Unit and so is no longer in the RNS. This information would at least identify which Work Unit(s) responded to the MPS; any further details such as Performing Element, anticipated product, etc., could also be added.

TABLE 6 (Continued)

d. Implementation Strategy: Implementation of this option requires two considerations, one for the 500-odd existing MPS, and one for future submissions of mission problems.

- MPS now in existence.

  Setting up a quality control system for existing MPS would probably best be done by a Task Force. Such a group might be chaired by the Office of Policy and consist of a representative from each Civil Works division in OCE. The group would work to:

  (1) Delete or consolidate duplicate MPS;
  (2) If necessary, rewrite MPS to provide a standard of clarity and consistency;
  (3) Develop a log system for existing MPS that could later accommodate new MPS;
  (4) Assign expiration date to each MPS;
  (5) Assign MPS to Research Areas, or to whatever categories the selected classification scheme has;
  (6) Provide originators with information as to the disposition of their mission problems.

- Future mission problems

  The process for entering new MPS would probably be best done in two phases.

  Phase I. As new mission problems accumulate, they should be reviewed and those that duplicate existing MPS, are being/have been researched, or are project specific would be screened out and their originators notified. MPS would also be tentatively assigned to categories during this review.

  Phase II. A group would meet and work to further review, rewrite, consolidate, and possibly delete mission problems, and also to categorize the acceptable MPS. After that meeting, the mechanics of logging in each MPS would be accomplished.

  Phase I could be done by the Task Force that cleans up the existing set of MPS; or Phases I and II could both be done by six Field Advisory Review Committees, one for each Research Area. The composition and other duties of these Committees are included in the description for the option for Developing Field Advisory Recommendations for Research Program Budget Priorities (Table 10). With respect to MPS quality control, each Field Advisory Review Committee would meet for one day after the final call for MPS submission and before distribution for field rating so to accomplish either Phases I and II or just Phase II.

TABLE 6 (Continued)

e. Decisions Necessary for Implementation:

- Any revisions to MPS format
- Procedure whereby originators can appeal the rejection of their mission problems
- Details on mechanics of log-in and retrieval system for MPS
- Categories by which MPS will be classified
- What group will review, revise, and categorize future mission problems

f. Positive Features:

- Existing MPS cleaned up
- Constraints imposed by existing MPS classification method eliminated
- Formal mechanisms for review of MPS, for appeal of rejected MPS, for classification of MPS, for accommodation of multidisciplinary MPS, for log-in and tracking of MPS, and for life span of MPS
- Reduced number of MPS.

TABLE 7

R&D Coordinator Conference

a. Portion of R&D System Directly Affected:

Research Needs System (Phase directly concerned with identification of MPS and rating of MPS).

b. Problem Categories Addressed:

- Differentiation of R&D vs. operation, planning design
- Understanding of budget and management process
- Understanding of roles and responsibilities
- R&D structural component relationships
- Coordination within and between R&D participant groups
- Perception of relationship of priority establishment to overall R&D System
- Lack of clear R&D advocates
- Processing of field needs

c. Description:

Conference held annually or biannually mainly for R&D field coordinators but also open to other R&D participants and to those interested in Civil Works R&D. The purpose of such a conference is to provide a setting for: (1) explaining the R&D System and particularly the Research needs System; (2) encouraging exchange of ideas and information on R&D; and (3) creating an interactive community interested in promoting means for improved research response to field needs.

d. Decisions Necessary for Implementation:

- Changes in MPS rating criteria and rating process
- Frequency
- Host(s)
- Appropriate scope and emphasis

TABLE 7 (Continued)

e. Positive Features:

- Serve as medium for communicating and explaining changes in R&D system
- Buildup of continuity and sense of purpose among field coordinators
- Increase understanding of R&D system
- Forum for R&D issues
- Encouragement of field participation in MPS submission and rating
- Demonstrate that there are R&D advocates
- Greater uniformity in rating process
- Field recognition of how a field office can affect R&D
- Interaction among coordinators and other participants
- Establishment of personal contacts

TABLE 8

R&D Bulletin

a. Portion of R&D System Directly Affected:

Research Needs System

b. Problem Categories Addressed:

- Differentiation of R&D vs. operation, planning, and design
- Understanding of budget and management processes
- Understanding of roles and responsibilities
- R&D structural component relationships
- Coordination within and between R&D participant groups
- Perception of relationship of priority establishment to overall R&D System
- Processing field needs.

c. Description:

Short bulletin, probably issed quarterly, and aimed at R&D coordinators in the field and laboratories to deliver information on new developments in the R&D System and research products, and to provide follow-up on the use and impact of MPS ratings.

d. Decisions Necessary for Implementation:

- Frequency
- Appropriate scope and emphasis
- Producer(s)

e. Positive Features:

- Serve as medium for distributing information and updating changes in the R&D Systems.
- Forum for R&D issues
- Encouragement of field participation in MPS submission and rating

TABLE 8 (Continued)

- Greater uniformity in rating process
- Field recognition of how a field office can affect R&D
- Improved perception of relationship of priority establishment to overall R&D System
- Greater understanding of R&D System

TABLE 9

Audio-Visual Tapes Describing the Research Needs System

a. Portion of R&D System Directly Affected:

Research Needs System

b. Problem Categories Addressed:

- Differentiation of R&D vs. operation, planning, and design
- Understanding of budget and management processes
- Understanding of roles and responsibilities
- R&D structural component relationships
- Coordination within and between R&D participant groups
- Perception of relationship of priority establishment to overall R&D system
- Processing of field needs

c. Description

Short visual tape of approximately ten minutes and certainly no more than 30 minutes, that would describe the Research Needs System and its relationship to the development of the R&D Program. Specifically, the film would show how NPS are submitted, accepted, rated, ranked, incorporated into a Work Unit or Research Program, and ultimately result in products with application to field needs. The film would present a clear and realistic message of how a field office can affect the R&D Program.

Film would be periodically updated. The DE and field R&D coordinators and laboratories could show it at appropriate intervals and require attendance.

d. Decision Necessary for Implementation:

- Details on content of film

e. Positive Features:

- Encouragement of field participation in NPS submission and rating
- Greater uniformity in rating process
- Field recognition of how a field office can affect R&D
- Improved perception of relationship of priority establishment to overall R&D system
- Medium for explaining how the Research Needs System works
- Build up importance of role of field and laboratory R&D coordinators
- Greater understanding of R&D System

TABLE 10

Develop Field Advisory Recommendations for Research Program Budget Priorities

a. Portion of R&D System Directly Affected:

Decisions on character of each Research Program.

b. Problem Categories Addressed:

- Coordination between and within R&D participant groups
- Balancing of research needs
- Balancing of research goals
- Responsiveness of performing elements to users
- Weak perception of relationship of priority establishment to overall R&D system
- Lack of clear R&D advocates
- Long-term planning of research goals
- Appropriateness of information used in decision deliberation
- Processing of field needs

c. Description:

Prior to Program Reviews and after MPS ratings have been ranked, six Field Advisory Review Committees, for each of the six Research Areas, would meet for one day to accomplish two tasks: (1) to list the MPS within each Research Program of the Committee's respective Research Area, in order of priority; and (2) to recommend priority rankings of Research Programs and relative adjustments to them under high, medium, and low budget conditions.

Task 1 would provide an overview expression of field need; this would complement the results of the RNS even though it might disagree with these results.

Task 2 would also add a dimension to field preferences by indicating a view of the comparative importance and need of Research Programs in terms of funding.

The recommendations on Research Program budget priorities would be given to RDO prior to Program Reviews as an aid in developing the FY+1 program. If the option to reinforce the function of the Civil Works R&D Review Committee were adopted, (Table 11) these recommendations would also be an important source of information for the proposed pre-Program Review meeting of the Civil Works R&D Review Committee.

Other possible duties of the Field Advisory Review Committees are given in the option for Procedures for MPS Quality Control (Table 6).

TABLE 10 (Continued)

d. Implementation Strategy:

This option would probably be best implemented if the Director of Civil Works designed a 5-yr schedule of assignment of members to each of the six Advisory Committees. Assignments would be for 1-yr terms and be rotated throughout the field offices. If unable to attend Committee meetings, assigned members could select a substitute.

Each Advisory Committee would consist of 10 to 12 members including:

- One or two members from lead laboratories in the particular Research Area
- Four members from district executive levels (e.g. Planning Chief for Water Resources Planning Studies)
- One member from Office of Policy, OCE
- One non-Corps technical consultant who is recognized as an expert in the subjects of the Research Area
- One or two technical monitors of research programs within the Research Area

e. Decisions Necessary for Implementation:

- Schedule of member assignments for each Advisory Committee
- Format by which recommendations would be of most use to RDO and to the Civil works R&D Committee should they meet prior to Program Review

f. Positive Features

- Provide RDO and Civil Works with a more traceable and formal expert view of long and short-term field-preferred content of each Research Area
- Increase the visibility and accountability of the development of research priorities
- Provide a method of obtaining a more complete and broader assessment of field needs than is obtainable through the RNS
- Provide a balance of field, laboratory, technical monitor, and non-Corps views
- Increase management-level interaction of field, laboratory, and technical monitors
- Incorporate non-Corps perception
- Bring the formal mission problem statement process closer in line with the informal field advisory process that tends to sprout up with new Research Programs
- Encourage viable R&D advocates

TABLE 11

Reinforce the Function of the Civil Works R&D Review Committee

a. Portion of the R&D System Directly Affected:

Decisions on character of each Research Program

b. Problem Categories Addressed:

- Understanding of roles and responsibilities
- R&D structural component relationships
- Use of numerical and statistical methods
- Conditions within and between R&D participant groups
- Balancing of research needs
- Balancing of research goals
- Weak perception of relationship of priority establishment to overall R&D system
- Lack of clear R&D advocates
- Long-term planning of research goals
- Appropriateness of information used in decision deliberation
- Timeliness of decisions

c. Description:

The Committee would have two major meetings each year, one prior to the Program Reviews and one in the quarter prior to the new fiscal year. Both meetings would involve consideration of Research Program budgets for both FY+1 and for FY+2; however, prior to the Program Reviews, emphasis would be on the FY+1 budget, and prior to the new fiscal year, the emphasis would be on the FY+2 budget. An agenda would be prepared for the meetings and information useful for deliberation would be prepared and distributed one to two weeks prior to the meetings. Meetings may require more than one day.

Meeting prior to Program Reviews.

- To review the Research Program budget target recommended at the previous meeting and to make adjustments as necessary. When formulated, these targets were for FY+2; in the interval, a new fiscal year has begun and since the targets now apply to FY+1 they need closer review and possibly revision.

- To develop preliminary guidance on possible relative increase or decreases in each Program for FY+2.

- Technical Monitor would provide information on short and long-term goals for each Research Program and would explain the impact of high, medium and low budgets on the programs.

TABLE 11 (Continued)

- If the option for Developing Field Advisory Recommendations for Research Program Budget Priorities (Table 10) is adopted, then information on the field perception of Research Program priorities would be available.

- Adjustments to the FY+1 budget plans would be through Committee member negotiations.

Meeting Prior to New Fiscal Year

- To establish Research Program budget targets for FY+2.

  In order to do this, the Committee would first establish five or six criteria that express significance of the Corps research at the Research Program level. Then, given that criteria and information provided by Technical Monitors on short and long- term goals for Research Programs, the committee would rank the Programs. Mechanically, this could best be done by either of two methods: the simple rank order method or the distributional vote method. By the rank order method, the members would individually rank the Programs, and then points would be assigned by place order in order to obtain a committee rank ordering. By the distributional vote method, each member would distribute a certain number of votes (e.g. five each) across the 29 Research Programs; such votes would represent weightings and the weighting of each program could be calculated so as to then establish the committee rank ordering Either method would force the committee members to engage in relative tradeoff analysis, which should be the basis for the committee's priority setting function.

- To complete final review and adjustment of the FY+1 Research Program budget. This would require that Technical Monitors provide general information on past accomplishments and ongoing research and explain the highlights of the upcoming year's Program relative to program goals.

Issues for deliberation at either meeting.

- At one of the meetings, the committee would consider the array of Research Area and Research Programs for the purpose of recommending the deletion or addition of any. If either of the two options involving the Field Advisory Review committees have been adopted, then consideration would be given to the possibility of a necessary change in any or all of those six committees.

TABLE 11 (Continued)

d. Decisions necessary for implementation:

- Criteria for deliberating significance of Corps. R&D at Research Program level (process of legitimation is recommended (see Appendix A, Part II).

- Information needed from Technical Monitors for both meetings and format, if any, for that information, e.g. a summary sheet for each research program indicating the current status anticipated goals would be useful.

- Methodology for determining percent increments and decrements to apply to each budget level for FY +2 budget targets

- Timing of meeting held before program review, would depend on whether or not the option called "Developing Field Advisory Recommendations for Research Program Budget Priorities.

- Flow preparation (agenda, information compilation) for meetings would be accomplished and who would be responsible.

e. Positive features:

- Provide performing elements with a better and more timely sense of Civil Works' assessment of relative priorities among Research Programs.
- Encourage Civil Works to more actively participate in formulating the R&D program.
- Encourage strategic program goal planning and provide a link between goal planning and budget planning.
- Provide committee members with an understanding of the need for and the impact of their recommendation.
- Improved coordination of R&D participants within Corps Works.
- Provide committee members with a greater sense of purpose.
- Eliminate use of invalid numerical techniques.
- More appropriate use of information and therefore a better balancing of research needs.

TABLE 12

Composition of Civil Works R&D Review Committee

a. Portion of R&D System Directly Affected:

Decisions on character of each Research Program

b. Problem Categories addressed:

- Coordination between and within R&D participant groups
- Balancing of research needs

c. Description:

- Add field perspective to Civil Works R&D Review committee by adding two rotational positions, one for a District Engineer and one for a Division Engineer, to be occupied for a year.
- Could also add a rotational membership for a non-Corps R&D management expert.

d. Decisions Necessary for implementation:

- Schedule for DE rotational membership
- Determination of possible non-Corps rotational members

e. Positive Features:

- Balance between Corps and non-Corps in committee decisions
- Balance between Civil Works and field in committee decisions: field perspective on prioritization and tradeoff deliberation
- Advantage of experience of non-corps R&D for avoiding pitfalls

TABLE 13

Establish Funding for Field Participation in Research Needs System

a. Portion of R&D System Directly Affected:

Research Needs System (phase concerned with rating of MPS)

b. Problem Categories addressed:

- Lack of clear R&D advocates
- Processing of field needs

c. Description:

Field offices would have an account number against which time required to rate MPS could be charged. The account would be supported by OCE transfer funds out, thereby decreasing funds available for research allocations.

d. Decisions Necessary for Implementation:

- Amount to budget for accounts
- Procedures for monitoring accounts

e. Positive Features:

- Demonstrate Civil Works commitment to and interest in field priorities for research.
- Encourage more serious field participation in MPS rating.

TABLE 14

Clarify Work Unit/MPS Relationship

a. Portion of R&D System Directly Affected:

- Decision on character of each Work Unit
- Decisions on character of each Research Program

b. Problem categories adressed:

- R&D structural component relationships
- Balancing of research needs
- Coordinating research in progress
- Responsiveness of performing elements to users
- Appropriateness of information used in decision deliberation
- Processing of field needs

c. Description:

For each Work Unit, new or ongoing, laboratories would provide during Program Reviews a short narrative description to indicate the extent to which the Work Unit will respond to the MPS it addresses. The description would also clarify the Work Unit's relationship to the Research Program goals. This could be followed up in Work Unit documentation and tied to the products of the Work Units.

d. Decisions Necessary for Implementation:

- Guidance, possibly formats, for indicating Work Unit/MPS relationship
- Short and long-term goals for each Research Programs
- Possible changes in Work Unit documentation requirements

e. Positive Features

- Aid to Technical Monitors in explaining research programs to Civil Works R&D Review Committee
- Link between MPS rating system and performing element behavior
- Clearer expression of research goals

TABLE 15

Clarify Job Descriptions for Technical Monitors and for R&D Coordinators in Field and Laboratory Offices

a. Portion of R&D System Directly Affected:

Research Needs System, decisions on character of each Research Program, decisions on character of each Work Unit

b. Problem Categories Addressed:

- Roles and responsibilities
- Coordination between and within R&D participant groups
- Lacks of clear R&D advocates

c. Description:

Job descriptions for Technical Monitor, R&D field coordinators, and R&D laboratory coordinators would be rewritten to specify their duties and time commitments to R&D.

d. Decisions Necessary to Implement

- Wording of description
- Estimate of time commitment

e. Positive Features:

- Increase credibility of the R&D effort
- Help to create Civil Works R&D advocates
- Clarify roles and responsibilities

TABLE 16

Change MPS Rating Process

a. Portion of R&D System Directly Affected:

Research Needs System (phase concerned with rating) and any portion of R&D system in which the results of the RNS are applied

b. Problem categories addressed:

- Use of numercial and statistical methods
- Appropriateness of information used in decision deliberation
- Processing of field needs

c. Description:

- MPS would be compiled by classification category and sent to field offices for rating. Classification by Research Area is recommended (see option for Procedures for MPS Quality Control, Table 6).

- R&D field coordinators would be encouraged to assign categories of MPS to a specific person knowledgeable of that category; a small team would probably be selected to accomplish the ratings in each MPS category.

- R&D field coordinators would also explain the rating process and the Research Needs System; if the option for Audio-Visual Tapes Describing The Research Needs System (Table 9) has been adopted, the coordinator would show this to the raters.

- MPS would be rated against four or five basic criteria and on a simplified nominal scale of one to five (e.g. from least important to most important).

- Field offices would report the nominal scale rating value for each MPS that they choose to rate and also the number of raters and their job titles.

d. Decision Necessary for Implementation:

- Categories by which MPS would be classified
- Alternate means of explaining the Research Needs System if the audio-visual tape option is not adopted
- Criteria against which the MPS would be rated. A process of legitimation is recommended (see Appendix A, part II).
- Possibility of having rating forms

TABLE 16 (Continued)

c. Positive Features:

- Encourage uniformity in rating
- Simplify rating
- Produce ratings which do reflect the significance of the field's priorities for research
- Eliminates invalid use of numerical methods

TABLE 17

Change MPS Rating Analysis Process

a. Portion of R&D System Directly Affected:

Research Needs System and any portion of the R&D system in which the results of the RNS are applied

b. Problem Categories Addressed:

- Use of numerical and statistical methods.
- Appropriateness of information used in decision deliberation
- Processing of field needs

c. Descriptions:

This option could be adopted even if the option for changing the MPS Rating Process (Table 16) were not. In addition to the number of field offices reporting a rating and average MPS rating values now calculated (by MPS, field office, and MPS classification category), the degree of consensus among the ratings would be indicated as high, medium, or low. This would roughly reflect the range of ratings and their distribution around the mean.

d. Decisions Necessary to Implement:

- Whether the high, medium, or low indication of degree of consensus would be satisfactory or if some other distribution indicator would be better.

e. Positive Features:

- Would reveal bias contained in MPS averages that is introduced when a few field offices give high priority to problems limited to their interest
- Would give more meaning to the rating average for each MPS
- Would give the decisionmaker using RNS results a better perception of the field expression of priority

TABLE 18

Index File of Field Office Project Studies

a. Portion of R&D System Directly Affected:

Technology transfer and to some extent, decision on character of each Work Unit.

b. Problem Categories Addressed:

- Coordination between and within R&D participant groups
- Coordinating research in progress
- Responsiveness of performing elements to users

c. Description:

RDO would build a file of scopes of work for field office projects studies conducted by or contracted by the district offices; this would be for those studies that would likely produce results having application in other districts. Research of regional or general interest could be reported in the R&D bulletin if the bulletin option (Table 8) were adopted.

d. Decisions Necessary for Implementation:

- Filing system
- How to obtain, maintain, and update system

e. Positive Features:

- Provide cross reference to field R&D
- Provide information to field contemplating research that could save them from duplicating research
- Facilitate transfer of knowledge among districts
- Provide a source of information on the types of problems field R&D undertakes; frequently occurring problems could indicate a need for a Work Unit

TABLE 19

Five-year Plans for Research Programs

a. Portion of R&D System Directly Affected:
Decision on character of each Research Program, decisions on character of Civil Works R&D Program

b. Problem Categories Addressed:

- Understanding budget and management process
- Understanding roles and responsibilities
- R&D structural component relationships
- Coordination within and between R&D participant groups
- Balancing of research needs
- Balancing of research goals
- Vector of existing research capabilities
- Weak perception of relationship of priority estblishment ot overall R&D system
- Lack of clear R&D advocates
- Long-term planning of research goals
- Timeliness of decisions

c. Description:

This option would have two focuses: Research Programs and the overall Civil Works R&D Program.

- In conjunction with the Program Review process, RDO, the Technical Monitor, and the Performing Elements would develop long term five-year Research Program goals and budgets. These should be reviewed by the Civil Works R&D Review Committee and the Corps' future direction group in the Resource Managment Office. If the option involving the Field Advisory Review Committees is adopted (Table 10), then the five-year plan should also be reviewed by them.

- These plans could also be integrated and synthesized to help in formulating long-term plans for the Civil Works Program. Major participants in the planning would be RDO and the Civil Works R&D Review committee. The Corps' futures direction group, the Research and Development Review Board, and a non-Corps advisory group would be the major reviewers.

d. Decisions Necessary for Implementation:

- Determining which groups would be concerned with preparation and review of the Research Program plans and of the Civil Works Program.
- Determining which office or group would have responsibility for final approval of Research Program plans and Civil Works Program Plans.
- Once participants, reviewers, and validators are identified, then a schedule to synchronize plan development could be figured.

TABLE 19 (Continued)

e. Positive Features:

- Provide link between research prioritization and strategic organizational considerations
- Include non-Corps consultation
- Provide formal mechanism for guidance in decisionmaking
- Encourage cooperation among participant groups to engage in goal planning
- Provide means for better balancing of short and long-term goals
- Demonstrate commitment to R&D

TABLE 20

Long-range Investment Budget and Priority System

a. Portion of R&D System Directly Affected:

Character of Civil Works R&D Program, research capabilities.

b. Problem Categories Addressed:

- Understanding of budget and management processes
- Coordination between and within R&D participant groups
- Balancing of research needs
- Balancing of research goals
- Vector of existing research capabilities
- Weak perception of relationship of priority establishment to overall R&D system
- Lack of clear R&D advocates
- Long-term investment priorities
- Long-term planning of research goals

c. Description:

This option consists of two parts, long-range budget generation and setting priorities for investment budgets.

- Long-range budget generation

Each laboratory would propose a long-range (5-10 yr) investment budget under criteria proposed by RDO and reviewed by the Civil Works R&D Review Committee and by the Research and Development Review Board. Several budget levels would be needed.

(1) Maintenance level - a level which would maintain present capability.

(2) Cut back level - a level which would eliminate low priority activities.

(3) Expansion levels - several levels which would add alternative capabilities in high priority activities.

The long-range investment budgets would account for plant facilities, equipment, human resources costs, maintenance, and facility management. When these budgets are submitted by all laboratories, the overall requirements would be known and priorities could be set.

- Investment budget priority setting

  The investment budgets would be arranged by functional R&D category (Research Areas and Research Programs) and by laboratory. The Civil Works R&D Review Committee and the R&D Review Board would devote one of their meetings each year to setting priorities for the investment budgets. The mechanism for facilitiating these decisions would include input from the Resource Management Office to correlate R&D investment strategy with emerging future directions in the Corps' long-range corporate planning objectives and the Command Goals system. RDO would prepare alternative budget strategies for the R&D Review Board's action while the Office of Policy would style similar strategies for action by the Civil Works R&D Review Committee.

d. Decisions Necessary to Implement:

- RDO criteria for formulating long-range investment budget
- Deadline for laboratory investment budget submissions
- Appropriate schedule for meetings for setting budget priorities
- Update interval

Positive Features:

- Enable an overall picture of the options for developing future R&D capability in the Corps.
- Place the Civil Works R&D Review Committee and the R&D Review Board more firmly in the position to manage strategic decisions
- Reduce financial and managerial crises

TABLE 21

Estimation of Effort Required to Initiate and Maintain Each Option

Option	Estimation of Effort to Initiate (I) and Maintain (M) Participant		Man Months per Year	Remarks
Procedures for MPS Quality Control	CWR, OCE staff, RDO	I	5	---
		M	3 to 4	May include Field Advisory Committee
R & D Coordinator Conference	OCE staff, R&D Coordinators, RDO	I	7	Includes travel and preparation time for an annual meeting
		M	5	
R & D Bulletin	CWR or assignee, RDO	I	10-12 (3/issue last yr)	Includes copy preparation, editorial and layout time; 6-8 pages/issue produced quarterly
		M	8 (2/issue)	
Audio-visual Tape	CWR and Contractor	I	4	Produce initial tape
		M	1 to 2	Update tape as needed
Field Advisory Committees	Field, OCE staff, non-Corps advisors, RDO	I	12 to 14	Includes travel and committee preparation time
		M	10 to 11	
Reinforce Function, CW R&D Committee	Civil Works staff	I	11	Decide criteria, information needs, formats for decision papers each fys. Program, and hold one annual cycle of meetings.
		M	9	Preparation time and the annual cycle of meetings
Composition, CW R&D Committee	Civil Works Direct.	I	2	Decision meetings and [illegible] of attendees and [illegible] of additional [illegible]
		M	1	Travel, orientation [illegible] and meeting for a field [illegible]
Funding, Field PMS Participation	CWR, OCE staff, field, RDC	I	75	Includes rating time and [illegible] management
		M	65	
Work Unit/MPS Relationship	Labs, RDO, Tech. Mon.	I	4 to 5	Establish requirements and [illegible] for [illegible]
		M	3 to 4	Three [illegible] until all [illegible]
Job Descriptions, Tech. Mon. and R&D Coordinators	RDO, CW staff, labs, field	I	1 to 2	Check existing, some may be satisfactory; define standards
		M	minimal	Update as needed
MPS Rating Process	Civil Works staff, field advisors, R&D Coordinators, RDO	I	1½ to 2	Establish criteria, committee meetings
		M	1/field office	Estimated rating time per field office
MPS Rating Analysis Process	CWR, WRSC	I	5	Time to develop format for analysis and reprogramfor that format
		M	2½	CWR updates instructions; WRSC prepares statistical summaries
Index File Field Project Studies	Field, RDO	I	8 to 9	Anticipate field reluctance
		M	2	---
Five-Year Research Programs	Labs, RDO, Tech. Mon., advisory groups	I	6 per Program	Some Programs have 5-yr plans; allows for for several meetings and travel
		M	3 per Program	
Long-range Investment Budget, Priorities	Labs, RDO R&O, RDRB, Civil Works R&D Comm.	I	6 to 8 for guidelines plus 6 to 8 per Program	Assume 6 to 8 man months for guidance plus another 6 to 8 per laboratory
		M	2 to 3	Laboratory update and meetings with OCE

NOTE: [illegible] of effort for any group of options would exceed the actual effort if that group were adopted because there is overlap between options and because the effort for any particular group of options could be organized for maximum efficiency.

