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Engineering Analysis and Management of Capital Projects by AID

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SUMMARY

This report represents the results of a study conducted by the Research Analysis Corporation during November and December 1967 for the Office of Engineering of the Agency for International Development (AID). The study describes the capital projects development process and the inputs required of the AID engineer in the process, identifies significant deficiencies in both the process and the AID engineering function, and recommends an alternative process.

The capital projects development process is described as consisting of six phases: project identification, preparation of application, review of applications, authorization of financing, financing agreement and implementation instructions, and implementation and monitoring.

The engineering inputs for the process are discussed in some detail. These include the informational content required from the host country in the application for assistance, the judgment of whether or not the project is feasible, the summary of the project in terms of nature, size, etc., the various engineering plans required, the determination of technical and economic soundness, information required for review of application, and others.

The significant deficiencies noted are: (1) inadequacies within the manual orders; (2) early loan commitment; (3) early reasonably firm estimate of cost (4) early heavy engineering effort; (5) lack of definition of inputs required and of the time and way in which AID becomes involved in the project identification step; (6) lack of a method for assuring that

project implementation reports are analyzed and remedial action taken in a timely manner; (7) lack of an evaluation step in the process; and (8) lack of logical and sequential structuring of the decisions required in the process.

The alternative process suggested is one which includes the following six logical phases for a development process: (1) identification of activity possibilities; (2) project definition; (3) project design and planning; (4) final review for financing; (5) project implementation; and (6) project evaluation. The type of input required for these six phases is discussed in some detail along with possible difficulties or questions that should be studied further for better resolution.

CHAPTER I
INTRODUCTION

The Agency for International Development (AID) has major responsibility for administering the foreign assistance program of the United States. The program provides assistance to developing nations in the forms of program assistance, technical assistance, and capital assistance.

This report describes the findings, recommendations, and related analysis of a study conducted at the Research Analysis Corporation (RAC) on the development process for capital assistance projects. AID capital assistance projects include the expansion or establishment of capital facilities or financial institutions financed wholly or partly by AID. This study considers only capital facilities. Each capital project from the time it has been identified as a potential project to the time construction has been completed, requires a number of activities conducted by numerous parties to the loan. These activities comprise the development process. The parties participating in the project development are mission directors, AID loan officers, lawyers, economists, and engineers as well as the agent of the borrowing country, consulting engineers and construction contractors.

This study has focused on the AID engineer's role in capital project development. The purpose of the study is two-fold: to describe the capital projects development process identifying the inputs required of the AID engineer, and to identify problem areas in the process or in the engineering function and recommend improvements. The approach used is illustrated in Fig. 1.

OUTLINE OF STUDY

**Review of AID
Documentation**

**Interview with
AID Personnel**

**Describe the
Development
Process and
the Engineering
Inputs Required**

Analysis

**Deficiencies
in Present
System**

**Recommended
Improved
Process**

FIGURE 1

GENERAL PHILOSOPHY AND APPROACH

The AID role is to ensure that the Foreign Assistance Program is soundly conceived and efficiently implemented although responsibility for the implementation rests with the borrower/grantee. AID is responsible for advice, review, approval and monitoring to assure: economic and technical soundness, contribution to economic development, consistency with policy, conformance with statutory requirements, adequate planning, availability of financial and other resources, and successful completion of the projects. The borrower/grantee is responsible for project formulation and implementation and is required to have AID approval of the choice of all consulting and supervisory engineering services and construction contractors.

The basic approach used in the process is that: (1) the borrower/grantee is primarily responsible for assuring that required professional services are provided for planning, development, construction, and operation of the project (AID provides advice and assistance in defining requirements and outlining possible methods of meeting them but ordinarily will not participate in the preparation of feasibility studies, or design, construction, or supervision of construction); (2) an engineering firm employed by the borrower/grantee to do design, prepare plans and specifications and supervise construction is generally required; (3) construction is normally to be undertaken through a borrower/grantee contract with a private construction firm; and (4) preliminary engineering in the planning and feasibility stage is financed by the applicant or AID (loan or grant) while the engineering and construction services for project execution may be financed by AID loan or grant.