D. Options Classed by Extent of Alteration and Degree of Necessity

1. Categories of Alternation

a. Actions involving no alteratin of system components or process sequence. The object of these actions would be to: (1) correct mechanisms within particular aspects of a process or component; or (2) to facilitate system processes, (i.e., to act as an accessory to the existing system.

b. Actions resulting in some alteration to the existing system but which do not require either the addition or deletion of system components. These actions would emphasize means to enable components to better achieve their intended function. Such options would involve more than simply correcting a mechanism, the improvements would be realized through an actual change in a components's operation; for example, a change in decision event time or method of deliberation.

c. Actions involving an alteration of the system. These actions would include either the addition or deletion of decisions or decision participants and so would also affect the sequential development of existing system processes.

2. Categories of Need

In order to completely present the options, the relative priority of need of each should be indicated. For this study, three levels are chosen:

a. High priority - actions that would be essential to improving the R&D system;

b. Medium priority - actions that should be undertaken;

c. Low priority - actions that could be undertaken and would improve the systemy.

Options of medium or low priority would not be effective unless the essential, high priority actions were implemented.

3. Identification of Options by Category

Each of the 15 options was reviewed as to the extent to which its implementation would alter the system. An assessment was also made as to how crucial each option would be in improving the system.

a. Actions Involving No Alteration of System.

Eight of the options would result in no change to the system structure or process and most of these are judged as being essential.

(1) High Priority:

- Procedures for MPS quality control
- Audio-visual tapes describing the Research Needs System
- Clarify job descriptions for Technical Monitors and for R&D Coordinators in field and laboratory offices.
- Change MPS rating process
- Change MPS rating process

(2) Medium Priority:

- Clarify Work Unit/MPS relationships
- R&D Coordinator Conference
- R&D Bulleting

(3) Low Priority:

- R&D Coordinator Conference
- R&D Bulletin

The R&D Conferences and the R&D Bulleting are listed both under medium and low priority; that is because if one were implemented then the other would be less needed.

b. Actions Resulting in Some Alteration of the Organization of the Existing System.

Four of the options occur in this category, one of which is considered to be essential in any plan to improve the system. The other three would be helpful but are not absolutely necessary.

(1) High Priority:

- Reinforce the function of the Civil Works R&D Review Committee

(2) Low Priority:

- Consider changes in the composition of the Civil Works R&D Review Committee
- Establish funding for field participation in the Research Needs System
- Develop an index file of field office project studies

c. Actions Involving an Alteration of the System Structure

Three of the options would affect the system by adding either an advisory group or a process that is not in the current system. One of these is considered of high priority and none are of low priority.

(1) High Priority:

- Institute a long-range investment budget and priority system

(2) Medium Priority:

- Develop field advisory recommendations for Research Program budget priorities
- Establish five-year plans for Research Programs

E. Possible Negative Implications

The adoption of certain options would need to be considered carefully since they could create additional problems.

a. Funding for field participation:

Would reduce the funds available for Work Units and could involve a cumbersome bookkeeping system that would offset the account's advantages.

b. Index file of field office project studies:

Although this action is not motivated by interest in budgetary or study content control over field offices it would be difficult to implement. If this option were seriously considered, it should be determined if such information is really needed and how best it would be acquired.

c. Changes in Civil Works R&D Committee composition:

There is not a clear indication of essential need for this action; it would probably not be prudent to consider this option until after the actions to reinforce the Committee function has been implemented and evaluated.

d. Field advisory committee recommendations:

Since several of the Research Programs have effective field advisory committees, this option could be more disruptive than useful. The existing groups would need to be examined to determine if their duties or membership could be modified to achieve those proposed by this option. At any rate, consideration should be given to establishing committees for Research Areas that lack field advisory support.

V. IMPACTS OF ALTERNATIVE SELECTIONS OF OPTIONS

For each of the 15 options formulated in this study, the problems addressed, positive results expected, relative degree of need, and comparative extent of system alteration have been identified in Section IV. This section examines what the general impacts of selected groups of options would be. These groups were chosen to represent the most likely combinations of options that would be considered for implementation. They also represent progressive levels of improvement: minimal, moderate, and major. The hypothetical selection of options for each of these groups (Table 22) is based on the assumption that options which correct the most obvious problems, incur the least disturbance, and require the least effort would be the primary candidates for an actual improvement plan. The groupings are not necessarily recommended ones, but are instead presented as scenarios to indicate what some improvements to the R&D System could acomplish.

A. Description of Alternative Option Groups

The minimal group of five options (Table 22) includes those that emphasize relief from problems in the Research Needs System. All five are judged as being essential and affecting no alteration to the overall R&D System. Of them, only the option to clarify job descriptions could reasonably be implemented alone; the other four strengthen each other.

The options grouped for moderate modification include the five in the minimal group along with three others which would: reinforce the function of the Civil Works R&D Review Committee, clarify Work Unit/MPS relationships, and institute an R&D Bulletin. Of these eight, the Committee option is the only one that would affect the sequence of R&D Program operation. None of the options in this scenario affect the system structure. It was assumed that actual development of the moderate modification alternative would not initially include both the R&D Bulletin and the R&D Conference, and that the Bulletin might be more likely to be selected since it is probably more easily implementable.

In addition to these eight options, the major modification alternative includes three (Table 22) that would alter system structure by adding events and participants groups to the decision process. These include the long-range investment budget system, five-year research planning, and priority recommendations from Research Area field advisory committees.

B. The Minimal Modification Scenario

The problems that the five options in the minimal group focus on include two of the four problem clusters: (1) the lack of understanding in acquiring and using appropriate information, and (2) weaknesses in coordination within and between participant groups in accomplishing program development tasks. If

TABLE 22

Selection of Options for Inclusion in Alternative Scenarios

Options Classed by Level of Priority Need and Extent of Alteration to R&D System*		Alternative Scenarios		
		Minimal Modification	Moderate Modification	Major Modification
High Priority:				
(I)	Procedures for MPS Quality Control	X	X	X
(I)	Audio-visual Tape Describing RNS	X	X	X
(I)	Clarif. Tech. Monitor, R&D Coordinator Job Descriptions	X	X	X
(I)	Change MPS Rating Process	X	X	X
(I)	Change MPS Analysis Process	X	X	X
(II)	Civil Works R&D Committee Function		X	X
(III)	Long-range Investment Budget/Priority System			X
Medium Priority:				
(I)	Clarification Work Unit/MPS Relationships		X	X
(I)	R&D Coordinator Conference		X	X
(I)	R&D Bulletin			X
(III)	Field Advisory Committees			X
(III)	Five-Year Plans for Research Programs			
Low Priority:				
(I)	R&D Coordinator Conference			
(I)	R&D Bulletin			
(II)	Civil Works R&D Committee Composition			
(II)	Funding for Field Participation in RNS			
(II)	Index File of Field Office Project Studies			
	Total Options:	5	8	11

* Extent of alteration to system indicated by:

(I) Involves no alteration of system,
(II) Involves some alteration of system organization, i.e. change in decision event time or method of deliberation,
(III) Involves some alteration of system structure, i.e. addition or deletion of decisions or decision participants.

all five of the options in the minimal group were implemented, the overall system would continue to function as it does now: decisions and priorities would continue to be set as in the existing cycle of events and by the same participants. However, certain deterrents to an effective determination of field needs and a valid determination of field priorities would be removed. Further, the process by which field needs and priorities are obtained would be considerably more efficient.

If successfully implemented, this group of options has the potential to accomplish the following improvements. First, a clean up and reduction of the existing compilation of MPS and a systematic means of ensuring that each fiscal year's compilation would continue to be well prepared. This action, along with the film to explain the system and a simplified, less time-consuming rating process would encourage a more concientious effort in submitting and rating MPS. The changes in the analysis of those ratings would produce results which are a valid expression of field priorities. Finally, these actions and the changes in job descriptions would collectively give credence and visibility to the Research Needs System.

C. The Moderate Modification Scenario

The additional options selected for this alternative would add the accomplishments realized by the minimal level of improvement primarily because these would address three of the four problem clusters including one not directly treated by the minimal alternative: weakness in coordinating and planning research goals.

Under this alternative, the Civil Works R&D Review Committee would exert a more timely and effective influence. This is because it would: (1) meet prior to Program Reviews to provide closer guidance on FY+1 priorities, (2) would consider appropriate criteria and information in recommending FY+2 budget targets, (3) would establish priorities through trade-off analysis, and (4) would be aided in its function by use of agendas and well-prepared Research Program information sheets provided in advance of meetings.

The action to clarify Work Unit/MPS relationships would further the improvements given by the minimal scenario since it would better link field priorities to research conducted. Indirectly, it would also aid the Committee's function since Technical Monitors could more easily explain Research Program content.

Finally, the impact from the third option, the R&D Bulletin, would depend on its scope, frequency, emphasis, and tone, but it has the potential of being extremely effective in promoting understanding of and encouraging participation in the R&D process. At the very least, it would be an efficient technique for informing interested persons throughout the Corps.

Overall, a major accomplishment of this set of actions is that the results of the Research Needs System would be appropriately applied in decisionmaking. Thus, the field needs and priorities would be limited to use

by the Performing Elements, Technical Monitors, and RDO in making yearly decisions on the content and goals of research within programs. Similarly, these options would clearly enable the decisions on Research Program priorities to be made through deliberation of program-level achievements, needs, and objectives.

D. The Major Modification Scenario

All three actions introduced in this alternative would have considerable impact on the R&D System structure and process. Unlike the minimal and moderate scenarios, the improvements included in this plan would address all four problem clusters: in particular, they would give attention to the lack of a comprehensive perspective in establishing long-term priorities and goals.

The option dealing with five-year plans for technical goals in each Research Program and subsequently for the overall R&D Program would involve interaction of participants at all levels and would produce plans formulated through a balancing of existing and expected capabilities, needs, and goals. By comparison, its partner option, the long-range investment budget and priority system, would deal with a later time frame (5 to 10 years) and would emphasize budget planning for facilities and capabilities rather than directives for research goals. Together, these two options would complement each other: the long-range 5-to-10-year budget priorities would lay the groundwork for future capabilities; then, the shorter-term 5-year planning would develop reasonable research goals on that framework.

The third additional option, Field Advisory recommendations for Research Programs would help the Civil Works R&D Review Committee in adjusting budget targets prior to Program Reviews. The Committee would have access to a knowledgeable overview assessment of field needs that would link its priority guidance to a sense of field needs and clearly avoid the inappropriate use of actual Research Needs System calculations.

E. Overview of Potential Improvements

The major modification alternative hypothetically included 11 of the 15 options. Those not included for this example are judged to be of low priority: while they do have their merits, their accomplishments would not significantly add to the improvements resulting from the 11 selected. The option for the R&D Coordinator Conference would offer benefits to any improvement plan and should be considered in its formulation.

The accomplishments of the progressive levels of modification that could be expected from the alternative scenarios are summarized below:

1. Minimal Modification

   - Effective determination of field needs
   - Valid determination of field priorities
   - Efficient operation of Research Needs System

2. Moderate Modification

   - Improvements as in minimal alternative
   - Valid determination of Research Program priorities
   - Confinement of Research Needs System results to decisions on program content

3. Major modification

   - Improvements as in minimal alternative
   - Improvements as in moderate alternative
   - Systematic formulation of long-term investment priorities
   - Decision process for long-term research goals that is conducted separately from that for annual within program goals

A comparison of the general operation of the existing system for determining needs and priorities with that which would occur with the major modification scenario is shown on Figure 2.

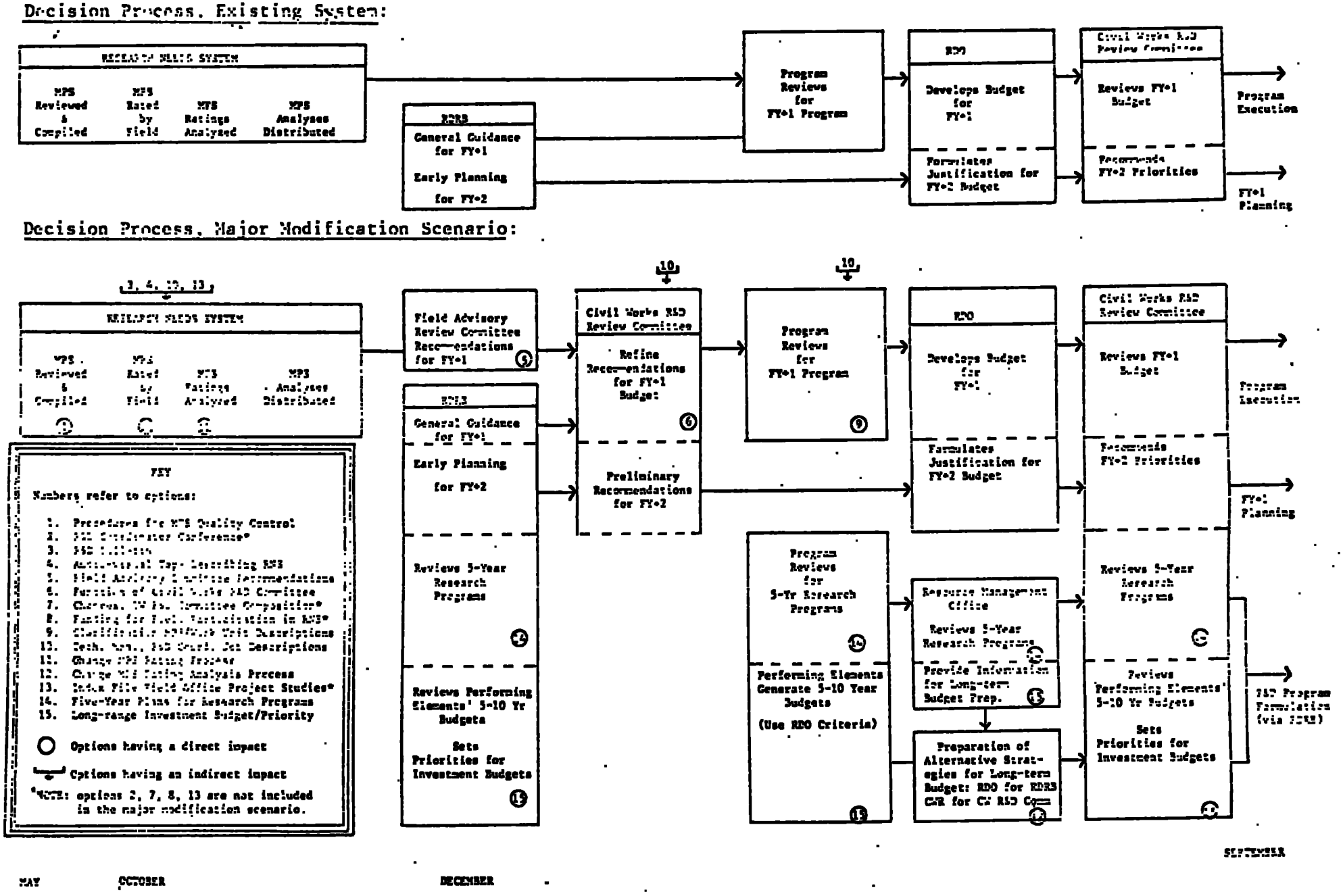

Figure 2. Comparison of General Decision Processes Under Existing and an Alternative System.

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Appendix B: Workshop on R&D Prioritization

Appendix C: Summary of Environmental Advisory Board Comments

Appendix D: Summary of Discussions with Attendees at July/August 1980 Meetings of Civil Works R&D Review Committee

Appendix E: Summary of R&D within Other Agencies

Appendix F: Review of Literature for R&D Analysis

APPENDIX A

FORMULATION OF THE CORPS CIVIL WORKS PROGRAM FOR RESEARCH AND DEVELOPMENT

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DESCRIPTION OF THE CURRENT R&D SYSTEM

The Civil Works Program includes endeavors concerned with intensive study of a subject, i.e. research, and those concerned with the translation of research findings into new or improved techniques, i.e. development. In order to obtain products from research and development, the Corps must ascertain its needs for internal operation and external interaction, must establish priorities for those needs, and must distribute its budget allocation in a way which matches needs with funds and which is effective in yielding the appropriate R&D products on time for users.

Planning and managing the Civil Works Program requires attention to needs and objectives both within the short and long term. Program operation necessarily consists of a continuous melange of needs identification, needs processing, and needs fulfillment, yet there are instituted cycles for budgeting, management, and problem solicitation. While the Program does not have a beginning or end, its formulation for a given year can be considered in terms of phases that are roughly linked to key events in the budget, management, and problem solicitation cycles. Five phases can be identified in the formulation of the Civil Works Program. As shown in Figure A1, these phases are:

I. Development of General Guidance for the Total Corps Research and Development Program

II. Identification of Civil Works R&D Program Research and Budget Needs.

III. Establishment of R&D Program Research and Budget Priorities.

IV. Development of R&D Program Appropriate to Research Needs and Budget Allocations.

V. Execution of R&D Program.

The portions of the Program that are emphasized in accomplishing the various phases can be regarded as a vertically structured hierarchy of concerns and activities (Figure A2). However, the phases of R&D Program formulation do not successively address the hierarchical levels.

This study's attention centers on the first three phases because R&D priorities are established then. The importance of each of these three phases within the overall Program, as well as the key decision points and interactions among participants and functional units are indicated in the following paragraphs. The specific role and responsibilities of each participant and unit as detailed in the regulations are presented in Inclosure A1.

Development of General Guidance for Corps R&D

Figure A1 presents the R&D Review Board as the principal functioning unit in this Phase. Figure A4 depicts in expanded detail, information as to members who serve on the Board and the inputs preparatory to the Board's meeting each January. The intent of this Phase is to enable a general evaluation of Corps R&D by way of the Board's review of accomplishments and objectives within the Corps three budgetary areas: Civil Works (CW), Operations and Maintenance (O&MA), and Research Development Test and Evaluation (RDT&E). The purpose of the Board meeting is to provide guidance on the short and long-term R&D Program emphasis within each budget area. The Board's guidance on concerns for the current budget year is developed in recognition of the Presidential Budget Guidance issued 2 to 3 months earlier and is also based on recommendations prepared through prior coordination between RDO and the OCE Directorate and also the Civil Works R&D Review Committee. The Board output is timed to occur before and to be used in the defense of the budget year program before Congress.

In reality the Board does not have the strength which is indicated in the regulations. The Board function is a validation of the Program's momentum and the planning that has largely been done by RDO.

Identification of Needs for Civil Works R&D

In Phase II, the Program that will be undertaken in the budget year becomes fairly well established by way of the Program Review System. Figure A5 illustrates the sequence of activity. The diagrammatic simplicity of the events and interactions belies their significance: the outcome of the Program Reviews has probably the most important single impact on the program. This impact can be realized when all phases are seen in overview. Essentially, the sense of this Phase is that the work unit program is developed, that alternative budget levels to fit within budget guidelines are all but finalized, and that the laboratories have considerable independence in preparing the Program which eventually is implemented.

RDO conducts a Program Review for each of the Research Programs at the appropriate principal laboratory.* The review consists of an examination of the budget year agenda of work units which has been prepared by the laboratory with some level of coordination and input from the Technical Monitor. The influence exerted by the Technical Monitors varies with the individual monitor, but in general their roles are not played to the extent intended. The programs proposed and defended by the laboratories at the reviews include the estimated funding needed for each work unit for each alternative budget (minimum, current, and enhancement).

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*Figure A4 depicts WRSC as a laboratory although in actuality it is an FOA. For purposes of the Program Review WRSC functions as a laboratory and so for convenience it is so designated here.

Figure A5 indicates that the field-rated results of the Research Needs System (Figure A3) are the major input to the laboratory's program development. In that the Research Needs System produces the field's priorities for needs and in that the field is the ultimate user of R&D products, the Research Needs System is meant to be of significant use in Program development. However, the purpose of the Research Needs System is hampered by the methods in which the the field input is obtained and analyzed (see later major sections of this appendix and Inclosures A1 and A2). In actuality the laboratories review the result of the Research Needs System with an interest in what the field percieves to be high priority and how the field rated the laboratory-generated mission problems. Thus, in preparing their work units the laboratories are guided more by their own interests in new tasks and committment to continuing tasks than by a concern to make a conscientious effort to address field needs. Justifying work unit accommodation of mission problems is facilitated by the mission problems generally being loosely written and so subject to flexible interpretation; besides, there is no requirement to demonstrate how or to what extent a work unit addresses mission problem(s).

Establishment of Research Program Priorities

As indicated earlier, Corps R&D component can be viewed in a vertical hierarchy which the phases of Program formulation do not successively address. The two previous sections showed that Phase I focuses on the first level of the hierarchy, i.e. the emphasis is on the three funding areas (CW, O&MA, RDT&E), while Phase II centers on the lowest level, the work units. The third Phase's interest switches back up the hierarchy and centers on the Research Programs.

The expanded diagram of participants and their interactional sequence in Phase II is shown in Figure A6. Although the Phase II activity appears to

be complex, most of the large number of participants and avenues of assistance are weak. Phase II is essentially confined to two events, the Civil Works R&D Review Committee meeting and the Director of Civil Works' approval of the budget year program.

Apparently, the current purposes of the Committee meeting are to (1) review the CY+1 budget and (2) rank the Research Programs in order to develop recommended adjustments to the CY+2 budget. Prior to the Committee's meeting, the CW Programs Office of RDO and the Office of Policy (primarily through the User Representative*) prepare a synthesis of the Program Reviews. This consists of a listing of the three budget level alternatives for CY+1 for each Research Program. The Office of Policy also prepares the percent increments and decrements to be applied to the CY+2 budget once the Committee ranks the Research Programs according to mission-based criteria; the rankings and the adjusted alternative budgets go forward to RDO as the Committee's recommendations for each Research Program (this process is more fully described in Section III of this Appendix).

Although the Committee has responsibilities to guide development of the total Civil Works R&D Program and the general content and goals within each of the Research Programs, it cannot exercise these responsibilities. First, with respect to the budget year R&D Program, the Committee is not as effective as it could be since it meets after program direction has been set in the Program Reviews. Second, the Committee restricts itself in affecting CY+2 priorities because it does not consider the long-term goals of each Research Program relative to the R&D accomplishments in each and the impact that budget changes might have on these goals.

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* Currently there is only one User Representative in Civil Works although according to the regulations there are several and are from each of the Divisions in the Civil Works Directorate.

Regulations Studied for Information on How the Current System Works*

ER 15-1-17	30 Jan 1978 Research and Development Review Board (RDRB)
ER 15-2-9	1 Nov 1972 Civil Works R&D Board
ER 70-1-5	20 Sep 1974 Corps of Engineers Research and Development Program
ER 70-1-6 (draft)	25 Sep 1979 Research and Development, Principal Laboratory
ER 70-1-7	20 Sep 1974 User Representative/Technical Monitor/Laboratory Relationship
ER 70-1-9 (draft)	29 Apr 1980 Transfer of Corps of Engineers Research and Development Technology
ER 70-1-11 (draft)	21 Sep 1979 Planning, Programming, and Documentation Requirements for the Corps of Engineers Research and Development Program
ER 70-2-3	15 Feb 1973 Civil Works Research and Development Management System
ER 70-2-6	20 Jan 1978 Civil Works Research and Development Research Needs System (RCS-DAEN-CWM-1)

*This listing does not include any ER's for which a draft is now in preparation.

PART II

MISSION PROBLEM STATEMENT METHODOLOGICAL CRITIQUE

This methodological critique focuses on the purpose of rating mission problems; it does not address issues involved with the generation of MPS or the use of MPS rankings once they are developed. The critique proceeds as follows. First the MPS rating process is briefly described. Second, general scientific terms that will be used in the critique are introduced and discussed. Third, the rating process is critiqued. Finally, a series of recommendations are made for improving the rating system based on the problems identified.

Description of Rating Process

The rating process begins each year when the Civil Works Office of Policy (CWR) sends the MPS to each District and Division for review and rating. The MPS have been collected and grouped into categories corresponding to the 29 Research Programs by the user Representative, Paul Jorgenson, of CWR. The grouped MPS Statements are sent to each District and Division R&D coordinator for rating. No specific guidance on the rating process is given and IG records demonstrate that District R&D coordinators follow a variety of procedures to develop rating of MPS (Inclosure A2). In some cases, for example, District R&D Coordinators break MPS up into areas corresponding to specializations in the District and send the MPS to the appropriate area in the District for rating. In other cases R&D Coordinators make the ratings and forward them up through District chains-of-command for approval.

MPS are rated on a four-item index of R&D significance. Each index item can vary from 1 through 10, with 1 meaning no importance on the item and 10 very high importance. The four indicators of R&D significance are urgency of need; potential dollar savings; safety and intangible benefits. Districts and Divisions give each MPS either a numerical rating ranging from 4 through 40 (1 through 10 on the four indicators) or a zero, indicating that the particular MP is not deemed to be of interest to the District or Division. Ratings are forward to CWR which then forwards the rating to WRSC where the total scores are computerized. Various calculations are then performed. The statistics developed are: average MPS rating; MPS rank; average Research Program rating; average MPS rating by Division.

Average MPS Rating

The average MP rating consists of total points divided by total number of Districts and Divisions rating the MP. Those elements which responded with a zero, indicating non-interest, are not included in the average.

MPS Rank

Average MP ranks are sorted in descending order to rank MPs from highest to lowest field priority.

Average MPS Rating by Research Program

As described elsewhere in this report, MPs are grouped into 29 Research Programs prior to being sent for field rating. An average rating for the MPs falling under each program area is computed to provide an indication of field importance regarding particular research program areas.

Average MPS Rating by Division

MPs are averaged by Division to derive an indication or regional variation in research needs.

Methodological Issues

This section presents a discussion of the methodology of index construction, focusing in particular on the issue of ways of measuring the validity of indices. In addition, a discussion of the methodological issue of reliability in the rating process is presented.

Index Construction

An index is a measurement technique which employs the combined use of several indicators to build a summary measure of an unobserved variable. In the case of the MPS rating system, the index is composed of four indicators which provide a summary measure of the variable of "R&D significance." It is important to keep in mind that "R&D significance" is a theoretical variable,

or a concept, and not a tangible physical object. Since R&D significance is a concept, it is necessary to specify what is meant by this concept. The end-product of the process of conceptualization is the specification of one or more indicators of the concept. Indicators are real and observable things that give evidence of the presence or absence of the concept (Babbie, 1978:120).

A major issue in the development of indicators is how to be sure that an indicator is measuring the absence or presence of the concept it is intended to measure. This is the issue of determining the validity of indicaotrs. To return to the concept of R&D significance, the question that needs to be asked is are the indicators of safety, dollars savings in tangible benefits, and urgency of need valid indicators of the concept?