THE ORGANIZATIONAL SETTING

The Agency is organized into five regional bureaus, which are the line organizations, and various staff offices which include the Office of Engineering, the General Counsel, the Office of Management Planning, the Office of Plans and Program Coordination, and others. The head of the Agency is the Administrator who has reporting to him five Assistant Administrators, each of which has administrative responsibility for a region.

The regional bureaus are independent operating units which administer the foreign assistance program in different parts of the world. There are bureaus for Latin America (LA), Near East and South Asia (NEESA), East Asia (EA), Africa (AFR), and Viet Nam (VN). Because of the special operating arrangements of the Viet Nam program, this bureau has not been considered in the study.

The engineering community within the Agency consists of three types of engineers - the central engineers, the regional or bureau engineers, and the mission engineers.

The central engineers are organized into the Office of Engineering, which is headed by the Director of Engineering. He serves as the Agency's principal engineering advisor and reports to the Administrator. The office provides engineering counsel to the Administrator, formulates policies, standards, and practices for engineering aspects of AID-financed capital projects, and supports the staffs of the regional engineering organizations (MO 204.4).

Each region has its own staff of engineers. The staff includes the bureau engineers who are in Washington and the field engineers who are on assignment in the various countries in which AID programs exist.

The bureau engineers have similar functions as the central engineers except at the regional level. They advise the regional administrators and formulate specific policies and standards within overall Agency guidelines for their regions. In addition, the regional staffs usually represent specific engineering skills which are required in evaluating and dealing with the engineering aspects of the aid program.

The field engineers are assigned to the various country missions and provide engineering support to the mission director. Their general functions are to oversee the engineering aspects of the aid program as well as to provide their expertise in assisting in the preparation of project applications and facilitating the development of capital projects.

In most circumstances none of these engineers is actually involved with capital projects as operating engineers in the sense of designing or constructing projects. They primarily represent AID's interests as an agency involved in economic development through the financing of projects.

CHAPTER 2

THE CAPITAL DEVELOPMENT ASSISTANCE PROCESS

The purpose of this chapter is to provide a background for the analysis of the role of the engineer in the implementation of capital projects. The existing development process as set forth in the Manual Orders is described.

The development process as can be understood from the Manual Orders consists of six steps: project identification, preparation of application for AID assistance, review of applications, authorization of financing, financing agreement and implementation instructions, and implementation and monitoring. These six steps are illustrated in Fig. 2.

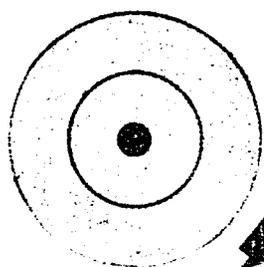
The first step, identification of activities, is to define potential projects which are likely to offer the most economical and feasible opportunities for fostering economic growth and for carrying out the AID assistance strategy. The objective is to translate broad strategy goals and plans into specific activities. While AID, in the form of the country mission, may advise and take some initiative in this step the fundamental responsibility belongs to the borrower/grantee.

Preparation of the application for AID assistance is the responsibility of the potential borrower/grantee. Guidance for preparation of the application is contained in M.O. 1232.1, 1233.1, and 1234.1 (Feasibility Study Application).

The applications are then reviewed by AID. The review of the request is divided into a preliminary review and an intensive review. The preliminary review, undertaken by the Mission or Regional Bureau, has as its purpose to determine whether the specific activity warrants commitment of resources for

EXISTING PROCESS

Project Identification



Preparation of Application



Review of Applications



Authorization of Financing



Financing Agreement and Implementation Instructions



Implementation and Monitoring



FIGURE 2
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detailed examination of its merits. This review focuses primarily on four considerations: (1) the merits of financing the proposed activity in the light of the overall US strategy in the country and the alternative activities which AID might otherwise finance; (2) the consistency of the proposed capital activity with the applicable statutory and AID policy criteria for financing capital activities; (3) the priority attached to the proposed activity by the government of the country concerned; and (4) the identification of obvious deficiencies in the content of the application.

If the preliminary review leads to the conclusion that the project merits detailed consideration, a request for intensive review is submitted to the Regional Assistant Administrator and the Capital Assistance Committee. The objective of this review is to develop specific recommendations as to whether AID will or will not finance the project. In this stage the technical, economic, and financial details of the proposed project are examined in depth. The intensive review results in submission to the Regional Assistant Administrator of a Capital Assistance Paper recommending AID financing or denial of financing. If the project is recommended, the various steps in implementation including design, preparation of proposed specifications, bid documents, and construction, are described.

The fourth step is the authorization of the financing. This decision is made by AID and is based on the Capital Assistance Paper, the feasibility study, the application, and reports from the Development Loan Committee, the National Advisory Council, and the Export-Import Bank.

The information from these sources specifies the availability of monies and whether the application and prospective capital project satisfy the statutory criteria.

The fifth step involves the capital assistance agreement and the implementation letters. The agreement and negotiations leading to it provide the legal foundation for the mutual obligations related to the agreement and during the development of the project, letters of implementation are issued. These are instructions to the borrower/grantee as to how to perform his obligations and obtain the necessary AID reviews, approvals, and lines of credit.

The final step is the implementation and monitoring. The actual implementation of the project is primarily the responsibility of the host country. There is AID surveillance to determine that the physical and financial progress is consistent with plans, schedules, and arrangements made to carry out the project, that the project is proceeding with due diligence and efficiency in conformity with sound engineering, management, and financial practices, and that the implementation is being carried on in compliance with the terms of the Capital Assistance Agreement and subsidiary undertakings.

Based upon interviews with members of the regional engineering staffs and loan staffs, there is the impression that the development process as executed is based only partially on the Manual Orders. The reason is that many things are not explicitly included in these guidelines and in other cases they simply are not clear. For example, the relationship between the feasibility study and the capital project and the various reviews described above is not clearly defined. Apparently the application and review procedure precedes financing of both the feasibility

study and the project with the requirement that a feasibility study be completed before money can be committed for the project.

CHAPTER 3
ENGINEERING INPUTS

The purpose of this chapter is to discuss the engineering inputs required for the Capital Development Assistance Process described in Chapter 2. The inputs described in the various Manual Orders are presented and inconsistencies highlighted.

The basic approach to AID activities in the engineering and construction area and the base for detailed procedure and activity guidelines are contained in Manual Order 1221.1 Capital Projects: Engineering and Construction Considerations. M.O. 1221.1 is inconsistent with other AID documentation in that it does not relate the engineering activities to the capital projects process described in M.O. 1201.1 and outlined in Chapter 2 of this report. Instead it states that consideration of engineering requirements is divided into two phases, (1) the preliminary planning and feasibility study phase, and (2) the project execution phase. It then immediately adds that the feasibility study is a fundamental document in the project approval process. It is, however, unspecific as to how these two phases are related to the six phases discussed in the other Manual Orders. As best as can be ascertained the preliminary planning and feasibility study stage described in M.O. 1221.1 begins with the Identification of Activities and runs to or through Authorization of Financing. At any rate, the remainder of this chapter presents those engineering inputs required by the M.O.'s for the Project Identification, Preparation of Application, Review of Application, Authorization for Financing, Financing Agreement and Implementation Instructions, and Implementation and Monitoring phases of the Capital Development Assistance Process.