Several strategies for determining the validity of indicators are apparent in the scientific literature. First is the criterion of face validity: Is the indicator consistent with logical or "common sense" definitions of the concept? We would reject out-of-hand as an indicator of R&D significance, a measure of the number of employers with a GS-12 rating. The indicator has no logical relationship to the concept of R&D significance. (Babbie, 1978:132.)

Another form of validity is experiential validity. An indicator gains greater validity if its measurements can be compared against experience. If an indicator lables something as important which our experience also tells us is important, our confidence in the indicator's validity increases (De Neufville, 1979:175). Another form of validity is theoretical validity.

Indicators of a concept can be deduced from a body of theory if the concept is capable of being specified by a well-defined model. For example, macro-economic theory defines the concept of unemployment as a pressure on the labor market. Given this model of the concept, an indicator of unemployment can be deduced as those without a job seeking employment.

A review of the literature of measuring validity indicates that there are not hard and fast rules for determining an indicator's validity. Rather, what is involved is a process where indicators are legimated through scrutiny and debate. In this process, the logical relationship of an indicator to a concept is called into question. The experiential base of those involved is tapped, and a demand for a clear specification of the meaning of the concept has been made. It has been pointed out that those policy indicators, such as the unemployment rate which find their way into deliberations about public policy issues have been legimated through such processes (De Neufville, 1979:184).

Having discussed in general fashion the issue of measuring validity, the validity of the MPS rating index can now be evaluated.

1. Specification of the concept of R&D significance: The concept has been specified as a perception of important problems facing Corps field level elements. Presumably, such problems can strain field attempts to attain Corps missions.

2. Indicators of R&D significance: safety, urgency of need, dollar savings and tangible benefits.

3. Validity tests:

a. Face validity: Do the indicators have any logical, or common-sense, relationship to the concept as specified?

b. Experiential validity: Do the indicators identify problems which are perceived by the field to be most critical?

c. Are the indicators capable of being deductibly derived from the concept as specified?

d. Process of legitimation: Where the indicators subjected to a process of critical scrutiny and debate about their merit?

4. Discussion:

a. Face validity: There is no reason to doubt that the four indicators are not logically related to the concept as specified. At issue, however, are, first, how well such indicators relate to the concept (i.e., are there other indicators which have a more direct logical connection?) and second, if the indicators chosen <u>completely</u> specify the concept (are there other indicators which relate to other important dimensions of the concept?)

b. Experiential validity: There has been dissatisfaction on the part of field and other Corps personnel that the MP rating process fails to identify critical problem areas. In addition, if the index is a valid measure of R&D significance, it could be expected that it would discriminate among the projects. In viewing the distribution of MPS ratings among projects, however, not much evidence of such discrimination is found. Instead of a normal distribution of ratings, MPS ratings are clustered around the midpoint with very little dispersion.

c. Theoretical validity: There is no indication of the process by which the four indicators were developed. It is not clear that the indicators deductively follow from the concept of R&D significance as specified.

d. Process of legitimation: It appears that the indicators jumped Athena-like fully formed from the head of one person at OCE and that little subsequent modification took place. Questions about the potential value of other indicators of the number of dimensions to the concept of R&D significance were seemingly never posed.

5. Summary:

In summary, it appears that the four indicators have serious validation problems. In particular, it appears that:

a. Careful and complete specification of the concept of R&D significance has not been undertaken.

b. An enumeration of possible indicators that can be deduced from concept as specified has not been performed.

c. Most importantly, that a process of debate over the relative merits of the indicators enumerated has not been undertaken. This process is likely to have resulted in the identification of a set of indicators which are logically related to the concept of R&D significance, and which adequately reflect its several dimensions.

Rating Process

The primary methodological issue confronting the process by which MPS ratings are developed is that of reliability. Reliability refers to the consistency of the measurement. With a completely reliable measurement process, repreated observations of a phenomenon would yield the same measurement. The greater the differences in measurement, the less reliable the measurement process in question. Reliability rests on a common understanding process and a common approach to taking measurement (Babbie, 1978:130).

In the case of the MPS rating process, it has been observed that there is a great variation in the manner in which ratings are developed. Some elements sned MPS to specific functional elements for rating, while some elements use committees. This variation of procedure undoubtedly creates reliability problems. There is also some question about the commonality of understanding among participants in the measurement process. For example, some participants

have viewed zero as a number indicating no significance, rather than as an indicator of no interest, while others have not. Given these problems, it cannot be ascertained whether the differences among field elements in MPS ratings can be ascribed to subjective and experiential perceptions of importance or are simply measurement errors introduced by variations in rating processes implied among elements or are variations in levels of understanding of the process among participants.

Recommendations

Indicators

It is recommended that the following steps be undertaken to develop indicators which meet accepted stsndards of validity:

1. Develop a preliminary specification of the concept of R&D significance, for example, the questions the definition of "problem" and "R&D problem" need to be raised, (e.g, something is a problem if...; it is a potential problem ameniable to R&D if.. .). A first step in this process is appended in the form of a questionnaire inviting readers to expand on the concept of R&D significance.

2. Develop an array of potential indicators which relate to the specific dimensionsof the concept.

3. Submit these lists to the field and invite their input review and additions.

The above would generate a set of indicators which are likely to be much more capable of measuring field perception of problems of R&D significance. Such indicators are much more likely to meet tests of validity than those much more in use.

Rating Process

1. To address reliability problems, it is recommended that one rating process be identified through regulation so that there is a common procedure employed across field elements to determine MPS ratings.

2. Clarification of the rating process so that a common level of understanding among the participants is achieved.

3. Suggested rating process:

a. MPS sent to field R&D Coordinator (RDC) would be only those surfaced during previous year that have passed CWR review process or those MPS that are two years old or less which do not have any work units underway. The CWR review process would be as follows: When an MPS is submitted to CWR, it would be compared against other MPS currently being funded and against R&D outputs which have already been completed. If duplication between the newly submittted MPS and either situation is found, the MPS would be returned with

the explanation that duplication appears to be present. A complete disclosure would be provided to the submitter and an appeal would be possible. (See the next section, CWR Duties Regarding MPS, for more detail on CWR duties.)

b. Field coordiantors would receive the MPS grouped by general functional area only (Planning, Engineering, Con-Ops, Real Estate). The Coordinator would send the MPS pertaining to a functinal area to a respective Chief. Each Chief would be responsible for filling out the index from rating the importance of MPS as R&D topics.

c. The Field Coordinator would assemble compelted forms and compute index values. The index values would be standardized on a 100-point scale. Those MPS in each functional area which receives a standard score of 85 or better will be identified as important problem areas. The Field Coordinator would prepare a report for the DE's review, transmitting MPS ratings and identifying the important MPS by group. This report would then be forwarded to CWR.

d. CWR would compute average standard scores from field rating sheets. The MPS would be aggregated by Research Programs within which those MPS with standard scores of 85 or higher would be identified.

e. CWR would prepare a report identifying these significant problems by Research Program and would forward this to the Civil Works R&D Review Committee for use in budgeting deliberations.

CWR Duties Regarding MPS

The duties of the CWR are described elsewhere in this report (Section I of this Appendix and in Appendix D). Several recommendations are made below concerning this office which have to do with enhancing the MPS rating procedure. These recommendations basically involve a more complete and systematic accounting for MPS through the following:

1. CWR would log in all MPS. These would be field-generated, lab-generated and OCE-generated. CWR would provide feedback to submitters of MPS on the fate of individual MPS submitted. When a new potential MPS is submitted, it would be screened against MPS already in the sytem. If there appears to be duplication, the submitter would be informed and given the chance to appeal or clarify the MPS. Potential MPS would also be checked for similarity to MPS which have already been addressed through completed R&D. Again, in the case of apparent duplication, the submitter would be informed and given the chance to appeal or to revise his MPS.

2. CWR would maintain a log of active MPS, (i.e., those which have work units being funded). This calls for a much more explicit link between work units and MPS. Work units must explicitly state how they expect to address a particulsr MPS.

3. CWR would maintain a log of completed R&D outputs again linking output to specific MPs.

4. CWR would monitor the life cycle of MPs. Each valid MP would remain in the system for a maximum of three years (three review periods).

5. Categorize MPs into:

a. Functional area (Planning, Engineering, Real Estate, Con-Ops).

b. Research Program categorization would be accomplished by a committee composed of CWR and one member from each OCE Division. This committee would meet bimonthly or as needed to categorize accumulated MPs.

References

Babbie, E. 1978. The Practice of Social Research. Belmont, CA. Wadsworth Publishing Co.

De Neufville, J. 1979. Validating Policy Indicators. Policy Sciences 10, pp 171-188.

PART III

METHODOLOGICAL CRITIQUE OF RESEARCH PROGRAM PRIORITIZATION PROCESS

This critique focuses on the methodological problems (validity, reliability) regarding the ranking of research programs. This critique is divided into five parts: (a) description of the reseach program prioritization process conducted during FY 1980; (b) methodological issues; (c) discussion; (d) summary; and (e) recommendations.

Description of the Research Program Prioritization Process Conducted During FY 80

Once the ratings are completed at the field office level, they are submitted to OCE. The raw data is then given the to the Data Collection and Management Division of WRSC for processing. Two types of listings are prepared for distribution. One set of listings is prepared for the research laboratories and technical monitors and one set is prepared for the field offices (districts and divisions).

- To the laboratories and technical monitors are sent: (a) total point ratings and average MPs rating by research program; and, (b) all MPS by priority ranking irrespective of research program.
- To the field offices the following information is sent: computer runs that show what the division and district ratings were vis a vis the remainder of the Corps field offices.

These two sets of listings were sent via RDO to the laboratories, technical monitors and divisions and districts. The listing of MPs were to be used by the technical monitors and laboratories during the program reviews that are conducted each year from February to April. For these reviews, the laboratories are required to prepare spread sheets for each work unit including a listing of the MPs that these units are supposedly responding to. Theoretically, higher priority is given to those MPs received from the field. (NOTE: Failure in the labs to respond to field initiated MPs may result in an incremental reduction in yearly budget. For example, this happened with Concrete in 1980.) The technical monitors utilize the MPS listing to establish funding levels for new work units in the various research programs.

The Civil Works R&D Review Committee is responsible for approving final ranking of Research Programs that are prepared by the Office of Policy. The approval procedure appears to differ from year to year. This year (FY 1980) a ranking of Research Programs devised by Office of Policy were circulated to members of the CWRDC. Each Committee member reviewed the rankings individually and cast a vote of concurrence on non-concurrance. Since a vote of non-concurrance was obtained a formal meeting of the Committee was scheduled for July 22.

Prior to the Committee meeting on July 22, each member received a memorandum. Inclosed in that memeorandum was a comparison of MPS by Research Program with budgetary ranking for FY 1982. More specifically, the MPs ranking and the number of MPs in the top 50 percentile were listed for each Research Program.

During the meeting, each participant was asked to evaluate each of the 29 Research Programs by six categories chosen by the Office of Policy. Five of these criteria represent primary authority areas where the Corps is currently involved. The criteria for Committee evaluation for FY 82 were:

-- Commercial Navigation
-- Municipal and Industrial Water Supply
-- Urban Flood Control
-- Environmental Preservation
-- Hydropower
-- Command Interest

Based on discussion with the Office of Policy, the following steps were followed in the ranking procedure:

1. Participants were asked to evaluate the contribution of each Research Program to the accomplishment of the criteria listed above. Under each criteria a Research Program was rated 0 - 5.

2. The responses of all the Committee members were averaged for each criteria by Research Program (i.e., six values for each program).

3. To the six values obtained from the meeting, two more values per Research Program were added. Points (0 - 5) were assigned to each Research Program based on the total number of MPS above the 50th percentile and snother set of points (0 - 5) were assigned based on the average MPS rating.

4. To obtain a composite value for each Research Program, eight values (each with equal weights) were summed. These composite values were used to rank the 29 programs.

These rankings were then used by the Office of Policy and Deputy of Civil Works to determine incremental changes in budget allocation. The Office of Policy had developed a separate formula for each funding level (e.g., minimum, current or ceiling, and enhancement). Program ranking determined what percent reduction or increase each Research Program would receive.

Methodological Issues

This section presents a critique of the validity and reliability of the index used in ranking Research Programs. There are a number of terms relating to index validity (i.e., face validity, experimental validity, theoretical validity and process of legitimation) that are herein discussed. Readers are referred to the previous discussion of MPS rating for their definitions.

Evaluation of Ranking Index Validity

Values from two different sources were integrated into the composite index used to rank Research Programs. Two values were obtained from the data collection from the field offices that rated MPS.

- The number of MPS in the top 50 percent by Research Program.
- Averages MPS total points divided by total number of districts and divisions rating MPS.

Apparently there was an attempt to standardize these scores. The exact process of standardization is not known but the values of these two variables were collapsed into scales 0 - 5.

These two index values for each Research Program were then combined with values generated during the Committee meeting. Individual scores for each Research Program by criteria were obtained. Participants were asked to rank each Research Program by the six criteria from 0 - 5. The individual ratings were totalled and averaged for each criteria. A composite ranking was obtained by summing the values from the six criteria with the two values obtained from the analysis of MPS.

Definition of R&D Significance

The concept of significance discussed in MPS rating process is not the same for program prioritization. Indicators that address the perception of important field level problems are included, but to this concept of R&D significance is added the idea of Corps authority in water resource management and how the various research programs contribute to the carrying out of these agency responsibilities (e.g., hydropower, environmental preservation, etc.).

Discussion

Concept of Significance

It is apparent that during the ranking of Research Programs, no unitary concept of R&D significance was achieved. This would lead one to suspect that possibly more than one dimension of R&D significance exists. The definition of the concept of R&D significance may depend on answering the question to whom is the R&D Program important? (e.g., field offices, laboratories, technical monitors, the Civil Works Directorates, and Corps clientele groups.) Each of these groups represent stakeholders in the system. The perception of significance and criteria for evaluation will probably be defined differently depending on what stakeholder is doing the evaluation. There is no evidence that attempts have been made to develop an integrated concept of R&D significance. In addition to adequately conceptualize R&D significance, one must have an understanding of the goals and objectives (short and long range) of the R&D Program.

Face Validity

Since there appears to be no unitary concept of R&D significance, the indicators at best could totally address only some of the dimensions of what appears to be a rather multi-dimensional concept. Therefore, the face validity of the ranking index is suspect.

Experimental Validity

Do the indicators identify problems perceived by the field and the Committee as being most critical? There is no definitive answer to this question. Due to the dissatisfaction and confusion expressed by the professionals in the field offices, the technical monitors and the Committee members there is reason to question whether the most critical issues are being addressed.

Theoretical Validity

The criteria established for evaluation of Research Programs by the Committee members were apparently developed in an Ad Hoc manner. No definition or theoretical explanation of why this set of indicators were chosen, has been found.

Process of Legitimation

There is no evidence that the criteria (indicators) for evaluation of Research Programs have been subject to scrutiny or debate by the various stakeholders in the process (e.g., laboratories, field office, Civil Works

Directorates). Until such scrutiny takes place and a set of criteria and procedures are negotiated, the process of R&D Program prioritization will be perceived as bogus by various stakeholders in the process.

The Ranking Process: The Problem of Internal Consistency

The problem of internal consistency or reliability is much easier to quantify than the problem of validity. Item analysis (bivariate or multivariate) would be an appropriate method of determining reliability. This study has uncovered no attempt to determine the internal consistency of the values generated in the process. The fundamental question that needs to be addressed is -- would repeated measures offer the same results? If the priority ranking were conducted over and over again on different samples of the same population, would they yield similar results. This is very hard to determine since the Committee's prioritization process changes every year.

SUMMARY

1. The contents and the process of the ranking of Research Programs in Civil Works changes every year. As a result there is much confusion over how the system functions and whether it produces reliable results.

2. No attempts have been made by the Office of Policy to determine the validity and reliability of the values that are the substantive basis for allocating $35 million each fiscal year.

3. There is no attempt to periodically determine the goals and objectives of the R&D Program and how they relate to Research Program prioritization.

4. The indicators on criteria for evaluation appear to be based on normative judgement by the Office of Policy staff with little input from stakeholders in the process. The criteria do not represent all the interests or concerns that these stakeholders represent.

5. The current process appears to be quite sensitive to minor changes in valuation. This is only a supposition, actual testing of the system sensitivity are beyond the scope of this project.

RECOMMENDATIONS

1. The futures group in conjunction with IWR should conduct a workshop to establish goals and objectives of the Civil Works R&D Committee. These objectives will then be transformed into criteria for ranking Research Programs.

2. Within the next two years, a sustained effort should be made to systematically develop evaluation criteria and procedures for prioritization that can be checked for validity and reliability.

3. It would appear that R&D significance actually may encompass several dimensions; indicators for each of these dimensions should be developed and the relative weight of the various dimensions should be scrutinized.

PHASES:	I. DEVELOPMENT OF GENERAL GUIDANCE FOR TOTAL CE R&D PROGRAM (SEE FIGURE A4 FOR DETAILS)	II. IDENTIFICATION OF CIVIL WORKS R&D PROGRAM RESEARCH AND BUDGET NEEDS (SEE FIGURE A5 FOR DETAILS)	III. ESTABLISHMENT OF R&D PROGRAM RESEARCH AND BUDGET PRIORITIES (SEE FIGURE A6 FOR DETAILS)	IV. DEVELOPMENT OF R&D PROGRAM APPROPRIATE TO RESEARCH NEEDS AND BUDGET ALLOCATIONS	V. EXECUTION OF R&D PROGRAM
	RESEARCH NEEDS SYSTEM (SEE FIGURE A3 FOR DETAILS) (IDENTIFICATION OF FIELD PROBLEMS AND THEIR RANKINGS, BY CWR) — FY+1 NEEDS INPUT COMPLETE — FY+2 NEEDS CONTINUE				
INTERACTION WITHIN CORPS OF ENGINEERS.	RDRB REVIEW OF ACCOMPLISHMENTS AND STATUS OF RESEARCH AND FUNDS. GENERAL DIRECTION FY+1 EARLY PLANNING FY+2	PROGRAM REVIEW SYSTEM (FORMULATION OF R&D PROGRAM, BY RDO) PERFORMING ELEMENTS PROPOSE PROGRAMS FOR FY+1 AT PROGRAM REVIEWS CONDUCTED BY RDO AND DEVELOP MINIMUM, CURRENT, ENHANCEMENT FUNDING LEVELS TECHNICAL MONITORS ESTABLISH PRIORITIES WITHIN RESEARCH PROGRAMS. RDO CONDUCTS PROGRAM REVIEWS	RDD DEVELOPS BUDGET FOR FY+1 AND FORMULATES JUSTIFICATION FOR FY+2 CWRDC REVIEWS NEEDS AND PRIORITIES. REVIEWS AND APPROVES BUDGET FOR FY+1 MAKES RECOMMENDATIONS FOR WITHIN RESEARCH PROGRAMS FOR FY+2 DCW APPROVES RESEARCH NEEDS AND THE RECOMMENDED PRIORITIES AND BUDGET FOR FY+1	RDO ISSUES FINAL GUIDANCE TO THE PERFORMING ELEMENTS FOR FY+1 PERFORMING ELEMENTS COMPLETE PLANS FOR PROGRAMS FOR FY+1 AND SUBMIT WORK UNIT DOCUMENTATION FOR FY+1	RDO SENDS PERFORMING ELEMENTS ALLOWANCE BUDGETED FOR FY PERFORMING ELEMENTS IMPLEMENT WORK UNITS PLANNED FOR FY
INTERACTION WITH OMB AND CONGRESS:	PRESIDENTIAL BUDGET GUIDANCE FORMULATION FOR FY+1 RDO & DCW DEFEND FY+1 BUDGET PLAN BEFORE CONGRESS			RDO JUSTIFIES BUDGET TO OMB AND CONGRESS FOR FY+2 RDO AND DCW SUBMIT BUDGET AND JUSTIFICATION TO OMB FOR FY+2	CONGRESS PASSES FUNDS APPROPRIATION FOR FY
APPROXIMATE TIME:	OCT--DEC	MAY- JUNE	JUNE–JULY	AUG – SEPT	OCTOBER

ABBREVIATIONS: CWR, OFFICE OF POLICY
CWRDC, CIVIL WORKS R&D COMMITTEE
DCW, DIRECTOR CIVIL WORKS
RDRB, RESEARCH AND DEVELOPMENT REVIEW BOARD
RDO, RESEARCH AND DEVELOPMENT OFFICE

FIGURE A1. PRINCIPAL PHASES IN CIVIL WORKS R&D PROGRAM

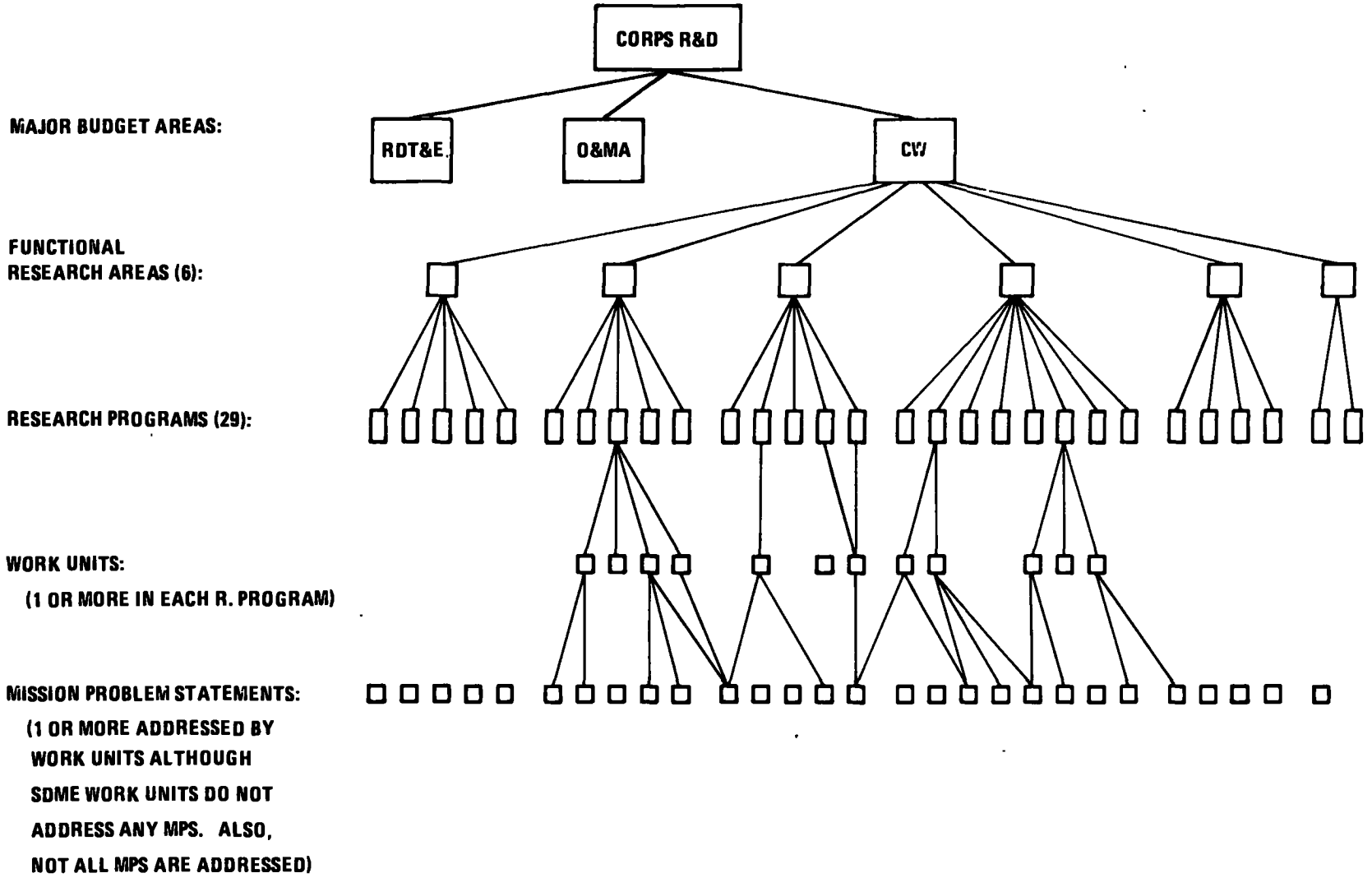
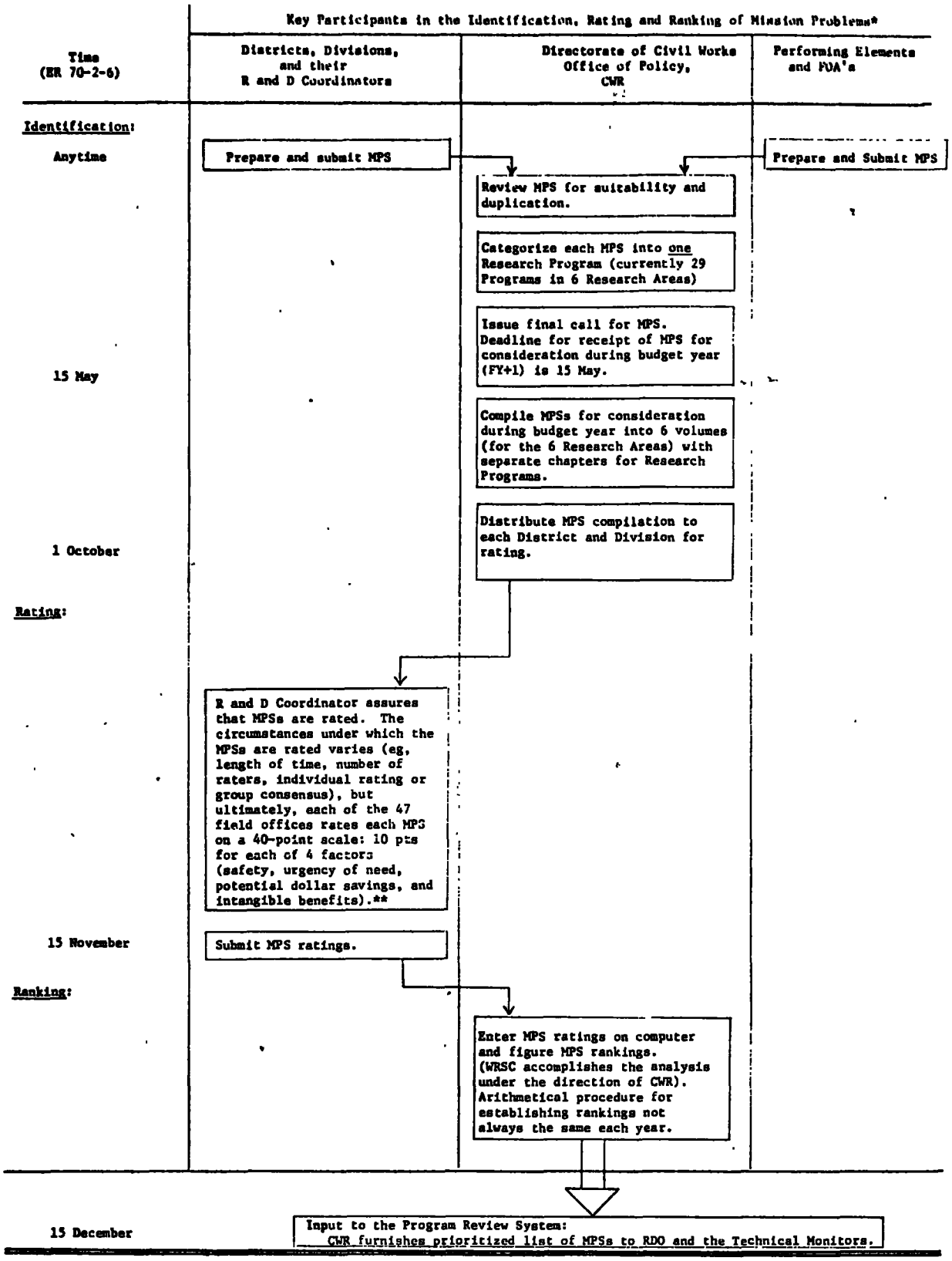


FIGURE A2. HIERARCHICAL STRUCTURE OF COMPONENTS OF CORPS R&D PROGRAM, CIVIL WORKS



* Mission Problems can be thought of in fiscal year groups. Those identified in FY are rated and ranked in FY+1, but could become addressed by an active work unit no earlier than FY+2.