PROJECT IDENTIFICATION

None of the AID documents relative to the capital assistance process deal specifically with engineering activities in the project identification phase. Reference is, however, made to the statutory requirement that projects must be economically and technically sound and to the Guide to Engineering, Management and Technical Consideration Section of the M.O.'s where the required contents of a capital assistance application are cross referenced. These references, however, cover the complete analysis required to determine whether a project is to be financed. They thus involve engineering activities which are clearly inappropriate to the project identification phase of the process and which obviously are not undertaken at this stage. It appears that the engineering inputs at this stage of the process are limited solely to rough judgments as to whether there are obvious technical problems associated with a project which are likely to make it inappropriate for undertaking.

PREPARATION OF APPLICATION

Far more documentation is available to provide guidance for this phase of the process. Three M.O.'s deal with the application for AID assistance in connection with capital projects and two M.O.'s cover the detailed informational content of the application. The former is discussed first.

Application For AID Assistance

M.O. 1231.1, Capital Assistance: Preparation of Applications, refers to M.O. 1221.1, Engineering and Construction Considerations, and M.O. 1221.2 Feasibility Study Manual, as containing the instructions for the detailed information required to be contained in applications. The M.O. then specifies that responsibility for preparation of capital assistance applications rests

with the borrower/grantee and that AID assistance should normally be limited to advice and guidance on the planning and content of applications. The possibility of AID participation in the actual drafting of or other tasks in connection with the application is, however, recognized. Beyond this it does not discuss engineering inputs.

M.O. 1232.1, Capital Projects Applications, contains a check list and discussion of matters expected to be covered in an application. It requires that a feasibility study accompany an application and, like M.O. 1231.1, refers to the Feasibility Study Manual as containing a detailed statement of requirements for an application. It adds nothing specific to the Manual and, at least insofar as engineering requirements are concerned, only repeats the general statements contained in the Manual.

M.O. 1234.1, Capital Assistance: Feasibility Study Application, outlines the information required to be included in applications for feasibility studies. This includes a short summary of the project in terms of nature, size, location, estimated cost, and present status; a short description of prior studies; and a discussion of the relation of the project to the economic development of the country. Also required is a "description of the procedures proposed to be used for selection of and contracting with engineering firms to be employed to make the study" (underscoring supplied).

Informational Content of Application for AID Assistance

Manual Order 1221.1 Engineering and Construction Considerations states that the feasibility study is a fundamental document in the project approval process. This M.O. further states that the purpose of the feasibility study is to demonstrate the economic and technical soundness of the project and to provide the basis for a reasonably firm estimate of the cost. These

findings are related to the provision of section 611 of the Foreign Assistance Act which requires that engineering, financial, and other plans necessary to carry out the project and a reasonably firm estimate of cost shall be completed before a loan or grant agreement is made. This section, and also the 1963 Foreign Aid Appropriations Act, requires that plans for projects involving the development of water and related land resources must meet the standards and criteria set forth in the statement of "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources," approved by memorandum of the President dated May 15, 1962, and published as Senate Document No. 97.

The M.O. further provides that to meet these requirements, feasibility studies should contain:

1. Engineering plans which include:
 - a. Preliminary investigations and surveys sufficient to identify all significant technical problems, establish the location of the project, and fix those general criteria and standards of construction which will have a major effect on the final cost;
 - b. Justification for the specific location, criteria and standards recommended, as compared with available alternatives;
 - c. Preliminary designs, in sufficient detail to permit a reasonably accurate estimate of work quantities;
 - d. An analysis of the construction operations in sufficient detail to provide a sound basis for the cost estimate.
2. A cost estimate, based on preliminary design, carried only to the point necessary to assure that all factors significant to the total cost of the project have been taken into account.

3. Benefit-cost evaluations for hydroelectric power, agriculture and irrigation, port development, and water and sewerage projects.

Finally, the M.O. provides that project proposals should include specific plans for project implementation covering such items as provision of professional services for detailed design, procurement, construction, and initial operation, and time scheduling.

M.O. 1221.2, Feasibility Studies, Economic and Technical Soundness Analysis, Capital Projects (referred to as The Feasibility Studies Manual), lays down the basic guidelines for the content and conduct of feasibility studies. The purpose of analysis made possible by the feasibility study is stated to be to permit "an evaluation, based on the integrated results of engineering, financial, economic, and other studies, of the advisability of undertaking the project." It is stated as being designed to permit a clear cut exposition as to why, "as far as technical soundness and the economic benefits and costs are covered," the project is sound.

This Manual Order, like M.O. 1221.1, relates the feasibility study to the statutory requirements for a finding that a project is economically and technically sound; for the completion of engineering, financial, and other plans necessary to carry out the assistance; and for a reasonably firm estimate of the cost to the U.S. of the assistance before a commitment to finance a project is made.

After laying this base the manual then deals with criteria for determining soundness and the information required for making the necessary determinations.

With respect to technical soundness it provides that a project will be considered technically sound if: (a) all pertinent technical aspects of

the project have been taken into account in the analysis; (b) the planned construction or procurement conform to accepted engineering standards and practice; and (c) the estimated cost of the project is as low as any other reasonably available alternate which would produce the intended results.

With respect to the requirement for completed plans, the manual provides that with respect to engineering plans there should be provided:

1. Preliminary investigations and surveys sufficient to identify all significant technical problems, establish the location, and fix those general criteria and standards of construction which will have a major effect on the final cost.
2. A justification for the specific location, criteria and standards recommended, as compared with available alternatives.
3. Preliminary designs in sufficient detail to permit a reasonably accurate estimate of work quantities.
4. An analysis of the construction operations in sufficient detail to provide a sound basis for the cost-estimate.

The manual then lists the subjects on which information must be submitted and which must be analyzed for all types of projects. Insofar as the engineering aspects are concerned, these include the following:

1. Present Status of the Project (if applicable). The present status of investigations, surveys, borings, engineering design, extent to which construction contracts have been awarded (documented by tabulations and evaluations of principal bids thus far received), whether such awards were based on international bidding, and the progress of physical construction to date.

2. Construction and Funding Schedules. Planned construction schedule, broken down by major items of the project, in the form of a bar chart,

with explanations. Schedule of anticipated expenditures in foreign and local currencies. (Procurement and delivery schedules for equipment should be included, or shown in a supplement.)

3. Engineering Services. Plan for obtaining necessary engineering services for final design, preparation of specifications, preparation of contract documents, evaluating bids, awarding contracts and supervising construction, including expediting, inspecting, and testing and reporting. Include mention of any special consultants, and responsibilities to be assigned to them.

4. Procurement of Non-Local Items. Planned procurement of major items of materials, supplies and equipment, recognizing current U.S. restrictions on source.

5. Construction. Plan for performance to carry out the project, particularly as to: work to be done and materials and equipment to be supplied by Applicant; work to be done by equipment suppliers; work to be done by construction contractors and type of contract; proposed methods of obtaining bids and awarding contracts; provision for bond for satisfactory performance; availability of technical, skilled and unskilled construction labor; availability of competent local subcontractors; local laws and regulations pertaining to import duties on personal property of contractors' personnel, personal income taxes, security requirements, visas, etc.; laws and regulations pertaining to contractors' payments, local taxes on contractors' operations and earnings, and transfer of dollar earnings to U.S.

After listing the requirements for all projects the manual then prescribes special requirements for particular type projects, i.e., industrial, electric power, agriculture and irrigation, mining and extraction, port development or storage, aviation ground facility, telecommunications, highway,

municipal street and storm sewer, municipal water and sewerage, railroad, and school or hospital projects. The special engineering requirements set forth for industrial projects are typical of the type of requirements set up for all projects and are included here as an illustrative example:

ENGINEERING ASPECTS AND TECHNICAL SOUNDNESS

A. Design

- Plant layout including storage for raw materials and finished products and provision for possible expansion.
- Tie-in with transportation systems.
- Types and size of major installed equipment items and structures, and justification of the selection of units and processes.
(Avoid both obsolescent and experimental technology.)
- Function performed by each major unit.
- Process flow sheet.
- Auxiliary capital equipment (standby, spare parts, transport, materials handling, etc.).
- Patents and licenses involved.
- Planned capacity and build-up of output after start-up.
- Estimated output as percentage of plant capacity for each of first five years of operation.
- Anticipated use of consultants on special phases of final project design.