** According to ER 70-2-6, the lowest rating that can be assigned for any of the four factors is 1. However, a District or Division can assign a zero rating to an MPS to indicate that they have no interest in that MPS. When zero ratings are submitted they are not treated as a response in the procedure for MPS ranking.

Figure A3. The Research Needs System

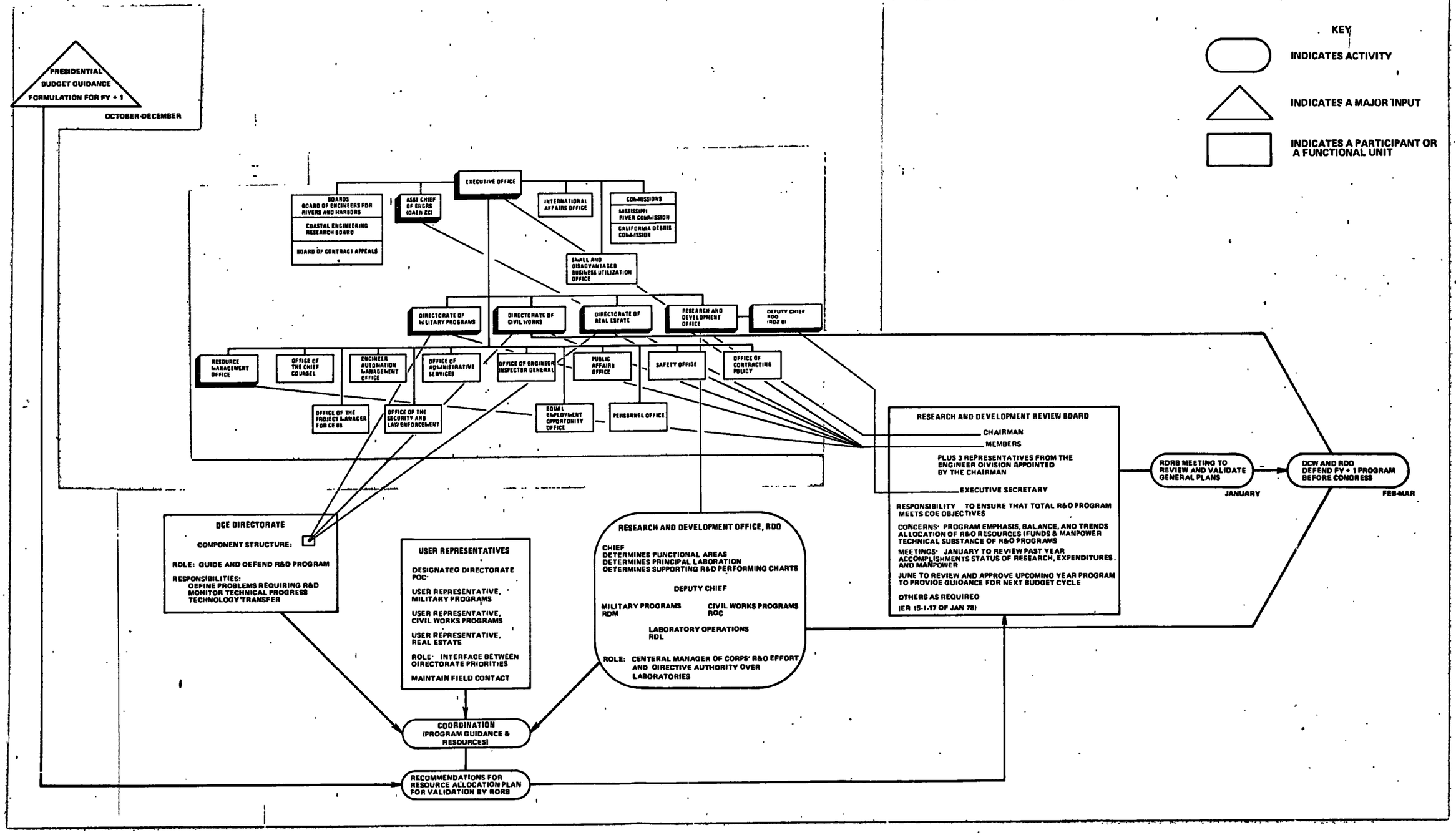
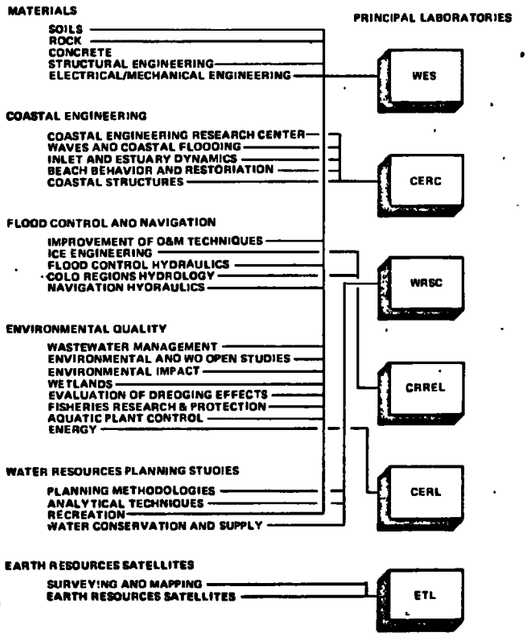
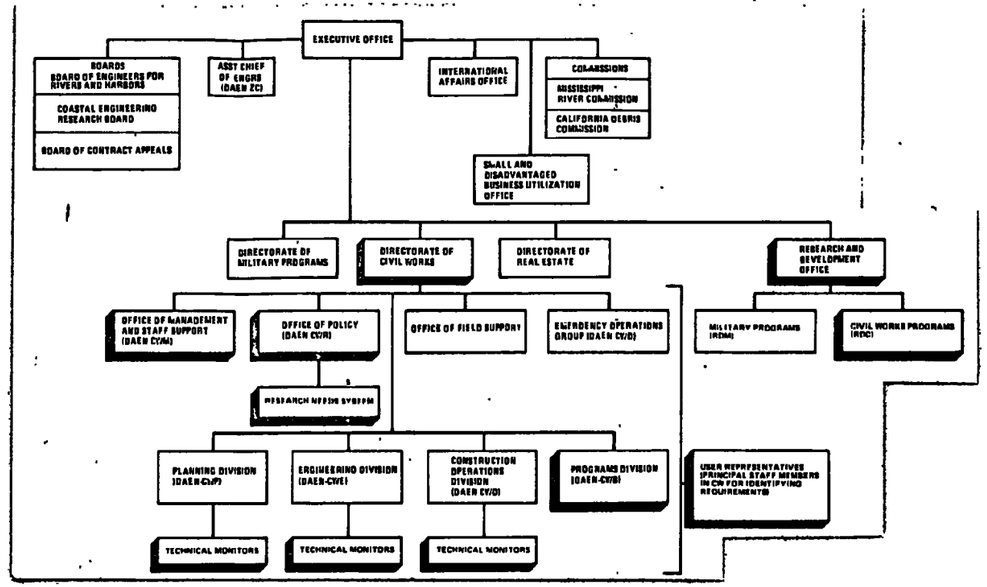


FIGURE A4. PHASE I: DEVELOPMENT OF GENERAL GUIDANCE FOR TOTAL CE AND R&D PROGRAM

R&D PROGRAM IS ORGANIZED BY RESEARCH AREAS WHICH CONSIST OF RESEARCH PROGRAMS. FOR EACH RESEARCH PROGRAM A PRINCIPAL LABORATORY IS DESIGNATED BY CHIEF, RDO. EACH RESEARCH PROGRAM IS MANAGED BY A TECHNICAL MONITOR APPOINTED FROM CW DIVISIONS (CWO, CWE, OR CWP). RESEARCH AREA AND PROGRAMS MAY CHANGE, IN 1980 THE PROGRAM REVIEW SYSTEM AREA, PROGRAMS, AND PRINCIPAL LABORATORIES WERE:



THE PROGRAM REVIEW SYSTEM



KEY

INDICATES ACTIVITY

INDICATES A MAJOR INPUT

INDICATES A PARTICIPANT OR A FUNCTIONAL UNIT

LOCATION OF PHASE II PARTICIPANTS IN CORPS ORGANIZATION

INTERACTION OF PARTICIPANTS AND SCHEME OF SEQUENCE IN PHASE II

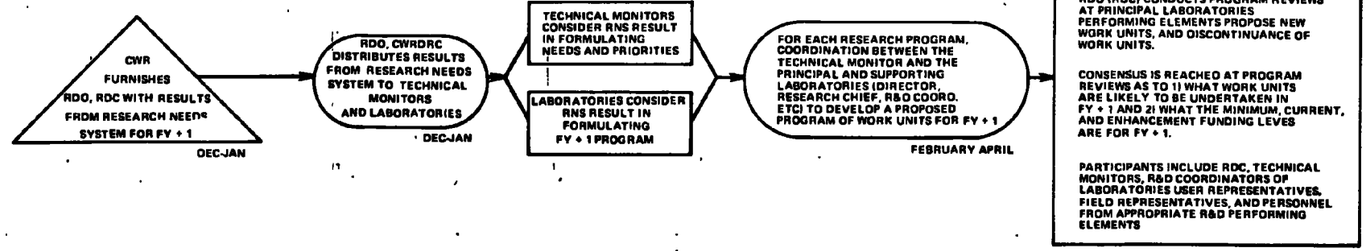
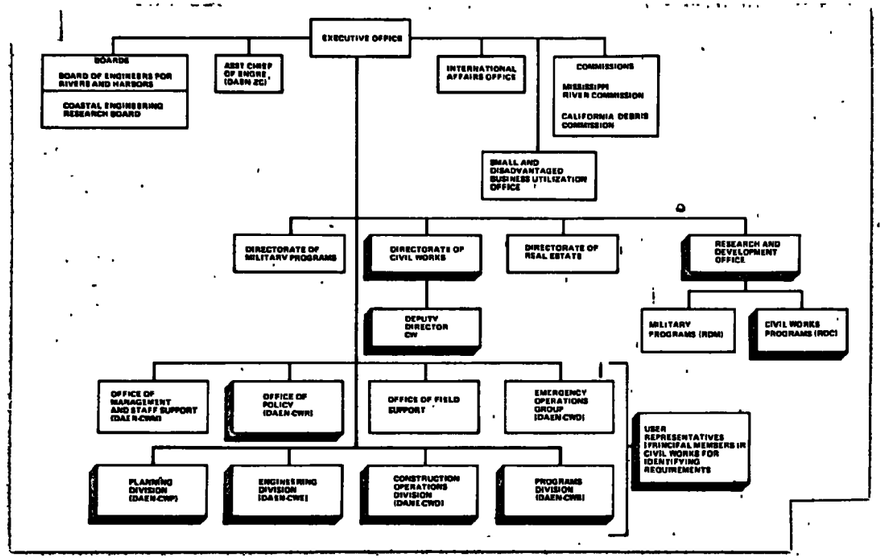
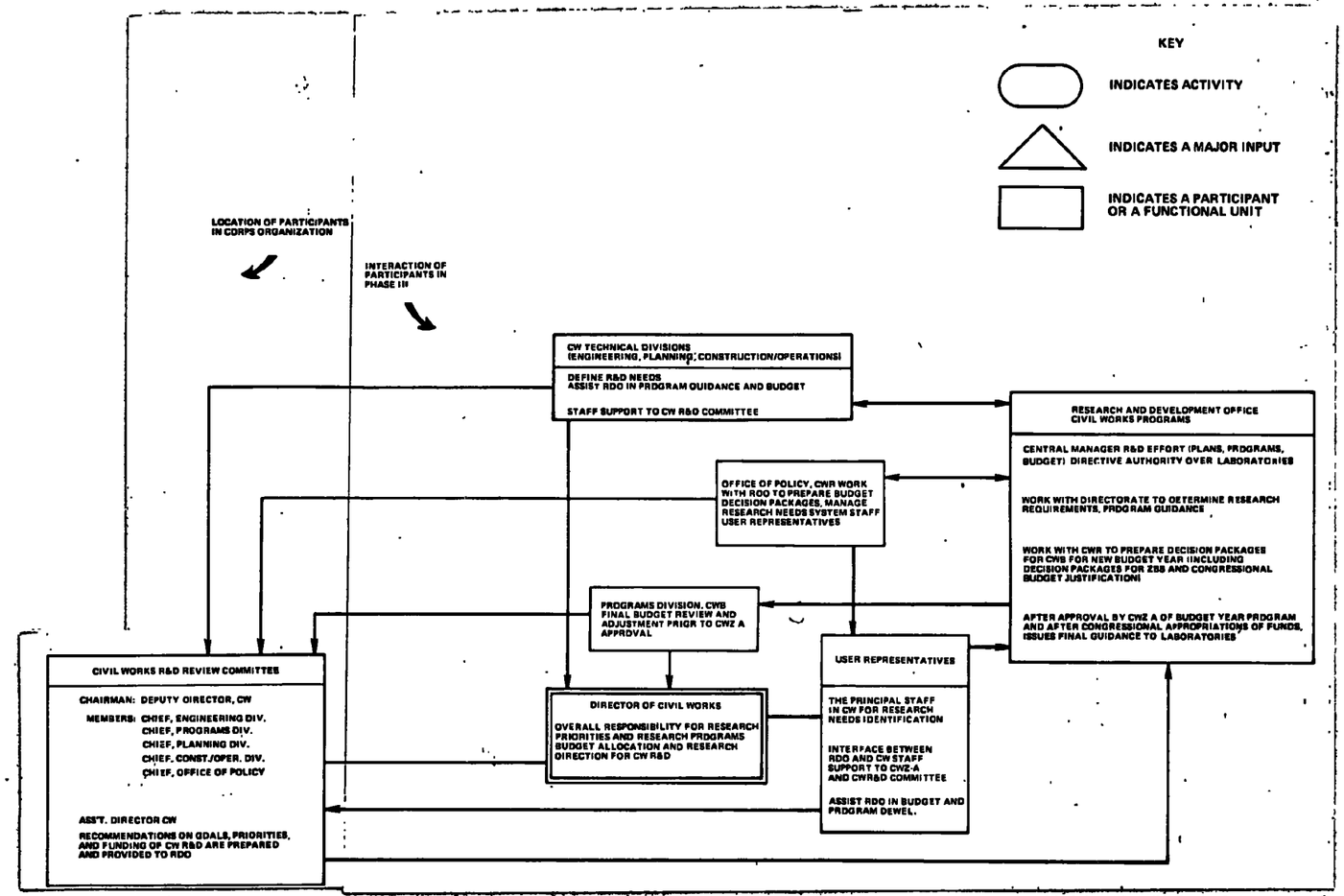


FIGURE A5. PHASE II: IDENTIFICATION OF CIVIL WORKS R&D PROGRAM RESEARCH AND BUDGET NEEDS





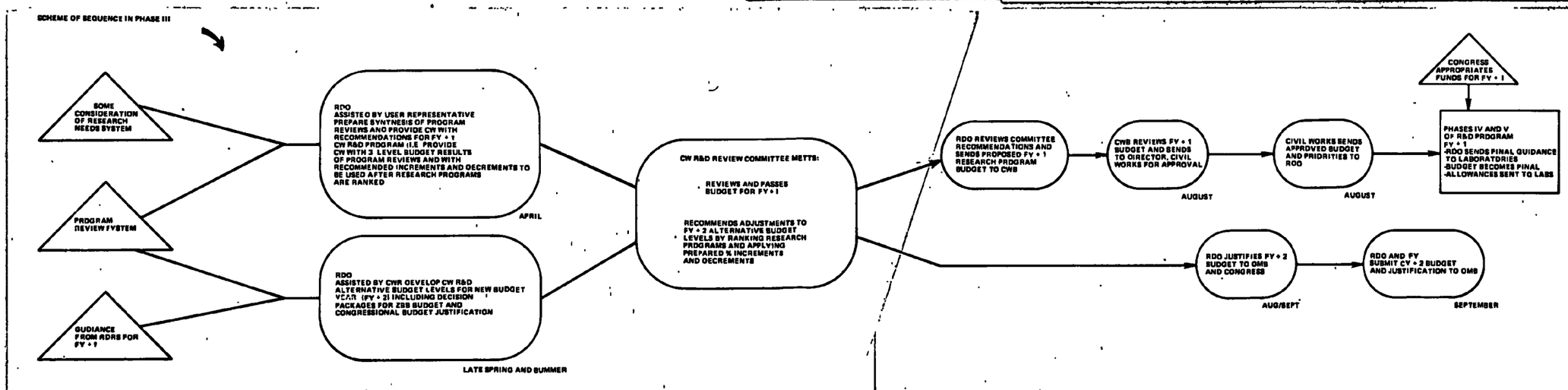


FIGURE A6. PHASE III: ESTABLISHMENT OF R&D PROGRAM RESEARCH AND BUDGET PRIORITIES

INFORMATION ON RESEARCH NEEDS SYSTEM OBTAINED FROM IG REPORTS*

PROBLEMS		PAGE
I.	Constraints to the Identification and Submission of MPS	1
II.	Problems in the Acceptance of MPS into Research Needs System	2
III.	Problems in Rating MPS	2
IV.	Problems in R&D Coordination	3
MECHANISMS		
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* The information summarized here was obtained from the Inspector General reports on the inspection conducted per EC 20-2-4, "Special Subject for Inspection Civil Works Research Needs System." This inspection was conducted from October 1978 through September 1979.

PROBLEMS

I. Constraints to the Identfication and Submission of Mission Problems

A. Lack of formal procedure

B. Field-level perspective of reserch needs

1. Research needs not generally foreseen by field

2. MPS from field are often restricted in scope.

3. Difficulty in distinguishing project-oriented and general research

4. Not aware of research accomplishments

5. Research needs already covered in existing MPS

C. Lack of field-level initiative

1. MPS not considered to be of sufficient significance to warrant the effort required for their development

2. OCE inhibits field initiative:

a. Promote programs for which there has been little or no field input

b. No feedback to field as to receipt, acceptability, or stature of MPS.

3. MPS submitted but not accepted.

D. Research needs not always appropriate to CW R&D Program

1. Problems are local, not national and short-term solutions are needed.

2. Turn about time from MPS submission to receipt; research product is too long; further, sometimes reserch is undertaken, but there is no product.

3. Because of time or nature of problem, field may rely on other means of satisfying research needs.

E. Workload too heavy to invest time in MPS preparation

F. Field-level Coordinator

1. Has little authority to force identification of mission problems, consequently, MPS tends to emphasize the particular research interest of the Coordinator

2. Has little contact with labs for assistance in identification of MPS

G. Division reviews District-generated MPS and may short-stop those considered to be inappropriate

II. Problems in the Acceptance of MPS into Research Needs

A. Duplication

1. Similar MPS may be submitted by more than one officer

2. MPS may address a need for which research is either ongoing or completed

B. Time

Field cannot always provide timely response to OCE request for MPS because of time required for routing MPS through District and Division offices

C. Not recognized as a valid research need (e.g., may be project-oriented, or may be a duplication.)

D. OCE lacks appreciation of field needs and priorities

III. Problems in Rating MPS

A. Time

1. Fatigue factor in rating large number of MPS

2. Investment of time required to do an adequate job, yet no cost code to which can charge labor

B. Several instances of duplication among MPS for rating

C. Criteria

1. Criteria are ill-defined

2. Criteria confuse raters

3. Criteria were not well thought through when formulated (e.g., does "safety" apply to safety in the short term or in the long term?)

4. Criteria are variously interpreted so that ratings are inconsistent and not comparable

5. Criteria poor, therefore ratings extremely subjective

D. System is cumbersome

1. Too many MPS to rate too short a time

2. Rating process is confusing.

3. Supplemental lists of problemsfurther complicates the confusion.

4. Deal with problems under diversity of funding sources.

E. Categorization

1. MPS should be categorized by discipline instead of research program; this was done before and it worked better.

2. Before distributing MPS for review, many research coordinators take the time to first categorize them by technical discipline so as to have appropriate specialists rate those MPS in their area of expertise.

F. Lack of feedback on how others accomplish ratings and what their ratings are

G. Significance of Ratings

1. So many MPS are general that rating isn't relevant; i.e., most can be construed to be related to a proposed work unit.

2. District ratings do not bear out sense of priority that DE's state.

IV. Problems in R&D Coordination

A. Field-level R&D Coordinator

1. Mission not regarded as important by others.

2. Has little authority to force identification of MPS

3. Little contact with labs for assistance.

4. Frustrated for lack of feedback in system; e.g., submitted MPS are not acknowledged

B. Field Elements

1. Confused by rating system and its significance

2. Many not aware of how Research Needs System works

C. Poor Communication

1. Between research laboratories and field

2. Between field and OCE

a. OCE not responsive to field problems

b. OCE does not provide field with its feedback.

MECHANISMS

I. Mechanisms in the Identification and Submission of MPS.

A. Time of Year

1. Prepared and submitted upon identification while need and awareness of problem are fresh

2. Identified in conjunction with annual review and rating of MPS

B. Solicitation of New MPS

1. Verbal encouragement

2. Annual canvassing of elements during MPS rating period

3. All elements required to submit an MPS annually

4. Written notices

5. Periodic reminders at weekly staff meetings.

6. Awards to those whose MPS accepted in Research Needs System

C. Coordination

1. R&D Coordinator actively solicits MPS and reviews ongoing projects for potential R&D needs

2. Liaison team between research laboratories and field offices and in identifying and preparing MPS

3. When laboratory recognizes a need, it may encourage field to submit a supportive MPS.

D. Responsibilities

1. Chiefs of Field Elements

a. Have primary responsibility for identification of research needs

b. Are continually and actively on lookout for research needs to bring to attention of R&D coordinator

2. R&D Coordinator

a. Encourages submission of MPS

b. Reviews, consolidates, revises MPS

E. Quantification of R&D Coordinate Senior position, extensive contacts, engineering background, lenghty tenure considered as assets.

II. Mechanisms Aiding Acceptance of MPS

A. Coordination with laboratories during preparation of MPS

B. Timely response to OCE request for MPS.

III. Mechanisms in Rating of Mission Problems (as they may occur during stages of the rating process)

A. Categorization of Mission Problems by functional area and/or by discipline ensures that specialists are rating MPS in their area of expertise.

Examples of function area are Engineering, Planning, etc. Examples of disciplines within an area (e.g., Engineering) are Foundations, Geology, Hydraulics, etc.

B. Knowledgeable persons do the ratings.

1. Specialists in functional areas or disciplines rate MPS in their field

a. Persons may be assigned to do ratings

b. MPS may be circulated among persons who choose which MPS they wish to rate

2. Specialists may assign ratings individually or meet as a group.

3. Functional chiefs and DE may or may not be directly involved in assigning ratings.

C. Raters may use a two-stage technique

1. First, group MPS by subjective opinion of need: high (8-10), medium (4-7) or low (1-3).

2. Second, assign numerical rating to MPS within numerical limits of first-stage grouping.

D. Ratings reviewed and consolidated so as to recommend the official District or Division rating for each MPS

1. Official rating may be an average of the individual's ratings; may be the highest rating; or may be established by compromise.

2. For cases in which an MPS has a range of ratings by individuals, the rating by the person with the greatest expertise in the subject area is given the most weight.

3. In cases of conflicting ratings for multi-disciplinary MPS, an R&D Board may discuss MPS and establish a consensus rating.

4. Persons involved in establishing ratngs to be recommended as official vary:

a. Individual raters and R&D Coordinator

b. R&D Coordinator

c. Functional Chiefs, DE and R&D Coordinator

d. Functional Chiefs

e. Functional Chiefs and R&D Coordinator

5. Review and Consolidation within a Given Field Office take into account the relative priorities of the field office

E. Ratings determined after one phase of review and consolidation may be routed to OCE through DE by R&D coordinator

or

Recommended rating for each MPS may undergo additional phase(s) of review and adjustment before being routed to OCE.

Persons involved in further review may vary:

1. Functional Chiefs and DE
2. Functional Chiefs

IV. Mechanisms for R&D Coordination

A. R&D Coordinator can increase effectiveness by:

1. Senior position, broad experience

2. Prompt dissemination of R&D material (e.g., bulletins, technical reports, etc.)

3. Close contact between District and Division level coordinators within a Division

4. Close contact with functional chiefs

5. Close contact with laboratories

6. Attendance at program reviews, conferences, seminars

7. Development of array of contacts throughout the Corps

8. Periodically reminding and encouraging persons to participate in Research Needs System

9. Development of his position into a working and visible unit

B. Seminars can be vehicles to explain Research Needs System; MPS submission; and R&D in-process review.

C. Designated POC's or deputy R&D Coordinator's within each functional division can effectively encourage participation in R&D concerns and can provide efficient means of channelizing materials to and from those most interested and qualified in various subject areas.

D. Persons designated as deputy R&D Coordinators can also functional effectively as a group (as in R&D Board) to resolve MPS rating conflicts and aid in setting the field office priorities.

E. Employees are better aware of research needs if they have opportunity to attend seminars, classes, etc., and if they maintain contact with research labs.

F. An R&D Service Manual has been developed by one District and is effective in providing R&D assistance.

G. An advisory committee can aid in coordinating laboratory programs with field needs; the committee takes into account the MPS and the effectiveness of the user product.

H. Field offices can expand participation in R&D by maintaining contact with status of their MPS through acceptance into Research Needs System; and monitoring progress and direction of work units which address it.

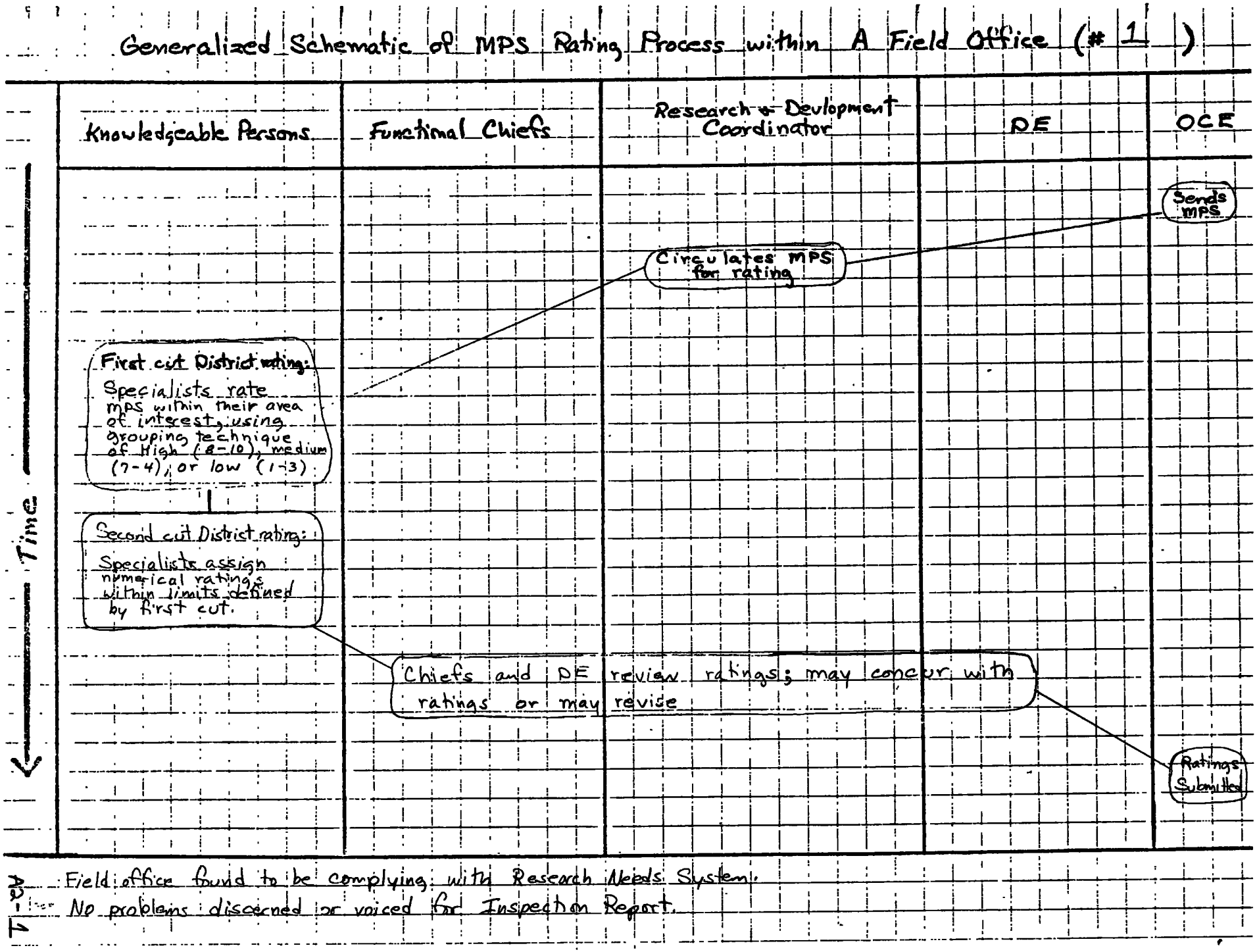
I. DE and R&D Coordinator can work together to provide authority for and response to Research Needs Ssytem; in addition, the DE ensures command interest and emphasis in his field office's response.

Graphic Representation of Processes for Rating Mission Problem Statements

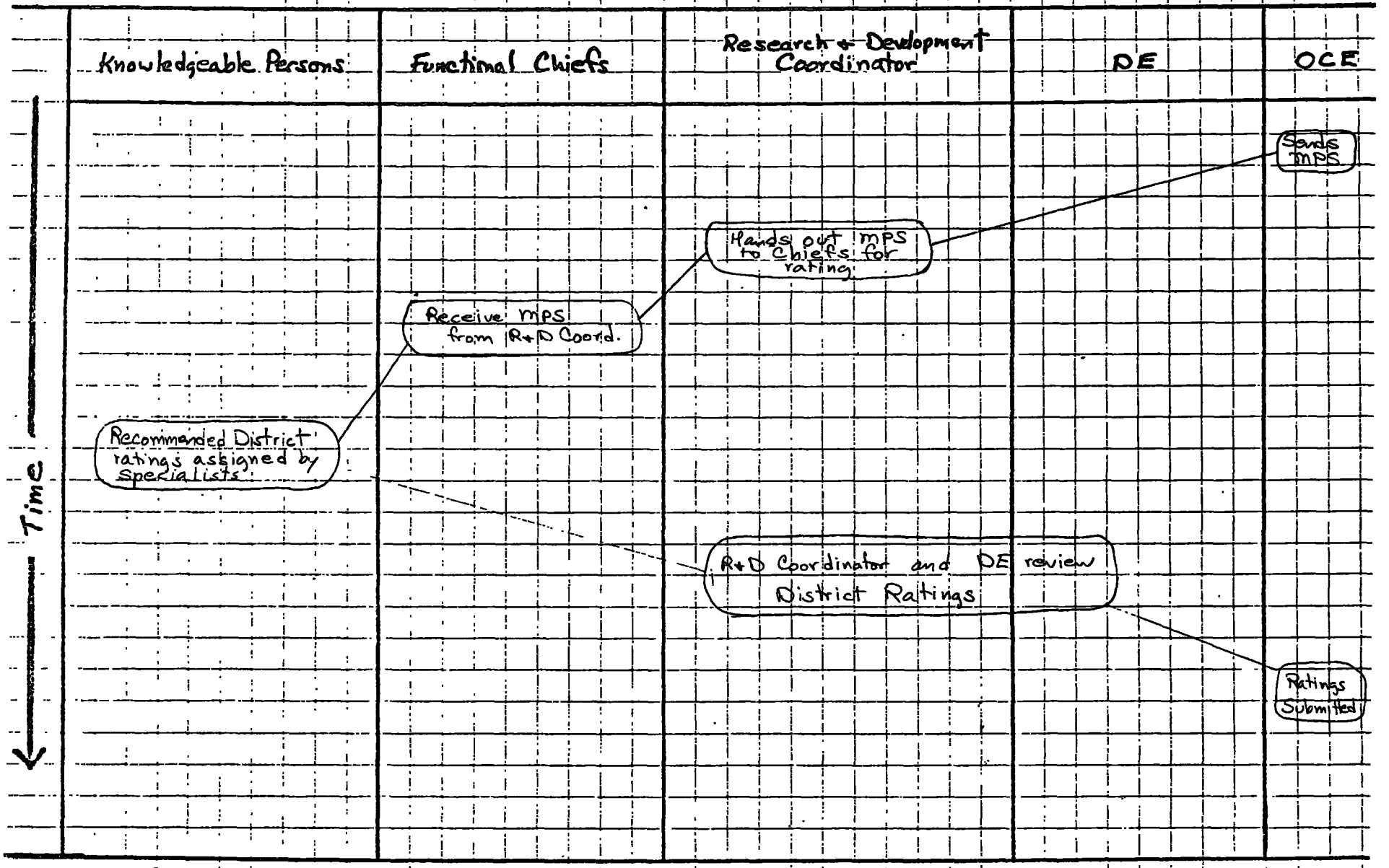
Each of the 10 figures in this inclosure illustrates a different inter-office process that has been used in a district or division to rate Mission Problem Statements. These figures were developed from information contained in the Inspector General reports on the inspection conducted per EC 20-2-4, "Special Subject for Inspection Civil Works Research Needs System".

The special inspection was conducted from October 1978 through September 1979 in those district and divisions which were scheduled for inspection during that period. The inspection also included several of the laboratories as to their participation in the Research Needs System. The amount of information contained in the IG reports varies greatly, however, thirty reports did provide useable information; Inclosure A8 is a synthesis of that information. Of these 30 reports, 10 provided sufficient detail to convey the process by which that office circulates MPS and develops its ratings. Interestingly enough, each of these 10 is different; by comparing the 10 figures, it can be seen that the process varies widely among the field offices.

Generalized Schematic of MPS Rating Process within A Field Office (# 1)



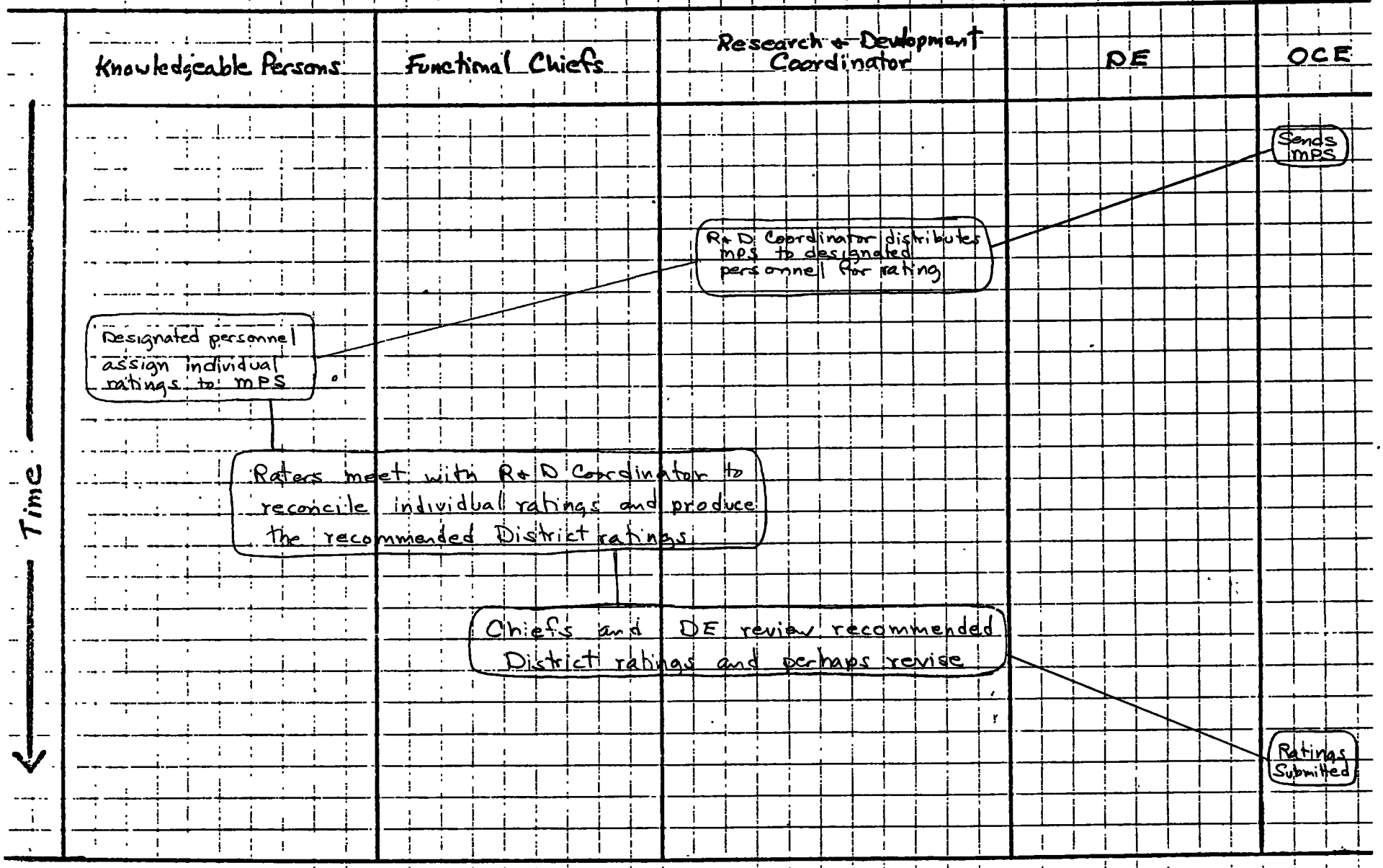
Generalized Schematic of MPS Rating Process within A Field Office (# 2)



PB-12

Field office found to be complying with Research Needs System.
No problems discerned for Inspection Report but field office complained that rating criteria are ambiguous.

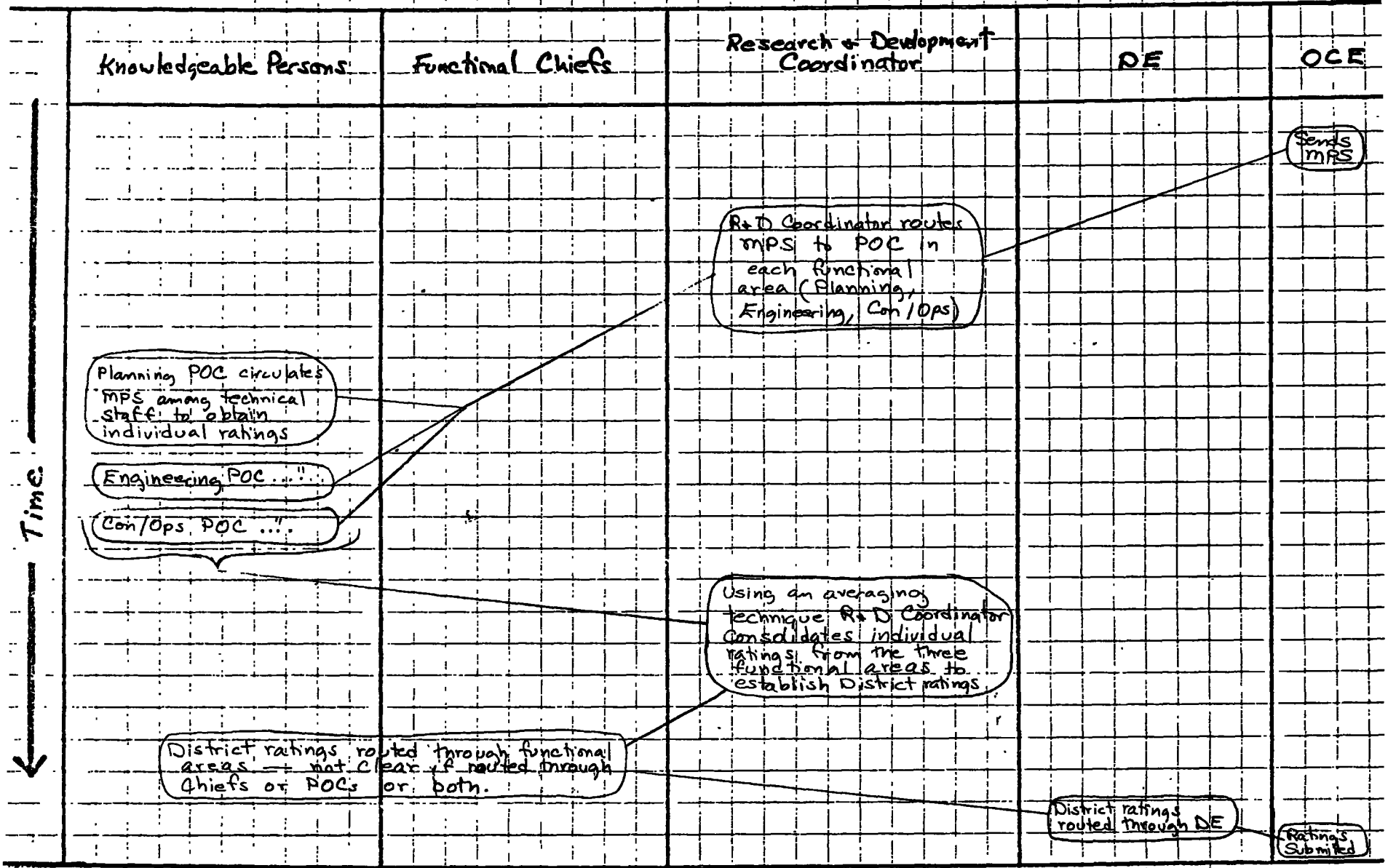
Generalized Schematic of MPS Rating Process within A Field Office (# 3)



A2-3

Field office found to have strong, effective program.
Has devised effective mechanisms for participating in Research Needs System.
No problems discerned or voiced for Inspection Report.

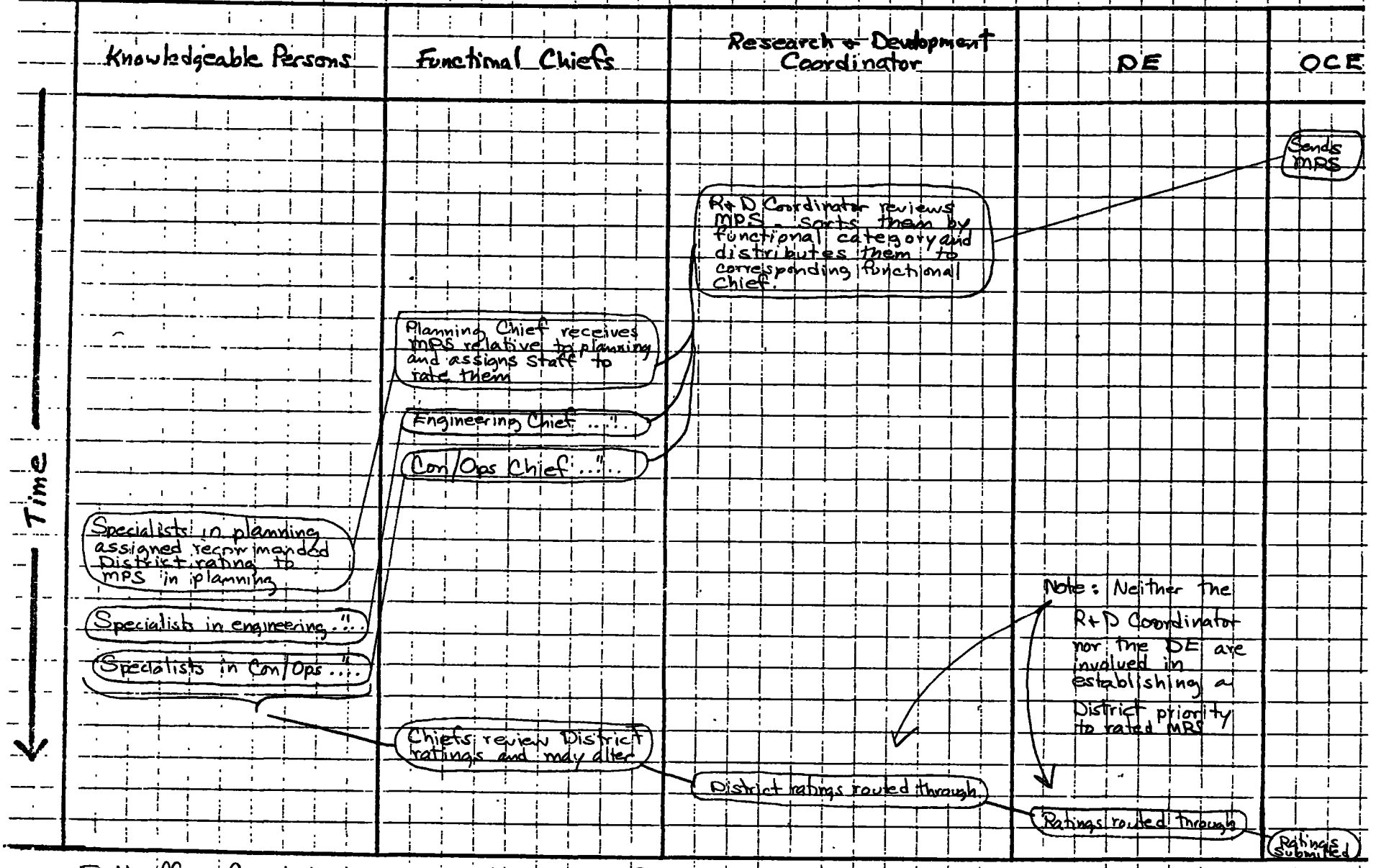
Generalized Schematic of MPS Rating Process within A Field Office (# 4)



4a+4

Field office found to be adequately participating in Research Needs System.
No problems discerned or voiced for Inspection Report.

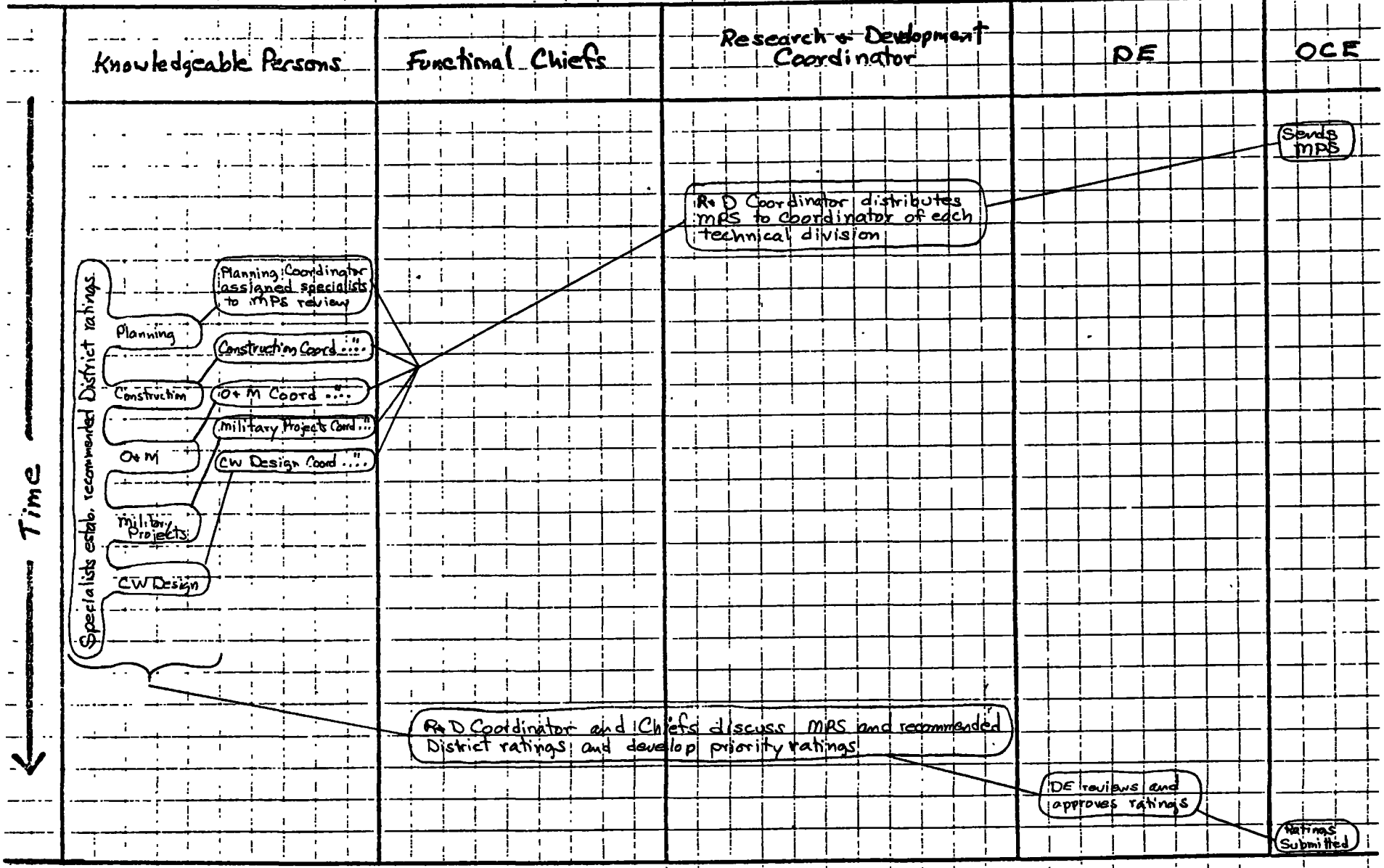
Generalized Schematic of MPS Rating Process within A Field Office (# 5)



Field office found to be in compliance with Research Needs System.
No problems discerned or voiced for Inspection Report.

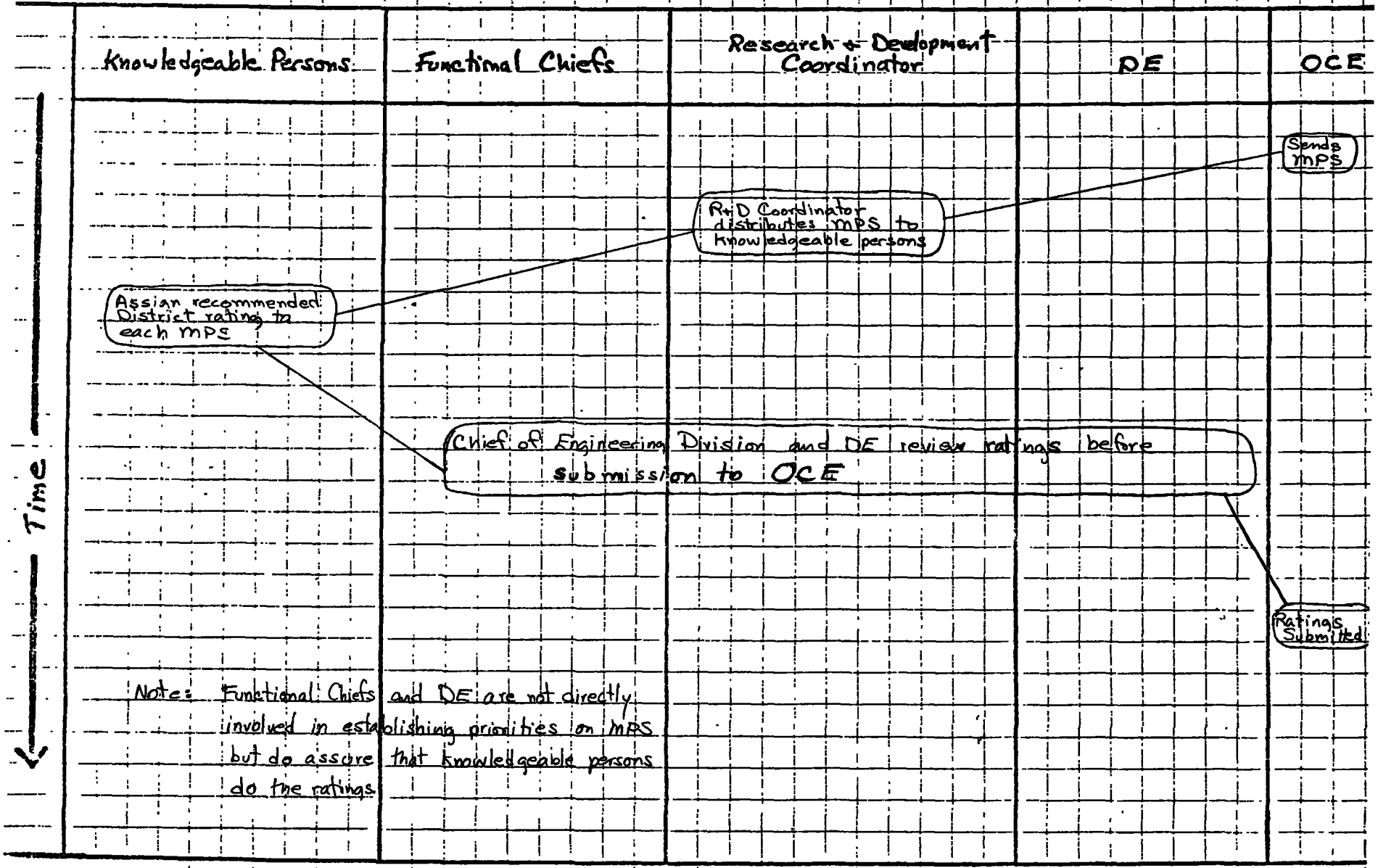
Dec

Generalized Schematic of MPS Rating Process within A Field Office (# 6)



Field office found to have an effective program.
No problems discerned for Inspection Report but field office complained that there are too many MPS to properly review and assign priorities.