B. Utilities Available or to be Provided

- Requirements, source, availability, cost and reliability of all utilities. Pertinent data on each system, and reason for selection of source in each case, including comparison of advantage of purchasing against in-plant production.
- Power requirement in peak KW demand and annual KWH consumption, initial and future.
- Electrical system shown by single line diagram covering major power uses.
- Fuel for heat, steam and plant processes.
- Water balance of the plant where applicable. Problems relative to water treatment, disposal of effluents (liquid and gaseous), including any which may be noxious or dangerous.
- Transportation facilities for raw materials and finished products.

C. Materials for Use in Manufacturing Processes

- Quantity, specifications, source and availability of raw and semi-finished materials.
- Proven reserves in case of minerals.
- If semiprocessed materials are to be obtained from another plant, evaluate the technical and economic soundness of such plant.

Estimated costs, possible cost variations, custom duties, any preliminary agreements on price and delivery and details of any contracts entered into for supplies and major raw materials.

Available facilities for handling and storing.

D. Plans and Specifications

Preliminary plans for all construction work in sufficient detail to permit calculation of work quantities.

Outline specifications for equipment and construction defining particularly those standards of quality which will have a significant effect on the cost of construction, with specific justification for any unusual standards adopted to conform with local conditions.

E. Construction Labor, Materials and Equipment

Manpower requirements and availability, including skilled and unskilled labor, and technical and supervisory personnel.

Local availability of cement, steel, aggregates, water for concrete, building stone, lumber and other construction materials.

Types of construction equipment required for the work, indicating what is available locally and what must be imported.

F. Special Construction Problems Foreseen

Climatic conditions, especially time and length of wet and dry seasons as they affect construction schedule and equipment use.

Necessity of keeping an existing plant in service.

Time required to obtain delivery of imported materials and equipment.

G. Plan for Execution of Project

General construction plan.

Proposed methods of contracting for engineering, construction, and construction supervision (see Chapter I).

Tests to be performed on completed plant.

Equipment guarantees to be required.

Engineering and construction schedules (attached).

H. Operating Organization and Quality of Management

Description of organization which will manage the business and supervise its operation accompanied by organization chart, present and projected.

Required number and qualifications of management and technical employees.

Experience records of available key management and technical personnel.

Number, qualifications and availability of required operating employees.

Plans for recruiting and training.

Provisions for competent management and maintenance throughout the life of the proposed loan.

I. Overall Technical Soundness

Justification of selection of location for project.
Proven reliability of plant processes and equipment.
Superiority of adopted processes.
Analysis of any adverse factors and measures to overcome them.
Assurance that plant described will produce the quantity and quality
of products specified, on a continuing and dependable basis.

Finally, the manual includes a number of annexes which establish further guidelines for the submission of information.

REVIEW OF APPLICATIONS

The criteria for both a preliminary and an intensive review of capital assistance applications is established in M.O.'s 1241.1 and 1241.2. The preliminary review is directed toward determining whether the project warrants further detailed analysis with a view to financing or should be rejected without further study. It is also directed toward identifying the deficiencies in the application. It is not intended that the review include detailed analysis of the economic, technical and financial data contained in the application which is required to be accompanied by a feasibility study. There is no specific reference in the M.O.'s to engineering inputs. By inference, review would include a general examination for engineering problems or deficiencies.

In the intensive review phase engineering analysis, based on the considerations outlined in M.O. 1221.1, includes:

Identification of the items to be financed.

Examination of possible technical difficulties.

Evaluation of the completeness of feasibility studies.

Determination of method of costing and appraisal of the reliability of cost estimates.

Site selection.

Assessment of availability of raw materials, supplies, transportation and power.

Adequacy of relevant supply contracts.

Availability of labor.

Based on this analysis a conclusion is reached as to the technical feasibility of the project.

The intensive review phase includes preparation of the capital assistance paper which serves as the vehicle for a decision to finance or not to finance the project. The engineer assigned to the project committee is responsible for preparation of a section of the paper dealing with the engineering considerations outlined in the preceding paragraph. The paper must also include a plan which outlines (1) the anticipated engineering, construction, and other procurement arrangements; (2) the division of implementing actions as between the said recipient and AID; (3) engineering and construction schedules; and (4) a schedule for meeting conditions precedent to disbursement.

AUTHORIZATION OF FINANCING

The formal authorization of financing is based on all the analysis performed during the previous stages and no additional engineering activities are involved in it.

FINANCING AGREEMENT AND IMPLEMENTATION INSTRUCTIONS

The financing agreement normally sets up certain conditions which must be met before disbursements will be made by AID. These usually include

(1) a requirement that before the first disbursement is made, AID must have approved a contract for necessary engineering and other consulting services; and (2) a requirement that before disbursements are made for other than engineering and other consulting services AID must have been provided with and must have approved (a) final plans, specifications, construction contract bid documents, cost estimates, and specific schedules for carrying out the project; and (b) an executed construction contract.

The implementation letter which should accompany the financing agreement gives specific instructions to the AID recipient as to the implementing actions listed below and as to requirements for AID review and approval:

- a. Provision of consulting engineering services.
- b. Preparation of detailed plans and specifications.
- c. Preparation of bid documents.
- d. Arrangements for construction.
- e. Master lists of equipment and materials required.
- f. A time phased plan for development and/or construction of any required ancillary facilities.
- g. Working plans and schedules.
- h. Progress reporting.

IMPLEMENTATION AND MONITORING

The Manual Orders provide five minimum AID steps which require engineering activity:

- a. Approval of proposed engineering firm and contracts for engineering and other professional services.
- b. Approval of bid documents, plans, and specifications.
- c. Approval of construction contract award

- d. Review of progress reports.
- e. Site inspection.

The steps required in the procurement of engineering and other professional services are stated to be (1) publication of notice; (2) pre-selection of firms; (3) preparation of request for proposal and solicitation of proposal; (4) selection of AE contractor; and (5) negotiation and execution of the contract. The AID Capital Projects Guidelines establish criteria for approval of the firms providing engineering services which relate to the experience of the firm and the personnel proposed to be assigned to the work. Information required to be submitted for AID approval of contracts includes a detailed breakdown of the cost and a statement of the qualifications of key personnel.

The steps involved in the procurement of construction service and major equipments are stated as including (1) publication of synopsis; (2) pre-qualification of bidders; (3) issuance of bid invitations; (4) selection of contractor; and (5) execution of the contract. It is stated that the bid submission must break the project down into appropriate components with a costing of each. In the review of plans, drawings and specifications, AID is concerned to insure their consistency with project requirements, the appropriateness of the level of design, their completeness and that they are so drawn as to permit maximum competition among eligible firms. While the instructions to the AID recipient as to information required to be submitted for review of proposed awards and of the actual contracts are laid down, there is no statement of the purpose of the AID review other than to state that the contract must contain certain provisions and be "otherwise satisfactory to AID."

A fairly extensive system of progress reporting is established which requires periodic reports on engineering, construction, and/or procurement and financial progress. A final completion report is also required which is designed to include a listing of the project, explanations of significant delays in completion and of increases in cost during implementation, and comparison of actual completed cost with estimated costs. (Analysis of these should be a function of the AID engineers.)