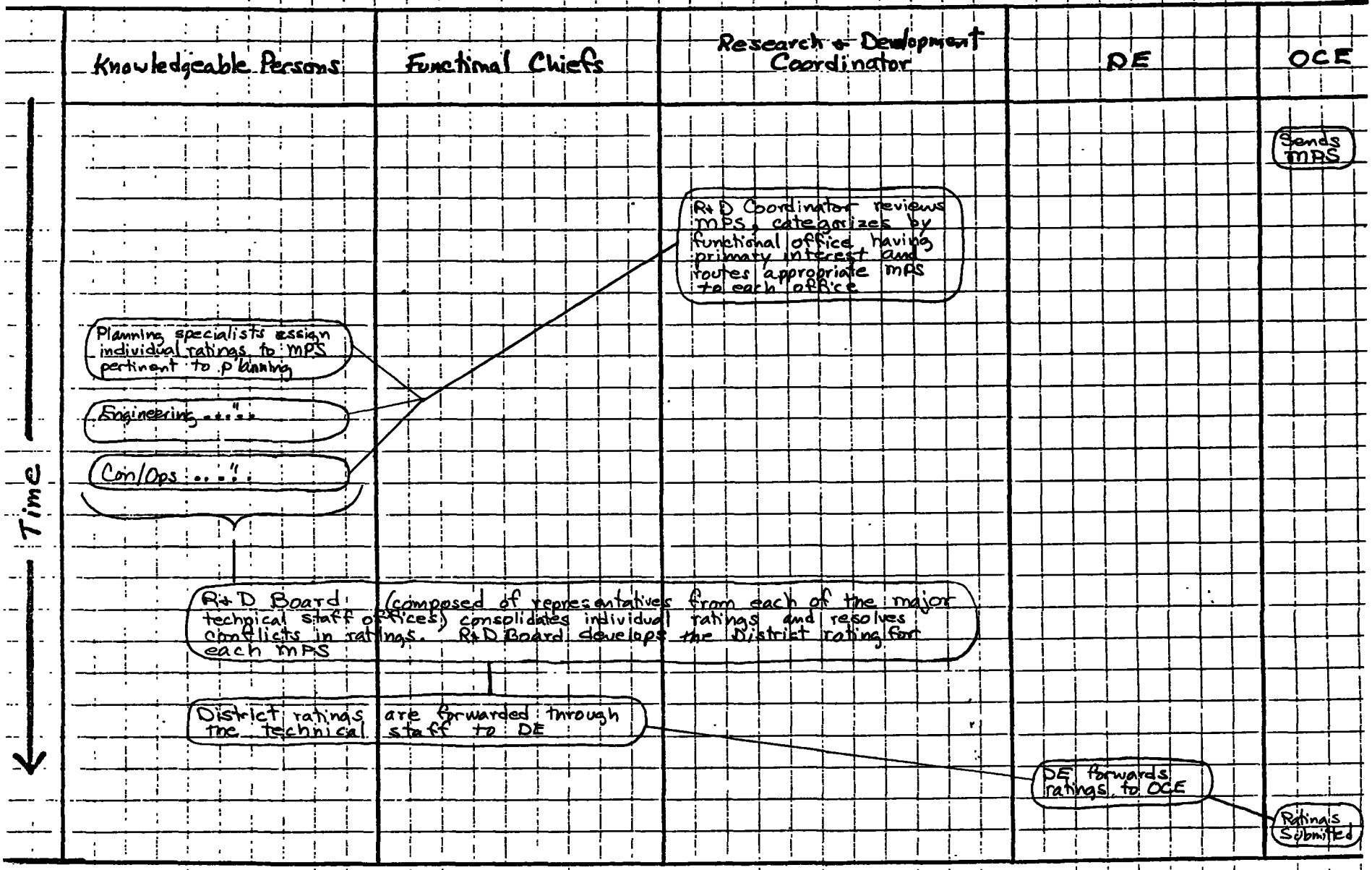
Generalized Schematic of MPS Rating Process within A Field Office (# 7)



Apt 7

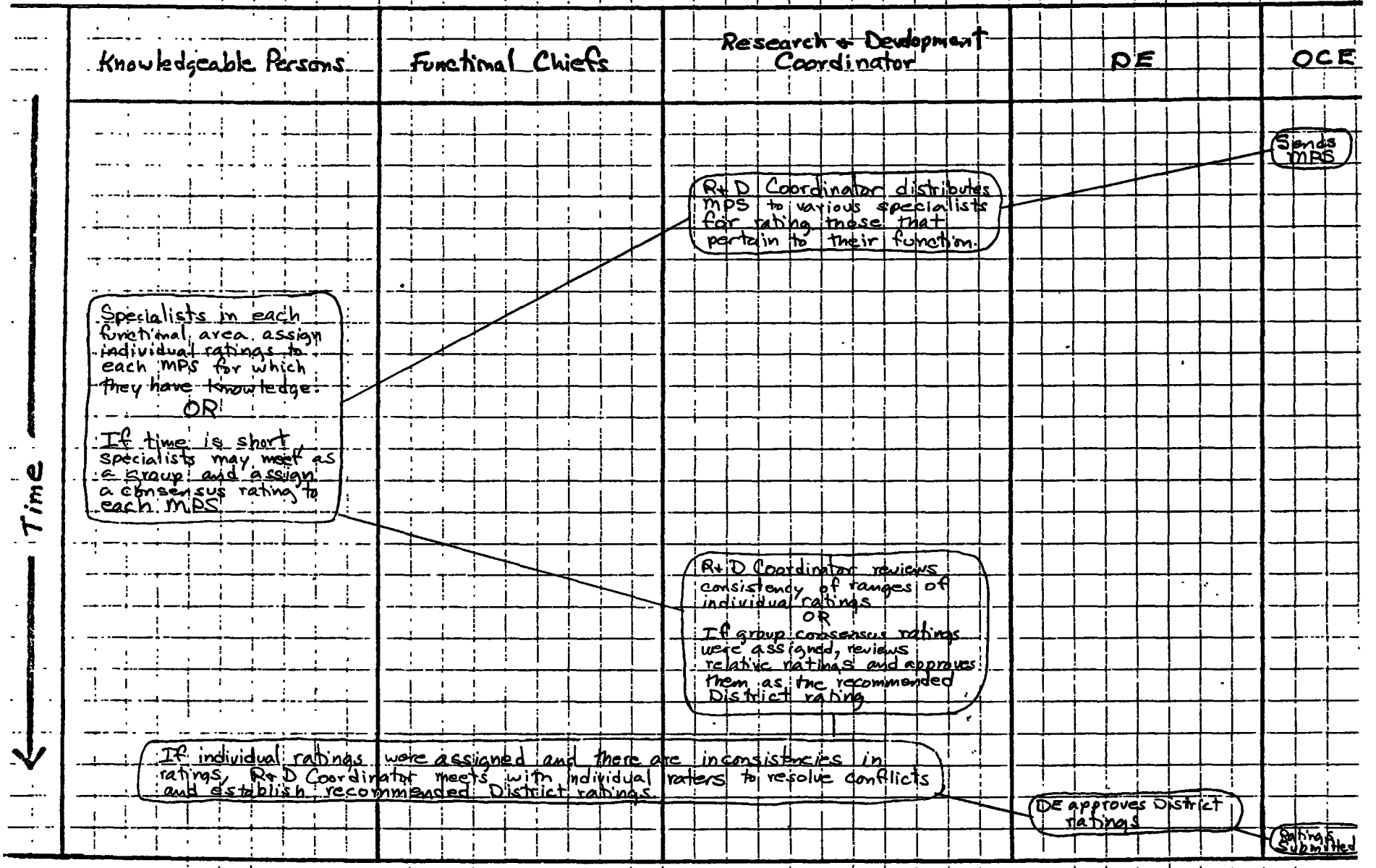
Field office found to be adequately implementing Research Needs System.
No problems discerned or voiced for Inspection Report.

Generalized Schematic of MPS Rating Process within A Field Office (# 8)



Dept 8 — Field office found to be complying with OCE guidance on Research Needs System.
No problems discerned or voiced for Inspection Report.

Generalized Schematic of MPS Rating Process within A Field Office (# 9)

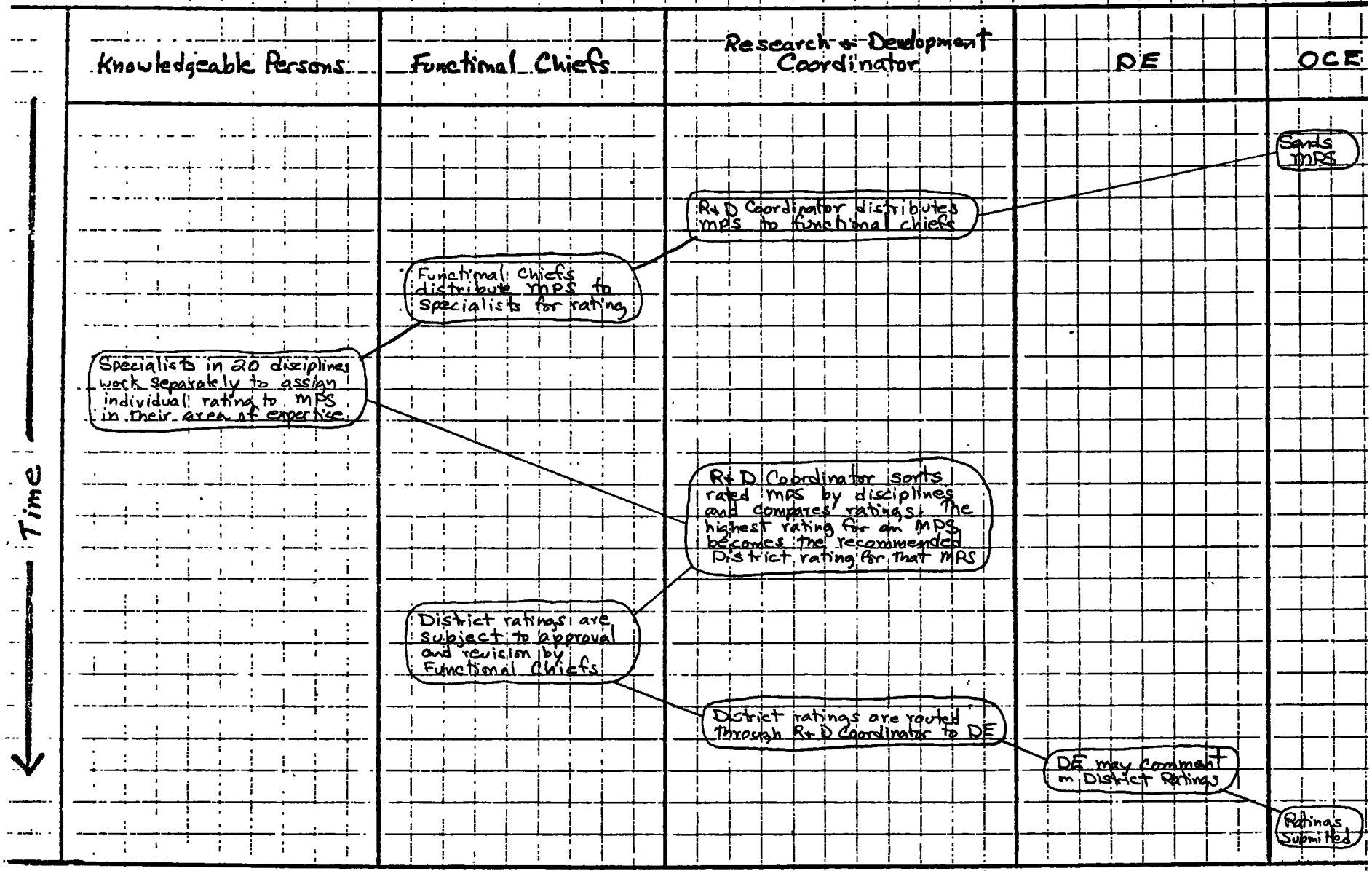


b-2-a

Field office found to be in compliance with Research Needs System.

No problems discerned or voiced for Inspection Report, however office does not actively encourage MPS submission.

Generalized Schematic of MPS Rating Process within A Field Office (# 10)



A2-10

Field office found to be complying with Research Needs System, but does have a problem in having MPS accepted, i.e. their requirements generally not recognized as valid research needs.

APPENDIX B

WORKSHOP ON PRIORITIES FOR CIVIL WORKS RESEARCH PROGRAMS

As a means to obtain information and ideas on the R&D prioritization systems, a one-day workshop was held on October 17. The workshop focused on identifying problems, successes, and possible solutions to problems in setting R&D priorities. The workshop was not designed to produce consensus, but rather to illicit the broadest range of ideas possible.

The 23 persons attending the workshop were separated into two groups. During the morning session each group concentrated on developing a list of problems and needs; this was done by first requesting each participant to list several items and then having individuals take turns, one item at a time, to present their lists to the group. At the close of the morning session, each group summarized the ideas generated. The problems and needs identified by each group, as well as the group-prepared summaries, are listed on pages 1 - 7 of Inclosure B1. The afternoon session emphasized ideas for solutions to the problems and needs expressed during the morning. The participants met as one large group, and using the technique employed in the morning, individuals took turns to present concepts for solutions. These ideas are listed on pages 8 and 9 of Inclosure B1.

After the workshop, a copy of ideas generated (i.e., a copy of Inclosure B1) was sent to each participant and they were encouraged to provide any additional comments. In addition, an synthesis of the information obtained from the workshop was prepared. This synthesis is given as Inclosure B2; the information is organized by categories of issues (e.g., Understanding of Definitions and Relationships) and R&D participants (e.g., R&D Coordinators) and also is structured in two columns corresponding to the two workshop

sessions: problems and needs identified during the morning are in the left-hand column; while ideas for solutions expressed during the afternoon are given in the right-hand column.

The 23 workshop attendees and their organization are listed below:

Office, Chief of Engineers

I. Civil Works:

A. Planning Division

1.	John Bushman*	(CWP-P)
2.	John Belshe'	(CWP-P)
3.	Bill Donovan*	(CWP-P)
4.	Bob Plott*	(CWP-F)

B. Engineering Division

5.	Sam Powell*	(CWR-HD)
6.	Ed East	(CWE-BU)
7.	Fred Anderson*	(CWE-DC)
8.	Vern Hagen*	(CWE-H)

C. Construction Operations Division

9.	Nancy Tessaro	(CWO-R)
10.	Dick Edwards	(CWO)

D. Office of Policy

11.	Paul Jorgenson**	(CWR-W)

II. Military Programs:

12.	Jess Pfeiffer	(MPR-A)

*Technical Monitor

**User Representative

III. Resource Management Office

13. Joyce Brunsell (RMI-F)

IV. Research and Development Office

14. Mel Martin (RDC)

Water Resources Support Center

15. Jack Jarman* (WRSC-C)
16. Charles Hummer (WRSC-D)
17. Jerry Delli Priscoli (WRSC-IWR)
18. Mary Vincent (WRSC-IWR)
19. Mark Dunning (WRSC-IWR)
20. Steve Light (WRSC-IWR)
21. Mark Mugler (WRSC-IWR)
22. Ike McKim (WRSC-IWR)
23. Bob Haring (WRSC-IWR)

IDENTIFICATION OF PROBLEMS AND NEEDS BY GROUP #1

a. Categorization of MPs into 29 research programs:

   -- each MPs goes into one program.
   -- one person (currently) responsible for categorizing.

b. No program review at decision level; the R&D committee has no idea what R&D is being accomplished with the funds budgeted.

c. The system (is defined in the ERs) is not fully documented. System says inputs come from MPs, but in fact, inputs come from other sources. These inputs need to be enumerated.

d. Mission problems:

   -- what controls their uniformity, is there any quality control?
   -- is there a formal way to amend or extend the life of an MP?
   -- what defines the life of an MP?
   -- what is the structure of an MP (i.e., authorship, keywords, time of initial suggestion)?

e. Lack of general understanding of R&D "system" by those outside of R&D.

f. Momentum of past research makes it difficult to make significant changes in the program.

g. How to incorporate and evaluate external R&D activity and needs.

h. Subjectivity in ranking and rating of MPs and programs in contrast to supposed "hardness" of priority rankings.

i. Decisions are made without an understanding of those decisions on the R&D system.

j. We should be focusing on Research Programs: decisions at headquarters should be made on Research Programs. The MPs should be evaluated by the laboratories. Decisions are being made at the wrong level.

k. Too little decision contained within CW Directorate as opposed to RDO and Chiefs Office -- more CW input on ZBB process is needed.

l. Need for "good press" to inform outside community of COE R&D.

m. More definition of role of Technical Monitor needed.

n. Different pots of money funding R&D but no one system to allocate money to programs.

Inclosure B1

o. R&D field coordinator's authority needs to be expanded -- need to be able to get field to operate within R&D system regulations.

p. There is subversion of the process.

q. We should submit R&D programs to field for review (evaluation) instead of MPs.

r. What are the outputs of the R&D system (i.e., what is the relationship between MP and work unit and products)?

s. There are problems with the work unit structure:

-- work units are too long in time.
-- too slow in start-up.
-- not multidisciplinary enough.
-- too academic in nature (small-scale).

t. Constant change in R&D system reduces confidence of the field.

u. Problems in how to deal with old ratings and new ratings.

v. Problem in the length of time it takes research need to be addressed through R&D system. Because of this, Districts may chose other means to address research needs (e.g., outside contracting).

w. Where did the four evaluation criteria for the MPs come from and what statistical validity do they have?

x. What should the relationship between "high priority" OCE-generated needs be with the R&D priority system?

y. Problem in reconciling competing R&D among labs.

IDENTIFICATION OF PROBLEMS AND NEEDS BY GROUP #2

1. Field input: too complex and need to simplify.
2. Field personnel either do not see or do not devote time to prioritization (those within each discipline).
3. Program is not built up from those who have the need (i.e., worker, designer, etc.).
4. Rigidity: do we have to lock work unit one year in advance?
5. The four categories by which Districts rate are not adequate, nothing is environmental.
6. No external review by peer group outside the Corps.
7. No feedback for MPs submitted (e.g., was it used).
8. Both FOA coordinators and Technical Monitors have job assigned as an extra job.
9. No provision within summation of priority numbers to compensate for areas such as coastal and cold regions, etc.
10. Program level prioritization: what about a low prioritized program but funded by Division Chief (out of O&M, A&D funds).
11. Where do you stop -- what is R&D and operation, and Design or Planning?
12. Too little opportunity to sort out an information need vs. a research need.
13. Problem not reviewed against existing guidance -- where are information gaps.
14. System is work intensive -- maybe we should try to cut down on work.
15. Must know role and location of R&D committee, Technical Monitor, and R&D office in review of submittal of program (i.e., need better definition of system).
16. Better type of evaluation methodology -- is there a ZBB process? Especially for low end of spectrum.
17. What about an obsolete R&D?
18. Budget is decided in summer before money is set out.

19. Because of Research Needs System, work units say they are responding to many MPS.

20. We need clarification to separate:

-- MP's
-- Work Units
-- Research Areas

21. How can short-term bias of the field rating be dealt with.

22. Too little input from Technical Monitors.

23. Too much processing by parallel organizations called R&D and not enough by lines and staff.

24. System is too subjective.

25. Statistics are built on subjective numbers.

26. Who actually rates the problems in the field? Are they routed up to Division level -- who should make ratings?

27. Who should vote at Research Program level and what information is needed?

28. CW Division coordinators need a bigger role.

29. Program is not reviewed for what is possible -- i.e., is it technically possible to research a given need.

30. Research priorities change yearly but MPS are behind.

31. Laboratories submit the majority of MPS.

32. Are field people given enough time to generate MPS?

33. Too many people involved at OCE level.

34. Too much lip service to role of Technical Monitor (he really does not have an active responsibility).

35. Inadequate use of chain of command.

36. Not responsive to field research needs: (a) new problems; (b) day to day.

37. Brand new research program: nobody looks to state of art -- is it needed? Difficult to establish a new program.

38. Research Areas and Programs -- how do the existing ones get modified and or dropped? How is it determined which one to drop?

39. Prioritization is a major problem -- pay back of field lab facility -- inhibits buying (cripples field lab as well as research).

40. How is R&D budget determined?

41. Cannot determine priorities at field or program level without human judgement and that is subjective.

42. Need an active Technical Monitor. Technical Monitor needs better tools.

43. Placement of MP in research areas.

44. Establishment of a contingency fund for R&D Committee.

SUMMARY OF PROBLEMS BY GROUP #1

Problem Categories

1. Inputs:
   c, d, e, f, g, h, l, x.

2. Decision levels:

   b, i, k, m, o.

3. Evaluation:
   a, h, j, m, p, q, r, s, t, u, v, w.

Highlights of Discussion within Problem Categories

1. Inputs:

   a. Documentation and diversity of documentation.

   b. MPs: Understanding their life cycle.
      Importance of their objective vs. importance of their use.
      Historical disposition and accounting of disposition.
      Variability in manpower expended by Districts.
      MP system requires considerable manpower.
      Need to redefine and redesign MPs process.

   c. Momentum: Feedback from labs serve as input to system.
      This feedback amounts to subversion of process because labs supply more MPs than field.

   d. Communication with external users and practitioners.

2. Decison levels:

   a. CWR&D Committee, Group 1 had a disagreement on the role of this Committee:

      -- The Committee has considerable idea of what is being accomplished as a unit (i.e., there is considerable accountability).
      -- The Committee has no idea of the entire program because they are not given enough information. Basically the committee is a group of proponents that spends time arguing over details.

      The group did agree that the level of detail that the Committee should be concerned with should be specified.

   b. There is no way to measure or evaluate the needs of one Research Program vs the needs of another.

c. Do we want objective evaluation on the part of the Committee members or do we want members to fight for a particular Research Program.

d. Perhaps the Committee should just look at the six Research Areas.

e. At the Committee level, there is no need to be concerned with work units.

3. Evaluation:

a. MP evaluation process was originally an information process to inform labs of important R&D needs. Now it is used as a statistical input to the program.

b. New ranking evalution processes are introduced without informing field of how they work or will be used (e.g., field does not know how zero score will be used -- whether as no interest or no significance).

c. The four categories for MPs evaluation create problems.

SUMMARY OF PROBLEMS BY GROUP #2

1. Identification field needs (MPs):

1, 3, 7, 8, 12, 13, 14, 19, 31, 32, 36, 37.

2. Technical Monitors' responsibilities:

3, 8, 12, 13, 14, 16, 17, 21, 22, 29, 31, 34, 36, 38.

3. Budgeting:

14, 18, 39, 40.

4. Program prioritization:

9, 11, 14, 16, 17, 20, 24, 25, 27, 37, 41.

5. Problem prioritization:

1, 2, 5, 9, 12, 13, 14, 16, 17, 19, 20, 21, 24, 25, 26, 38.

6. Institutional limitations:

1, 2, 4, 6, 7, 8, 14, 15, 17, 19, 20, 23, 26, 27, 28, 29, 30, 32, 33, 35, 36, 38, 39, 40.

SOLUTIONS IDENTIFIED BY GROUPS 1 AND 2

1. Keep the ER number and start all over.

2. Put MPs in perspective as to their impact on the system, i.e., identify their role as to what they can and cannot do.

3. Define the goal of R&D research needs system.

4. Define RDO's function vis a vis CW budget and lab manager.

5. Educate the field about the R&D system (but first, decide on the goal of the system).

6. Recognize that the system does work.

7. Clarify the ways in which priorities are set for MPs, work units, mission programs.

8. Develop what percent of R&D budget is actually available for new R&D.

9. Develop new criteria for rating MPs and consider the question of whether or not we should continue MPs.

10. If we do not use MPs we will need some other method for District and Division input.

11. Redefine the research inputs.

12. Establish criteria for rating programs.

13. Separate prioritization for MPs, new programs, special capabilities, and retirement of programs.

14. Technical Monitor should review MPs when submitted.

15. Should establish a contingency final for R&D Committee.

16. Mandatory problem priority accomplished by Chiefs responsible for area at District (i.e., Chiefs of Planning prioritize planning problems, etc.).

17. Give OCE Chiefs authority to set priorities based on OCE information obtained by consulting with Technical Monitors and Districts and Divisions input. This would be done through meetings between Division and District technical people.

18. Use a chain of command system - e.g., CW directs Division Chiefs to consult with field by discipline biannually. This would allow discipline by discipline response to technical counterparts.

19. If R&D focuses on "end product," the Technical Monitor should write, edit, and review MP's.

20. If R&D Committee gets responsibility for prioritizing broad program level goals, they should review validity of on-going research:

    -- Technical Monitors could brief them on accomplishments.
    -- Technical Monitors could identify needs for new initiatives.

21. Technical Monitors, lab representatives and District representatives should meet to establish priorities.

22. Get rid of numerical rating and ranking of MPs and Research Programs.

23. For evaluation, keep the Research Needs System, but use it for information only:

    -- Use input only from Districts and Divisions, no labs.
    -- Let Technical Monitor have final review.
    -- Let evaluation apply only to new starts.

    Field review for on-going R&D:

    -- Need valid statistical method for input.
    -- Use only as information.

Main Points of Discussion on Solutions

1. Operating R&D system top-down vs bottom-up was discussed. Problems of delegated responsibilities (chain of command) and time to accomplish responsibilities were pointed out.

   There are difficulties in deciding responsibilities, especially that which is interdisciplinary. The R&D needs process could combine with other activities.

2. Need to rewrite ER and specify role that MPs play as well as other important components of the system.

3. Technical Monitors need an expanded role particularly in field review of R&D needs process. Why do we still need the Research Needs System information -- the numbers are not important. Also, labs do not need to be involved in System, they are there for technical input only.

4. Special advisory committees can provide a useful function (e.g., CERB):

    -- Members on these boards are R&D types.
    -- Members can influence Technical Monitors by virtue of their expertise.
    -- Major contribution is information exchange with the outside technical community.

Organizational Synthesis of Ideas Generated at Workshop on
Priority Setting Within Civil Works Research and Development Program

Problems and Needs	Ideas and Solutions
I. Understanding of Definitions and Relationships	
A. Basic Perceptions	
1. Lack of general understanding of R&D system by those outside of R&D.	
2. The system (as defined in the ER's is not fully documented. System says that inputs come from MPs but in fact, inputs come from other sources. These inputs need to be enumerated.	
3. What is the conceptual distinction between R&D and other activities such as operation, design, and planning.	
4. What are the outputs of the R&D system, and how do MPs and Work Units interrelate to yield these products.	
B. Role distinction	
1. Need clarification of purpose, use, and relationships of Mps, Work Units, Research Programs and Areas.	
2. Need clarification of role and timing of input by CW R&D Committee, Technical Monitor, and RDO with respect to review and submittal of program (i.e. need better definition of R&D System).	
	- Keep the ER number and start all over. - Recognize that the system does work. - Define the goal of the R&D system and educate the field - Define the goal of the Research Needs System - Redefine research inputs - Define RDO's function vis-a-vis CW budget and lab managers - Put MPs in perspective as to their impact on the system, i.e. identify what the role of Mission Problems is and clarify how they can and cannot be used.
II. Activities	
A. Decision levels and Appropriateness of Decisions within Levels	
1. Decisions are made without an appreciation of their significance on the system.	
2. Too little decision is contained within the CW Directorate as opposed to RDO and the Chief's office.	
3. There is no program review at the level at which program decisions are made, i.e. the CW R&D Committee has no idea what R&D is being accomplished with the funds budgeted.	
4. Decisions are made at the wrong level: - Field should review Research Programs instead of Mission Problems - Mission Problems should be evaluated by the laboratories - Headquarters should be focus on Research Programs	
5. Who should make decisions at the Research Program level and what information is needed to make these decisions	
6. How is it decided when and which Research Programs to drop or add.	
7. The budget is decided in the summer before the money is set out.	
8. More CW input is needed in the ZBB process.	
	- Technical monitors should meet with representatives from Districts and Laboratories to provide CW Division Chiefs with information for setting priorities.
B. Evaluation and Priority Setting	
1. Subjectivity: Cannot determine priorities at field or program level without human judgement and that is subjective statistics are build on subjective numbers. Subjectivity in rating and ranking of both Mission Problems and Research Programs in contradictory to the significant attributed to the numerical scores	
2. It is possible to subvert the process and it is subverted	
3. Field-level evaluation: - The field either does not realize the significance of their MP evaluation or else does not devote time. - The four categories by which the field rates Mission Problems are inadequate. - How can the short-term bias of the field be dealth with	
4. Research Programs: - Field should review Research Programs instead of Mission Problems - There is no provision within summation of priority numbers to compensate for research needs like coastal or cold regions problems. - What should the relationship be between high-priority OCE-generated needs and the R&D priority system. - Constant change in system (use of field input) reduces confidence of the field	
	- Get rid of numerical ratings and rankings - Clarify ways in which priorities are set for MPs, Work Units, and Research Programs - Establish separate prioritization for MPS, new programs, special capabilities, and retriving programs.
	- Develop new criteria for rating MPs - Consider question of whether or not to continue MPs; if not, will need some other form of input from field. - Need valid statistal method for field input
	- Establish criteria for rating Programs - Keep Research Needs System but use it only for information source

Inclosure B2

Organizational Synthesis of Ideas Generated at Workshop on
Priority Setting Within Civil Works Research and Development Program
(Continued)

Problems and Needs	Ideas and Solutions
5. Funding Research Programs: - Perhaps a Program with low priority could be funded by a Division Chief (e.g. out of O&M funds). - There are different pots of money funding R&D but no one system to allocate money to programs. - A better type of evaluation methodology is needed--is there a ZBB process, especially for the low end of the spectrum. - Prioritization is a major problem--pay back of field lab facility--inhibits buying (cripples field lab as well as research).	
C. Coordination	
1. External: - How to incorporate and evaluate external R&D activity and needs. - Need for good press to inform outside community of COE R&D. - There is no external review by a peer group outside the Corps.	
2. Internal: - Inadequate use of chain of command - Too many people involved at OCE level - Too much processing by parallel organizations.	- Should employ chain of command system, e.g. Director CW would direct CW Division Chiefs to consult biannually with field, discipline by discipline. This would provide response between field and OCE technical counterparts.
3. Mission Problems: - Lack quality control and uniformity. - Not reviewed against existing guidance to see if are addressing information gaps.	- Technical monitors should brief CW R&D Review Committee on accomplishments of ongoing research and on needs for new research
4. With Field: - Not responsive to field research needs either for new problems or on a day to day basis. - No feed-back to field on MPs submitted. - Constant change in system reduces confidence of the field.	- Technical Monitors should review and edit MPs. - Field should have feed back on disposition of MPs. - Educate the field on the R&D System - Technical Monitors should meet with District and Lab representatives to provide CW Division Chiefs with information for setting priorities
D. Research	
1. Research needs are not reviewed for what is technically possible to research.	- Redefine research inputs
2. Momentum of past research makes it difficult to make significant changes in the program.	- Have field review ongoing R&D - Determine what percent of R&D Budget is actually available for new R&D.
3. Problem in reconciling competing R&D among labs.	- Technical Monitors should brief CW R&D Review Committee on accomplishments of ongoing research and on need for new research.
4. Problem in length of time it takes research need to be addressed through R&D system	
III. Participants	
A. R&D Coordinator, Field Level 1. Coordination responsibilities are an add-on job. 2. Authority needs to be expanded, has no authority to force cooperation.	- District representative should meet with laboratory representatives and Technical Monitors to provide information for setting priorities.
B. Laboratories 1. Problem in reconciling competing R&D among laboratories. 2. Research Program priority setting cripples laboratories as well as research. 3. Momentum of past research makes it difficult to make significant changes in the program. 4. The majority of the Mission Problems are submitted by the labs.	- Laboratory representatives should meet with District representatives and Technical Monitors to provide information for setting priorities. - Define RDO's function vis-a-vis CW Budget and lab managers.
C. Technical Monitors 1. Better definition of his role and time of input needed. 2. Responsibilities are an add-on job. 3. Need more active responsibility and input 4. Needs better tools	- Technical Monitors should review and edit MPs when submitted. - Technical Monitors should meet with lab and District representatives to provide CW Division Chiefs with information for setting priorities. - Technical Monitors should brief CW R&D Committee on accomplishments ongoing research and on needs for new research.
D. CW Division R&D Coordinators need a bigger role	
E. CW Directorate: Too little decision contained within CW Directorate as opposed to RDO and Chief's office--need more CW input into ZBB process.	
F. CW R&D Committee 1. The Committee has no idea what R&D is being accomplished with the funds budgeted. 2. Need to establish a contingency fund for the Committee. 3. Need to clarify the Committee's role and the time of their input.	- Should establish a contingency fund for CW R&D Committee. - Committee should have responsibility for prioritizing broad Program level goals and should review validity of ongoing research.

Organizational Syntheses of Ideas Generated at Workshop on
Priority Setting Within Civil Works Research and Development Program
(Continued)

Problems and Needs	Ideas for Solutions
C. RDO	
1. Has too much decision in ZBB process (as compared with CW Directorate's role).	- Define RDO's function vis-a-vis CW budget and lab managers.
2. Need to clarify RDO's role and the time of their input.	
IV. Functional Units (separable components of the R&D Program)	
A. Research Needs System	- Technical Monitors should review and edit MPs when submitted. - Field should have feed back on disposition of MPs.
1. Mission Problem identification and categorization: - Laboratories submit the majority of the MPs. - Are field people given enough time to generate MPs - Categorization of MPs into 29 research programs has two problems, first that each MP goes into one program; second that one person (currently is responsible for categorizing. - MPs are not reviewed against existing guidance to see if they cover information gaps. - Too little opportunity to sort out an information need vs. a research need. - Research priorities change yearly but MPs are behind. - No feed back to field on MPs submitted (e.g. was it accepted, was it revised). - Problems not reviewed for what is technically possible to research	
2. Mission Problem Rating: - Field personnel either do not recognize the significance of their ratings or elese do not devote sufficient time to the task. - Who actually rates the problems in the field; are they routed up to Division level; who should make the ratings? - Where did the four evaluation criteria come from and what statistical validity do they have. - The four categories are not adequate, nothing is environmental. - MPs should be evaluated by laboratories and field should be reviewing Programs instead of MPs.	- Develop new criteria for rating MPs. - Get rid of numerical ratings for MPs. - Need valid statistical method for field input.
3. Mission Problem Ranking: - Problem in how to deal with old ratings and new ratings. - Problem in how to deal with short term bias of the field. - Constant change in method reduces confidence of the field. - Field input is too complex; needs to be simplified.	- Clarify ways in which priorities are set for MPs.
4. Mission Problem Mechanics: - What controls the uniformity of MPs, is there any quality control, is there a formal way to amend or extend the life of an MP, what defines the life of an MP, shouldn't there be a basic structure to an MP (i.e. authorship, keywords, time of initial suggestion).	
5. Problems General to the Research Needs System - How does the system deal with obsolete R&D. - System is work intensive, perhaps work could be reduced. - System is subverted. - System is too subjective. In particular, the numerical rating and ranking of MPs is subjective yet the scores are treated as if "hard" values. - What should the relationship be between "high-priority" OCE generated needs and the priorities based on field input. - Problem in the length of time before a research need is actually addressed in research. - System allows work units to say they are responding to many MPs. - Need to clarify difference and relationships between MPs, Work Units, and Research Areas and Programs	- Put MPs in prespective as to their impact on the System, i.e. identify the extent and significance of their use - Keep Research Needs System but use it only as a source of inofrmation Use imput only from Districts and Divisions, no labs. Let Technical Monitors have final review Let evaluation apply only to new starts - Define the goal of the Research Needs System. - Consider the question of whether or not we should continue MPs, if we don't we will need some other method to obtain input from the field
B. Research Areas and Programs	
1. Establishment. - How do existing ones get modified or dropped. - No one looks at the state of the art before a new one is established and it is difficult to establish a new one. - Programs are not built up by those who have the need.	

Organizational Synthesis of Ideas Generated at Workshop on
Priority Setting Within Civil Works Research and Development Program
(Continued)

Problems and Needs	Ideas for Solutions
2. Priority Setting: - Should submit Programs to field for review (instead of MPs). - What should the relationship be between "high-priority" OCE generated needs and the priorities based on field input. - Decisions at headquarters should be on Programs, not MPs. - No provision within summation of priority numbers to compensate for special areas such as coastal and cold regions etc. - Subjectivity in rating and ranking of Programs, yet numerical scores are treated as "hard" values. 3. Need to clarify difference and relationships between MPs, Work Units, and Research Areas and Programs. 4. There are different funding sources for R&D, but no one system to allocate funds to programs.	- Establish criteria for rating Programs - Get rid of numerical ratings of Programs - Clarify ways in which priorities for Programs are set. - In setting Program priorities, use field input only as an information source.
C. Budget 1. How is the R&D budget determined. 2. Is there a ZBB process. 3. Too little decision contained within CW Directorate as opposed to RDO and Chiefs Office--need more CW input on ZBB process. 4. Different funding sources for R&D but no one system for allocation to programs 5. Need a contingency fund for the R&D Committee. 6. Budget is decided in the summer before money is set out.	- Define RDO's function vis-a-vis CW Budget - Determine what percent of R&D budget is actually available for new R&D.
D. Work Units 1. Need to clarify difference and relationships between MPs, Work Units, and Research Areas and Programs. 2. Problems with work unit structure: - too long in time - too slow in start-up - not multidisciplinary enough - too academic in nature (small-scale) 3. Do we have to lock in work units one year in advance. 4. Research Needs System allows work units to say they are responding to many MPs.	- Clarify ways in which priorities for work units are set.

APPENDIX C

SUMMARY OF COMMENTS BY THE ENVIRONMENTAL ADVISORY BOARD ON THE CORPS RESEARCH AND DEVELOPMENT PROGRAM

AUGUST 1980

The Environmental Advisory Board (EAB) included the Corps Research and Development Program as a topic at the meeting held in August, 1980. The Board felt that the Corps Program is vigorous, of good quality, and has made great contributions. However, in their brief review of the R&D Program, the Board members were disturbed by the lack of an overall plan for research and recommended that the Program needs revising and strengthening in order to ensure its effectiveness in the future. In particular, the Board noted that: (a) the present Program's system for determining research needs and priorities is confusing; (b) that regardless of position in the Corps organization that the Program is generally not understood by those who participate in it; and (c) that there is little consultation with professionals outside the Corps.

The EAB offered observations and comments on the following aspects of the R&D Program: evaluation, contributions of field staff and recognized professionals, research categories, levels of responsibility, staffing for research, writing Mission Problem Statements, funding research, and some miscellaneous aspects. The Board's major points on each of these topics are summarized in the following sections.

The Evaluation System

Focusing on three areas in the evaluation system, the Board recognized several real problems. First, that the method for Mission Problem Statement evaluation has no statistical significance and is heavily weighted against environmental projects. Second, that the method for classifying Mission Problem Statements is disadvantageous to environmental research because environmental staff is outnumbered and because Mission Problems with environmental considerations may be placed

in engineering or economic categories. Third, that the end result does not reflect field participation in the decisionmaking process.

The EAB commented that the fact that more than 1/3 of the research budget is allocated to environmental quality appears to be inspite of rather than because of the evaluation system. It was suggested that if the objective is to recognize EQ as being equal to NED, that it would be appropriate to develop a separate evaluation system for EQ that would incorporate field conferences in all Corps Divisions.

Contributions of Field Staff and Other Recognized Professionals

The Board discerned that there is too little field representation and too little use of professionsla outside of the Corps. In addition, when the field is included on committees for projects having an environmental element, persons with natural or socail science backgrounds are in the minority.

The EAB believed that it identified three separate review panels at the OCE level: the Civil Works R&D Review Committee, the Chiefs of the Divisions in Civil Works, and the Technical Monitors. The Board was concerned about these three since they are not truly separate; i.e. the Committee is composed of the Division Chiefs and the Division Chiefs appoint the Technical Monitors.

The Board suggested that OCE should establish priorities based on some input from the field and non-Corps personnel and that the system of appointing Technical Monitors be reevaluated.

Organization of Research by Functional Categories

The EAB thought that the present system of categories for environmental

research is too general and could be subject to abuse; the Board suggested that instead, the categories should reflect specific disciplines and areas of study. The writeup for the meeting included a listing of 8 Functional Categories into which 25 of the 30 work units in FY81 could be placed:

1) Should be included in EWQOS
2) Estuarine Ecological Planning and Impact Assessment
3) Aquatic and Wetland Ecology
4) Marine Ecology and Coastal Projects
5) Coastal Vegetation Ecology and Impacts
6) Habitat Evaluation Procedures
7) Computer Assisted Assessment Techniques
8) Miscellaneous

The Board pointed out that not only would an organization according to functional categories enable the Corps to better accomplish its mission, but also that work unit costs could be decreased.

Levels of Responsibility for R&D

The Board saw three major levels of interest and responsibility for research: OCE, the Districts and Divisions, and the laboratories. The OCE level is concerned with aspects of R&D having Corps-wide impact. The Districts and Divisions are concerned with both regional (e.g. river basin) and unique or project-specific problems. Field problem solutions may or may not have wide application depending on the nature of the problem.

The Board appeared to be sympathetic to suggestions for allocating research funds and som research policy authority to the field so that regional and unique problems could be undertaken more efficiently and with more timely results.

As for the laboratories, the Board advised that they become more specialized in specific areas of research so as to minimize duplication of effort and facilities and to reduce the difficulties in coordinating a

research area in which efforts are scattered among several laboratories.

Staffing for Research

The Board commented on two problems in staffing scientists at Corps laboratories: (1) that the Corps loses good young scientists to other agencies because the pay levels are not comparable, and (2) that the laboratory scientists often lack field experience. A system to rotate scientists from the laboratories for a period in the field could be helpful. In addition, allowing the Districts to undertake more research could help reduce costs of research, enhance job interest, and could increase the useability of research findings.

The field-level R&D Coordinator also concerned the Board; these persons hold a vital role, but may not have ther interest or time to esure tnat responsibilities for this add-on duty are carried out.

Writing Mission Problem Statements

The Board perceived that the field may not know how to formulate Mission Problem Statements and that field MPSs may be at a disadvantage to those written by the laboratories. The Board also remarked on the lengthy system to process MPS and the transformation that an MPS can undergo.

Funding for Research

There were several comments on funding in addition to an earlier suggestion that the field be allocated more funds and authority. The Board expressed particular concern for the way in which the EWQOS budget was decreased and for laboratory cost overruns and delays.

The Board remarked that outside funding could lead to cost effectiveness, better use of Corps researchers in Corps mission-oriented research, and a wider distribution and possibly better acceptance of results. Among other difficulties are funding for problem areas outside the continental U.S. and funding for hypothesis testing on projects under construction.

Other R&D Aspects Considered

The Board was enthusiastic about coordination with other agencies, peer review, the Cooperative Program, one-stop R&D service, and improved information exchange and made suggestions to increase these activities.

The Major Recommendations

In addition to any other comments, suggestions, and earlier recommendations, the Board advised that the following were especially worth considering towards improving the Corps R&D Program:

1) develop an updated statement on R&D goals and objectives and a clearer definition of R&D.

2) prepare a Corps-wide five-year R&D plan.

3) develop a system in which the overall research plan is clear and in which the linkages within the structure are clear.

4) evaluate the current R&D Program particularly as to its organizational structure, use of field input, and balance between NED and EQ in R&D needs and priorities.

5) house all matters pertaining to CW R&D in the CW Directorate.

6) establish review teams (which include outside expertise) for environmental projects.

7) have Mission Problem Statements submitted in abstract form and include certain essential information.

8) have OCE and non-Corps personnel attend the Environmental Chiefs' annual meeting.

9) allocate R&D funds to District and Divisions.

10) add a column on R&D to a newsletter having Corps-wide distribution.

11) establish a better system for communicating appropriate research results to states, cities, and towns.

APPENDIX D

SUMMARY OF DISCUSSIONS WITH ATTENDEES AT JULY/AUGUST 1980 MEETINGS OF CIVIL WORKS R&D REVIEW COMMITTEE

Framework for Discussion
Comments on the R&D System
Significance of the Committee
    Actual Role
    Ideal Role
Information of Use to the Committee
Comments on Committee Mechanics
    Research Program Ranking
    Membership and Meeting Schedule

Framework for Discussion

The Civil Works R&D Review Committee consists of six members: the Deputy Director of Civil Works, who is also the Committee Chairman; and the chiefs of each of the five Civil Works Divisions, i.e., Office of Policy, Planning Division, Engineering Division, Construction Operations Division, and Programs Division. For the Committee meetings held in the summer 1980, only two of the six members were able to attend; the other four sent substitutes from their staff. Committee attendees at the 1980 meetings were:

Attendees	Office	Substituting For
COL G. Robertson	CW Executive Office	BG H. Robinson
G. Brazier	Construction Operations	---
L. Duscha	Engineering	---
J. Belshe'	Planning	A. Shwaiko
H. Schwartz	Management	H. Pointon
R. Wolff	Policy	L. Blakey

Individual appointments were made with each of the attendees (except one who was on extensive TDY) to determine from them: (a) their perceptions of what the Committee's role is and/or what it should be; (b) their judgement of the utility of information received prior to Committee meetings; and, (c) their concept of the appropriateness of Committee members and timing of Committee meetings. In addition to ideas on the Committee role and function, the individuals also expressed perceptions on other aspects of the R&D system. The information and opinion obtained from those interviews is summarized in the following sections; it should be noted that this summary does not necessarily represent a consensus.

Comments on the R&D System

Ultimately, Congress is the key to research levels and emphasis and Congress can be changeable in its regard because research offers an easy whipping boy. The next link in the chain, the Office of Management and Budget (OMB) has also not demonstrated an interest in research. OMB gives each agency a budget ceiling within which the agency's R&D proponents do not have much room to manuever in competing for funds for their needs. The portion of Corps funds that are budgeted for research can be affected by the Chief of Engineers; e.g., if the Chief is convinced that research is important and can convey this to OMB, then research may receive increased funding. In addition to the Chief of Engineers, the Director of Civil Works must also be an active advocate for R&D else Civil Works R&D funds do not have a chance of being increased.

Within the Corps, research funds are distributed according to priorities and need and, although there are methods for their identification, there are weaknesses in them. The basic method is the Research Needs System (RNS), through which the field identifies and rates needs. However, the perceptions obtained through RNS may be considerably different from those that develop in OCE. For example, the field could never have scoped the Dredged Material Research Program through RNS, yet this was a major Corps effort. That there are two major sources of research needs (field and OCE) is not a problem, but how the outputs from the two are mixed is; thus research may be undertaken on needs which have not surfaced through the system.

Another weakness in the existing R&D system is that there is no real proponent for R&D; there are many participants at different levels, yet for each, the R&D duties are additional to other responsibilities and may not be given the attention they require. This problem is compounded by a tendency among the principal R&D participants at OCE to maintain a steady course and avoid any fundamental changes. Thus, these principals generally act by responding to issues and problems rather than by proposing program adjustments. The R&D system cannot truly be controlled unless those who should be concerned with its development are willing to make impactive decisions.

Some of the Committee attendees also expressed concern for where the research money goes relative to what it purchases. Part of the difficulty is that more research dollars could be obtained if it could be proven that research is a meaningful use of funds; however, there is a time lag between research initiation and results, and another lag between results and their transfer to users. Another part of the difficulty is that some of the research has not been satisfactory in yielding results: either the results have not justified the expense or the results are not expressed in a useable form.

There are other concerns about funding and products that were pointed out. For example, one attendee described the distinction between certain research problems and certain project specific problems as a twilight zone, indicating that some portion of R&D funded research would more appropriately be paid for by project funds. Regarding research product justification and useability, it is clear that those guiding the R&D system should take a greater interest in: (a) those research results that have impacted day to day field activities; and (2) in improving the communications between the scientists and the field.

Finally, at least one attendee commented that although R&D is a relatively small portion of the Corps budget that it is R&D that gives the Corps its capacity to adapt to changes and to help maintain the Corps at the forefront across a range of interests and agencies. Without some reputation for R&D, the Corps would just be a construction agency.

Significance of the Committee

Interestingly enough, the attendees' perceptions of the Committee's impact within the R&D System differed. One said that the Committee functioned like a rubber stamp, but had no choice since it is presented with a fait accompli after the Program Reviews. Another emphatically stated that the Committee has a big impact, yet he was unable to support that. However, most did believe that the Committee does not have as much control as it should.

The Committee focuses on research priorities at the Research Program level, the 29 programs within the six Research Areas. There is difference of opinion as to what features the Committee should consider within the Research Programs; in fact, more information was obtained on what the Committee should do than what it does.

Actual Role

The Committee does meet to establish priorities among the Research Programs for the new budget year(FY+2). The priorities are determined by a ranking of the Programs and are used to prepare budget targets for each Program for FY+2. The results are provided as guidance to RDO to aid in the development of a budget package and justification for submission to OMB. Thus, the Committee does have a role in overall budgeting among Research Programs. The impact of that role is not clear, however, because RDO does not return information to the Committee as to how much of the guidance was incorporated, nor does the Committee solicit such information.

The Committee also meets to review the budget year (FY+1) Research Program funding that is prepared by RDO after the Program Reviews. The Committee does have an opportunity to recommend revisions to the budget, but apparently generally passes on it. After Committee validation, budget year planning enters its final stages: RDO compiles the package for the Chief of the Program Division to review; and then the Director of Civil Works completes adjustments and approves the budget.

The Committee does provide a forum for discussion on the Research Programs and has been successful in resolving issues that cut across the interests of several Research Programs and more than one Civil Works Division. Because it is chaired by the Deputy Director of Civil Works, the Committee also serves to bring issues to the attention of higher authority. Although the Committee may be impassive to items that it finds uninteresting, it can provide an important complement to the field since it may identify or give emphasis to issues that the field cannot perceive. Finally, as the attendees pointed out, it is important that regardless of the impact of the Committee recommendations or the methods used to develop them, that those recommendations are the consensus of the members (or their designated respresentatives).

Ideal Role

In listening to the perception of what the Committee should do, it became clear that there is some tension between the domains of RDO and Civil Works, at least at the Committee level (This tension is exemplified by the following comments: (1) RDO has no obvious criteria for setting priorities; budgets are determined on an ad hoc, gut-feeling basis; (2) RDO is oriented to doing what the laboratories want done but gives no information on what or how far they will let the laboratories go; (3) RDO operates without regard to what Civil Works wants; and, (4) RDO negotiates with the Office of Management and Staff Support.) One attendee felt that the Committee should have responsibility for all Research Program priority setting budgeting and that RDO should work with the laboratories to put together and manage work units which are responsive to Civil Works requirements. Thus, the Committee should be concerned with R&D requirements, needs, and priorities for the Research Programs as well as for the Corps, while RDO should then follow through with providing the necessary resources, facilities, and products.

Most believed that the Committee has not exercised its responsibilities, that it should be more active in guiding the emphasis of R&D and, if necessary, recommend deletions of Research Programs within its responsibilities. The Committee has the potential of not only impacting the R&D program but also the Corps' mission. Evidently the relative impact of the Committee as opposed to RDO is founded in which one takes the initiative. In that the Committee has not done this and particularly since it has not followed up on its recommendations, then RDO has had to become strong where the Committee is weak.

In other perceptions: (a) the Committee should represent the field in what R&D accomplishes and should function as an arbitiator between the field and the Technical Monitors; and, (b) the role of the Committee should be to provide a balance among long-term R&D, short-term R&D, and R&D external to the Corps.

Information of Use to the Committee

In that the Committee is concerned with Research Programs, it makes use of information on these programs. The attendees were asked to comment on the material given to them before the meeting and to indicate if it were adequate or what additional information would be useful. From the response, it is clear that the Committee needs something to react to. Without exception, two points were made: (1) that the information is not provided far enough in advance of the meeting (only one week's lead time prior to the July meeting); and, (2) that there should be a summary sheet of pertinent information for each Research Program (however, there were different ideas as to what that pertinent information would include).

There are other problems with the information: (1) it often changes just before the meeting; (2) there is no overview explanation of what it is and what the pluses and minuses mean; (3) it is not uniform, (i.e., the same type of information is not given for each Research Program); and, (4) besides being inconsistent and unexplained, some of the information is not the right kind anyway.

Recognizing these problems, an agenda was prepared for the July meeting to highlight what major concerns should be addressed. The attendees found this to be helpful and would like to have agendas for future meetings. Perhaps the agenda could be expanded to provide a guide to the information package; this guide would in effect explain the information (i.e., would indicate that based on this data, these issues require Committee decisions).

There are different perceptions of what sort of back-up material the Committee needs and what Research Program elements the Committee should consider. For example, one attendee had some definite ideas for summary sheets for each Program: the sheet should provide information on the Program's origin, status, and future directions; should show how and to what extent Work Units within that Program relate to Mission Problem Statements; should give an indication of the spread of problems across Districts that relate to the Program; and, should indicate what R&D is being pursued on the Program topic by other agencies. For a new Research Program; the summary sheet should provide some measure of the Program's potential.

Another attendee had ideas which would supplement such summary sheets: he called for impact statements for each Research Program. Essentially, the impact statements would: (1) chart accomplishments and status of the Program relative to the short- and long-term goals of that Program; and (2) would demonstrate the impacts of funding level changes on Program goals. The justification for Research Program Summary Impact Sheets is that if the Comittee is to set priorities, it needs information on what each R&D Program is doing, what the Program goals are and how they are to be achieved, and what other agencies are doing relative R&D.

In contrast to these ideas, another attendee was equally emphatic that the Committee should not address status and performance within each Research Program because this is done at the Program Reviews. In his view, the Committee should be concerned with the relative importance of the Programs as measured against the Committee's perception of Civil Works' mission priorities at that time; thus, short and long-term goals or goal achievement would be the responsibility of RDO and the Technical Monitors and so would not be considered by the Committee. It is difficult to understand how this concept is able to overlook the relationship between Committee recommendations, and Program impacts. For example, supposing the Committee ranks the Programs and recommends a 10 percent increase for the top five Programs. Program objectives and accomplishments aside, such an increase would have a considerably different scale of impact on high and low funded Programs. Further, such a recommendation would not make sense if a program does not need that increase (e.g. close to accomplishing its objective) or if a Program cannot assimilate that increase (e.g., the resources needed to expend those funds are not there).

Currently, the Committee rests heavily on the Technical Monitors for information on individual Programs, any Committee awareness of Program accomplishment and need comes through the monitors; however, some monitors may provide information reluctantly and resist having their Program examined. Also, there are presently no mechanisms for incorporating a sense of external R&D in the Committee's decision Process or for building a perspective of a new Research Program, consequently the addition of a new program can be very difficult.

Finally, most of the attendees believed that information as to what the field wants is important but they are unsure how to obtain and use that information. In general, they feel that the RNS does not truly reflect the field's needs.

Comments on Committee Procedures

Research Program Ranking

The numerical method used in the July Committee meeting to rank Research Programs in order to develop FY 82 target budgets is perhaps the most mechanistic and formal that the Committee has used. The attendees were asked to comment on the July 1980 criteria and procedures and they gave some unexpected answers.

Prior to 1980, Research Program priorities were established essentially by reaching an agreement among the Committee members individual conceptual priorities. That process became increasingly difficult as the number of Research Programs and the range of disciplines they represented increased. The intent of the 1980 procedure was to simplify this process and to increase the level of objectivity.

The details of the 1980 procedure (described in Appendix A) can easily be criticized on the basis of both statistical and R&D significance of results. However, it is interesting to note that this did not seem to bother the Committee attendees so much as the fact that the procedure was sprung on them at the last minute. They were more frustrated by the timing and the limited opportunity to discuss the criteria than they were by the index scaling of results of the Research Needs System or the subjective scoring of the criteria.

Some of the problems that the Committee attendees identified with the 1980 procedure were: (a) that it was overly mechanistic and led the Committee to haphazard decisions not founded in logic or mediated discussion; (b) that the meeting ended up with a ranking for which there was documentation but which emphasized arithmetic instead of judgement and reflection; (c) that the procedure probably favored the engineering disciplines over the environmental; and, (d) that the procedure overlooked the broader issues that the Committee should consider such as the long-term perspective on R&D. Also, one attendee pointed out that only the titles of the Research Programs were used (i.e., that the ranking was accomplished without access to a descriptive definition

of each Research Program). In that Program descriptions are frequently revised or new ones added and in that over half of the attendees were substitutes, it is likely that some were unsure of Program content.

In summary, the Committee attendees apparently accepted the idea of a more formal procedure; however, they would have preferred to have been more involved in its development or at least to have known about it in advance of the meeting. Further, they do not want their recommendations to be based so heavily on arithmetic.

Membership and Meeting Schedule

In general the attendees were satisfied with the make-up of the Committee and the number of members. One problem is that the persons who are members are extremely busy people; many times, and often at the last minute, they must send a substitute who has not had time to become familiar with the issues. It was felt that having the Deputy Director of Civil Works as the Chairman was good since that provides the Committee with a link to the Chief's office. Also having members from the Offices of Policy and Programs is good because they are more impartial to R&D than the technical divisions. One attendee philosophized on the question of membership by saying that the proper membership depends on what Civil Works wants the Committee to do. None of the attendees advocated increasing the Committee. Since most of the attendees interviewed had substituted for Committee members at the 1980 meetings, their comments on the currently circulating issue of adding the Director of WRSC as a member cannot be taken as the opinion of the members. However, the attendees were not in favor of this idea, they felt that that would dilute the Committee and that it would be unfair to add one laboratory proponent without adding all. One attendee stated that he felt the Committee was too large a group for efficient discussion, but that since all the Civil Works proponents should be and are represented, that the group could not be decreased. He suggested instead that perhaps the Committee should meet more often.

Few of the attendees originated the idea that Committee should have more meetings; however, when they were specifically asked, all thought that that would be an improvement. More meetings would give the Committee more visibility, give it a greater sense of impact on the system, and help restore its eroded responsibilities. There were a few suggestions as to meeting timing. First, that the Program Reviews be held earlier to allow more time for Committee preparation (apparently the Committee cannot meet on the budget year program any later than it does). Second, that a meeting designed and timed to provide a better interface with the Research Needs System would be advantageous; this meeting might be best timed to occur before the Office of Policy begins processing the field needs. Third, that the Committee should meet when the OMB passbacks are received, and at that meeting should use OMB guidance to develop recommendations to be sent to RDO.

APPENDIX E

SUMMARY OF R&D WITHIN OTHER AGENCIES

U.S. Fish and Wildlife Service
Office of Water Resources Technology
Tennessee Valley Authority
Military Programs Directorate
Water and Power Resources Service

Interviews were conducted with representatives from several agencies with water resource missions in order to learn how these agencies identified and selected R&D projects. It was felt that learning how others have addressed the problems of R&D selection would yield valuable insights which might be able to be applied to the Corps.

Agencies approached were TVA, WPRS, the Fish and Wildlife Service, the Office of Water Resources Technology (OWRT), and the Military Programs Division of the Corps. The representatives from TVA indicated that the Authority does not have an R&D process, so no interview was conducted with TVA. Interviews with the other agency representatives are contained in this appendix.

Meeting with Mr. Duncan McDonald
R&D Coordination Office
Wildlife Research Program
Fish & Wildlife Service - Oct 1980

GENERAL INFORMATION

The Fish & Wildlife Service (FWS) has several major Divisions which run independent R&D operations. The description of the R&D project selection process below applies to the Wildlife Research Program of FWS.

R&D Selection Process

Major actors in the R&D selection process includes FWS area offices; regional offices; labs; the Research Coordination Office; program development staff; and program managers. As with the Corps of Engineers' process, the fundamental mechanism for structuring is need. These research needs can be generated by field elements, by labs, or by program managers.

FIELD GENERATED NEEDS

Labs generate the bulk of potential R&D needs. Lab-generated needs are submitted to the Research Coordination Office (RCO). The RCO exercises a review and evaluation function similar to that played by area and regional offices described above. The RCO submits those needs that it feels are important to the Program Development Office. The RCO is not limited to submitting five needs as are regional offices.

CONTINUOUS TRACKING SYSTEM

An important feature of the FWS needs identification process is that "full accounting of all needs surfaced is maintained. Area offices must provide feedback to individuals submitting needs to keep them abreast of the status of the need. Regional offices must "close the loop" and explain to individuals why a particular need was not submitted to the Washington level.

PROGRAM DEVELOPMENT OFFICE

Lab-generated and field generated needs which have passed screening reach the Program Development Office (PDO). Here staff evaluates the needs in terms of relationship to National needs and agency goals and objectives. The evaluation criteria are implicit in an FWS program management plan continuing agency goals and objectives which is prepared on a five-year basis. Using these general evaluation criteria, the needs are ranked in importance and sent back to the RDC. The RDC distributes the needs among labs on the basis of which labs are most suited to to address the particular needs. At this time, all labs must contact the initiation of the need. This step insures that there is additional clarification about what is at issue. The FWS respondent indicated that some problems are solved at this step without initiating an R&D project

because labs were able to solve the problem, or were aware of existing or on-going R&D which met the needs.

Labs then submit work plans for all issues that need R&D back to the RCO. Work plans contain funding needs. The ROC then incorporates those needs which have received highest priority from PDO into the Fiscal Year budget. About 20 percent of the R&D budget is earmarked for such new starts. Remaining needs which cannot be funded will have a schedule for being phased into active R&D. The ROC then submits the recommended R&D budget and phasing plan to PDO for approval.

LONG RANGE PLANNING

The five-year management document that is used to evaluate the significance of needs provides some long-range or strategic focus to the R&D selection process. In addition to this document, the RDC prepares a document entitled "Budget Issues" which highlight emergent issues and problems. This document is circulated to the field for its review and input and then submitted to the PDO. This document thus also serves to alert program managers about issues that may be important in the near future.

CONCLUSIONS

Perhaps the most noteworthy aspeect of the FWS R&D process is the care that is taken to insure that each need generated is accounted for. R&D managers feel this care communicates their belief that the field's needs should be listened to. The FWS respondent felt that by providing feedback the R&D system encouraged individuals to generate R&D needs. In addition to the responsive feedback, the R&D selection process seems to have a solid link to long-range and strategic planning. This link helps provide a coherent focus to the character of R&D being undertaken.

Meeting with Mr. Frank Carlson
Office of Water Resources Technology - Oct 1980

GENERAL INFORMATION

The Office of Water Resources Technology (OWRT) manages several R&D programs. Two R&D programs which were the topic of the interview were the allotment program and the matching grant program.

Most of the R&D effort takes place within or is associated with one of the 57 water resources institutes which are funded through OWRT. These institutes are part of land grant colleges.

ALLOTMENT PROGRAM

Each year OWRT provides $110,000 to each water resource institute. Funds are for administrative exepnses and provide for small research projects. Each institute has an advisory group which helps set R&D priorities for these funds. Membership of these advisory groups typically consist of representatives of Federal agencies, river basin commissions, and local interests. The allotment program is primarily a grant program and control over allocation of funds rests at the individual institute level.

MATCHING GRANT PROGRAM

This program is a national competition for research funds. OWRT matches funds provided by States or other agencies. Proposals outlining research objectives and procedures are sent to OWRT by individual investigators or through water resource isntitutes. At OWRT, proposals are screened for technical competency and general soundness of research design. Proposals are also evaluated against several criteria to judge the significance of the research. Criteria include National Academy of Sciences water resource priorities contained in the recent National Academy report Water Resources Research Priorities for the FY 82 Budget. In addition some concern is given to the regional distribution of matching grant funds to ensure that all research grants are not going to to one part of the country.

Phone call to TVA 23 September 1980.

Mr. Dick Connelly and Mr. Ralph Brooks R&D Administration

The Tennessee Valley Authority (TVA) research people (Dick Connelly & Ralph Brooks) were contacted by phone in Knoxville Tenn. and were asked about their research and if they have a system to determine priorities for that research.

Our conversation revealed that TVA does not have a system for developing their research needs nor a way of setting priorities for their research. They perform research as the need arises for their projects and as funds are available thru the Zero Base Budget process. They had knowledge of the Civil Works Research Needs System and commented that they were not as "regimented" as the Corps. They discouraged us from visiting their office.

MEETING WITH MR. JIM STILLMAN
R&D COORDINATOR FOR CORPS MILITARY
PROGRAMS DIRECTORATE, 3 OCT 1980

The Military R&D program is responsive to needs of the Facility Engineers of the Major Army Commands and the Corps Military Programs Directorate. The Military Programs (MP) Directorate is the central point of contact for the other major commands.

There are ten major project technical areas which are considered each fiscal year by the Directorate for placement in a priority order. The ten technical areas are:

- Energy
- Environmental Quality
- Automative Planning Design and Construction
- Military Construction Management
- Facilities Operation and Maintenance
- Military Construction Technology
- Architectural Habitability
- Military Pavements
- Permanent Hardened Facilities
- Military Constructive and Maintenance/Operations in Cold Regions

The technical areas are prioritized through a process called OCR (Qualitative Construction Requirements). In order to reach the OCR priorities, construction problem statements developed by OCE staff or field offices are reviewed by all potential users (MACOM's-Div-Dist) who rate them in importance on a scale of 1 to 5 within those technical areas.

Based upon the collective response, the Military Programs Director establishes the priorities of individual requirements within the technical areas. Also based upon the user responses, research work efforts are estimated in dollars for budget purposes. The listing of requirements, by priority within the technical areas and the appropriate technical area priority are then furnished to the Research and Development Office (RDO). The RDO sends the information to the Corps labs who prepare research work statements with funding requirements and return the information. The RDO selects the appropriate lab to do the research for each work effort or technical area.

The above information was gained from discussion with Mr. Stillman, ER 70-3-2. (1971) provides further details. Mr. Stillman is in the process of revising the ER.

Meeting with Mr. B. J. Brink -
R&D Coordinator, Water & Power Resources Service
29 September 1980

General Information

Mr. Brink's office is responsible for developing WPRSA's research program. The office is located in the Engineering & Research Center of WPRSA. The E&R Center coordinates and performs most of WPRSA's R&D. Mr. Brink indicated that WPRSA has a relatively small R&D program (for FY 81 it is $4.6 million), and that since it has been small and field problem oriented the agency has not had until 1980 any explicit system for allocating research funds. Since the reorganization of the agency, however, WPRSA appears to be moving in the direction of instituting a more formal system for its R&D program. This new, more formalized, system is similar in some respects to the Corps' R&D procedures.

R&D Selection Process

WPRSA is organized into seven regional centers in the 17 western states. These field elements often generate research needs. Unlike the Corps, there is no formal mission problem process. Instead, the field notifies the Engineering & Research Center that it needs research done. This can be done informally or formally. Informally the field contacts researchers in the E&R Center and asks them to promote a specific research topic area. In this case, researchers would prepare research proposals addressing these needs and send them to the R&D office. Formally, the field sends a letter to Brink's office at the E&R Center requesting research. Upon receipt of such a request, the R&D office sends the request to the appropriate part of the E&R Center where staff evaluates the significance of the problem. Should the request pass evaluation, a research proposal is prepared. Besides field-generated needs, research topics are frequently suggested by individual researchers working within the E&R Center. All research proposals have an optimum funding estimate attached with them. Brink's office is responsible for collecting all R&D suggestions.

Since, as Brink indicated, the process for selecting R&D projects is in flux, both the new and old selection processes will be described.

Former Selection Process

Under the former evaluation process, a briefing describing all potential projects was presented to the Research Review Committee. The Research Review Committee (RRC) is chaired by the Assistanct Commissioner for Engineering and research of WPRSA; members include chiefs of major Divisions within the E&R Center and several individuals from Washington who have responsibility for R&D. In the former evaluation process, each potential project was described to the committee by the Research Manager under whose control the research would be performed. Regional staff could attend the meeting and comment to

the committee. After hearing committee comments in the briefing, Brink and his Division Chief would meet apart from the committee and choose high priority R&D projects. The choice represented their own experience, input from Research Managers and comments from the RRC.

In the past the RRC's role has been advisory. Since the reorganization of the Bureau of Reclamation into WPRSA, the RRC has been given control over the choice or selelction of R&D projects. Brink indicated that there has been a demand by the RRC for a more explicit and accountable decision-making process. The process described below reflects this new demand.

New Evaluation Process

Under the new system, Brink's office collects research proposals as before. Now, however, these proposals are sent to regional offices and branch Research Managers at the E&R Center. In regional offices a regional reseach coordinator is responsible for staffing proposals to proper elements for review. Regional office and Research Managers are expected to give each project a ranking on a scale of "1 to 10" which reflects regional or research department priority. Brink averages the rankings. Those projects which have an average significance of "6" or greater are recommended by Brink to the RRC. The number "6" appears to have been chosen because the cost of those projects at or above "6" was within the overall R&D funding constraints.

Brink reported that in 1980, the first year of the new evaluation process, the RRC made no changes in the set of projects recommended via the ranking process. In 1980, proposed R&D projects were sent out for ranking in categories which related to general R&D areas. Brink's office has performed this categorization. There was some dissatisfaction with the pre-categorization of R&D projects, however, and in 1981 proposed projects will be sent out for ranking uncategorized.

Advisory Group

The RRC has an advisory group composed of the regional research coordinators. This group has no formal structure (no chairman, etc.). It attends the meeting where the proposals are presented and can make recommendations about the projects under review. This group must leave before the RRC makes its final selection of research projects.

Long Range Planning

WPRSA has no department charged with long-range planning. It does, however, have a Permanent Management Committee which is responsible for forming policy on emerging issues. This committee consists of the commissioner and all assistant commissioners of WPRSA and all chief of regional offices. Brink felt that this committee could and did orient some of WPRSA's R&D based on its perceptions of the long range needs of WPRSA. Brink stressed that most of WPRSA's R&D is mission-oriented and applied work closely linked to field problems and needs.

Overall R&D Budgeting

Determining the size of the R&D budget is a negotiated process involving Brink's office, OMB and Congressional delegations as well as the research evaluation system already described above. The initial budget estimates are based on previous-year figures with inflation factors added. OMB can then trim some funds or demand that a certain portion be spent on a certain area. Congressional delegations infrequently add money for special projects. Out of this process an R&D Budget emerges. Brink noted that in 1980 the R&D budget was $2.6 million, largely because of the acquisition of a dam safety research program.

Conclusions

WPRSA appears to be moving from an R&D selection process which emphasized informal negotiation to a more structured ranking process. This ranking process is similar to the Corps' process both in character and in the relative lack of control over field rankings. One component of the R&D selection process which appears useful is the field advisory Group. This group has a chance to lobby for or against research proposals before the RDC makes its final determination.

APPENDIX F

SUMMARY OF LITERATURE REVIEWED REGARDING R&D PRIORITIZATION PROCESS

Introduction

In conjunction with the critique of the current R&D Prioritization Process in the Civil Works Directorate of OCE, a review of research literature pertinent to this topic was conducted. The purpose of this appendix is to summarize the literature reviewed and to provide a bibliography for further study (if need be). This summary was used as background information for the discussion of findings, and recommendations by IWR staff members. The literature was summarized under the following headings:

- o Trends in science, technology and their management.
- o Problems and issues of R&D management.
- o Quantitative techniques for prioritization of research projects.
- o The evaluation of existing research programs.

Trends in Science and Technology and their Management

For 25 years from the Marshall Plan to the mid-70's, the U.S. and the world experienced and unprecedented period of economic growth. It was a period of rapid growth and change -- predictable change with technical continuity. However, today the U.S. appears to be in the throws of a fundamental shift in the foundations of productivity. A new resource scarcity has occurred as a result of the overproduction of existing technologies, which may signal a new wave of technological innovations. It is quite possible that these new technologies may drastically alter the structure of society in the next 20 years as growth shifts to new foundations. As times become more economically trubulent, organizations will be forces to pay more attention to agenda setting.

-- What is the organization? What is its role, function, and goals?

-- What are the external environmental conditions involving major long-term trends or discontinuities that may threaten the survival of the organization or provide new opportunities for growth?

-- Where does the organization want to go and how can it get there?

Research and development expenditure has proven to be directly related the the productivity of an industry. So as society seeks to revitalize (increase productivity), their industries, more not less attention will be placed on R&D.

In the past 15 - 20 years, U.S. technological lead has been reduced.

-- Labor productivity has increased more slowly in the U.S. than in Western Europe and Japan.

-- U.S. Orignated about 80 percent of the major innovations during 1953 - 1958. This percentage has diminished to 57 percent of major innovations from 1965 - 1973.

The percent of GNP, devoted to R&D has declined in the U.S. during the last 15 years, whereas the USSR, West Germany and Japan, have increased their percent GNP devoted to R&D (U.S. House of Representatives, 1980).

It has become quite apparent that the U.S. has been resting on the laurals of past innovation and has been content to reap the benefits of past discoveries and innovations without adequate reinvestment. Some analyst contend that the U.S. is experiencing a failure of management. Management of our public and private bureacracies have been dominated by lawyers and accountants, whose approaches to management have fostered profit taking and risk aversion. R&D is risky. It requires capital investment and the

acceptance of a "batting average" well below 1000. But such investment is necessary to capture the long-term benefits of increased productivity, lower inflation and lower unemployment.

Our society is growing more complex and interrelated. The growth in scale of human enterprize is outstripping the capacity of our human organizations to understand, manage and control such activitity. The process of social learning is made nore difficult. In the past, science has specialized in developing techniques adept at analyzing things in a reductionist mode. But due to the increasing complexity of life, science and our scientific endeavours to meet national needs will be called upon to develop ways of analyzing and understanding the whole, the collectively, the system. (Coates and Hitchcock, 1980.)

The trend toward the politicization of all aspects of research, from its location and level of funding down, is inevitable as a dominant theme -- the centrality of science and technology -- and increasingly becomes a matter of broad consciousness as the site of the R&D pot increases and as the number of problems to which science is seen as applicable grows. The trends with regard to politicization fall into three categories:

-- Declining autonomy of science.
-- Rising public and policy expections from science.
-- Growing concern for the health of science. (Coates and Hitchcock, 1980.)

Problems and Issues of Research Management*

The Civil Works side of the Office of the Chief of Engineers, administers a $35 million research and development program each year. The problems and issues encountered during the management of the research programs are much the same as other organizations, public or private, involved in the business of science and technology.

All organizations must ask the question of how best to allocate their resources. How should funding levels be decided? Which research areas should be stressed? And how much better will the organization's operations be (potentially at least) with results of the research? How well will the organization be able to understand and utilized the techniques or results that will be developed from this research?

Many of these questions are universal to the field of research and development. But knowing the right questions does not a management system make. The organization must be willing to commit the resources necessary to effectively manage and resolve the fundamental issues inherent in any R&D effort. The following are just some of the issues that the Civil Works Research and Development program must attempt to resolve:

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* Summary represents an embellishment of article by Gladwell, 1976.

1. Basic vs Applied Research

How much of an organization's resources should be devoted to basic or applied research? Sometimes its extremely difficult to determine. The amount of basic research may depend on the relative scientific fertility of the field, or the likelihood that useful technology might come from the research.

The amount of applied research must also be evaluated by adequate criteria. What is the investment to payoff ratio likely to be for a given project? How close is the state-of-the-art to the theoretical limits of subject matter. Will this study be a major catalyst to create new insights and areas of investigation?

2. Priorities

Prioritization process requires the interaction of four vital groups: those that experience and live with the problem; those that can articulate the need and sharpen the understanding of the problem; those who can go about solving it; and those that can utilize the output. The problem is that each one of these groups represent different sets of objectives. Managers must learn how to successfully cope with this multiplicity of objectives in their prioritization process.

The future of research and development is fought with uncertainty. It is difficult to determine which research endeavors will be most beneficial during the prioritization process. Surely if research programs venture into the unknown we cannot expect the same type of performance required from more programmed, routine operational activities.

Lastly, there is a tendency to ascribe total "objectivity" to the priorization process. But to demand such objectivity is to ignore the fact that proponents of a given field quite often and quite naturally tend to be advocates. Therefore, the prioritization problem is fundamentally a political question within an organization which should be negotiated and bargained.

3. Duplication

Duplication of research is a problem that can occur within an organization, among competing labs, or between one organizations and other peer organizations, or it may occur among organizations at different levels (federal vs. state). As our organizations and society become more complex and sophisticated, it may be harder to keep track of all the advances in the field. This problem requires that great attention be given to the coordination of efforts and cooperation of labs in the research community. That is not to say that all duplication of research should be avoided. It should simply be purposive.

4. Technology Transfer

All too frequently, research seems to be done for research's sake. The time is not taken to follow through with the results of a research activity to show how the new knowledge may be effectively put to use. The researcher must be keenly aware of his/her audience, their needs, and the effect of the research on their work.

Statistical Methods of R&D Project Evaluation*

Much research has been conducted by the management scientists to model the decisions regarding project selection. Unfortunately, the real world complexities of multiple objectives and constraints do not conform to the assumptions built into the decison models.

Many of the models assume one decision-maker who has complete knowledge of all alternatives and the benefits, risks, and opportunity costs, as well as the organizational goals. The realities are that there are many decision-makers in an organization. The goals of the organization are constantly changing. Information is imperfect, scattered, and absent in many instances. Optimal solutions do not exist but must be created through negotiation and bargaining.

Most models for decision fail to address the following organizational behavior needs:

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* Summary of article by Souder, 1978

-- Organizational goals and constraints at all levels of the orgainzation must be clearly defined and agreed upon. They are the ultimate standards for killing some projects and accepting others.

-- Most project evaluation data are necessarily subjective in nature. Unless a spirit of trust and openess is felt by the parties, it is not likely that such data will be fully and openly exchanged.

-- For successful project evaluation, a minimum level of personal awareness is needed. Involved parties must know and truly comprehend the nature of the projects they are proposing or deliberating. This means two things:

(1) They must have a depth of factural knowledge; and,

(2) The parties involved must have complete awareness of their own feelings vis a vis others since much of the decision data are highly personal. (Souder, 1978.)

The Evaluation of Existing Research Programs

Research programs once authorized and funded, tend to take on their own life and per petuate themselves. Not only must managers have a means to evaluate new initiatives, they must have a means for evaluating continuing programs and candidates for retirement as well. But evaluation is not easy.

One of the major problems of evalution is that there is no straightforward definition of success. No all new knowledge or achievements contribute directly to and agency's mission. In addition, there may be problems in identifying and valuing outcomes.

* Summary of report by Salasin, et.al, 1980.

Research endeavors may serve many purposes and groups. Each group has their own agenda which must be respected. So to evaluate research programs on just one dimension may provide a very stilted view of research performance. Evaluation methods must be able to cope with a multiplicity of objectives and constraints.

The development of a composite evaluation of research programs requires the combination of quantitative and qualitative factors. The question is how are these values expressed and integrated into the process of evaluation. It is now becoming apparent that qualitative values are becoming recognized as legitimate and as worthy of consideration as more quantifiable values.

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