Site inspection by AID engineers are also conducted from time to time. These are performed to satisfy the AID engineer that the project is conforming to accepted engineering standards and specifications.

The Capital Assistance Committee has the responsibility for verifying that the agreed upon conditions precedent have been fulfilled. Responsibility for the actual monitoring of project implementation is not clearly assigned to individuals of either AID/W or the missions (M.O. 1264.1).

The existing process is summarized in Table 1.

Table 1

EXISTING PROCESS

Step	Purpose	Major Responsibilities	Information Required	Results
1. Project Identification	To identify a specific project for financing by AID, e.g., a housing development at a particular site in the country	Host Country		
2. Preparation of Application	To prepare the financing application and attendant documents for submission to AID	Host Country	Instructions on filing application	Loan/Grant Application
3. Review of Application	To review application in context of other assistance programs and with respect to other sources of financing	AID		Recommendation on financing to the Administrator Capital Assistance Paper
4. Authorization	To authorize loan or grant for capital project	AID	Application Feasibility Study Recommendation on Financing Capital Assistance Paper	Decision (not) to finance entire capital project from design through construction
5. Financing Agreement and Implementation Instructions	To establish the legal basis for AID financing and the related obligations of the host country	AID and Host Country	Authorization	Loan/Grant Agreement Implementation Letters
6. Implementation and Monitoring	To develop the project through completion including design and construction; to assure consistency of work with agreements and implementation instructions	AID and Host Country A/E Contractor Construction Contractor	Loan/Grant Agreement Implementation Letters	Completed Project

CHAPTER 4

DEFICIENCIES IN PRESENT SYSTEM

The purpose of this chapter is to present the significant deficiencies found in the existing process for the development of capital projects.

Analysis suggests these significant deficiencies are: (1) inadequacies within the M.O.'s; (2) making the loan too early in the process; (3) making a reasonably firm estimate of cost too early in the process; (4) requiring a heavy engineering effort too early in the process; (5) lack of definition of inputs required and of the time and way in which AID should become involved in the project identification step; (6) lack of a method for assuring that project implementation reports are analyzed and any needed remedial action taken in a timely manner; (7) lack of an evaluation step in the process; and (8) lack of a logical and sequential structuring of the decisions required in the process.

Inadequacies of the M.O.'s include too much fragmentation, cross referencing, and moving back and forth from one to another; great specificity as to what information the applicant for aid is required to submit but lack of specificity as to exactly how AID is to use it; and dealing with the process as one of "review of applications" rather than one of project development.

Making the loan before selection of an A&E, final design, and preparation of specifications results in a very long pipeline. These activities are time consuming because of the many variables involved and thus the obligated funds are tied up for years while details are being worked out.

Attempting to make a reasonably firm estimate of cost before final design and preparation of the specifications results in a wide variation between estimated and contract costs. In addition, this early decision to determine costs results in an inadequate basis for findings as to economic feasibility.

The heavy engineering effort required early in the process is a result of the current philosophy of performing a feasibility study to determine economic and technical soundness. For example, a typical feasibility study requires:

- (a) Development of a detailed implementation plan including engineering and construction schedules.

- Methods for contracting for engineering, construction and construction supervision services.

- Equipment guarantees required and tests to be performed on completion.

- Management, organization, and personnel for operations of the project.

- (b) Engineering and technical inputs including:

- Plant layout.

- Selection of types and signs of major equipment and structures and processes.

- Process flow sheets.

- Patents and licenses.

- Diagram of electrical system.

- Calculation of construction work quantities.

- (c) Proof of reliability of plant, process, and equipment before a judgment has been made or concurrent with efforts to make a judgment as to the limits of cost within which a project would be economically justified.

This results in the requirement for too much engineering too early in the process with consequent excess expenditure for required studies and probably frequent selection of an inappropriate type of firm for conduct of the study.

With respect to the specific steps of the existing process, there are at least three deficiencies. First, there is an unclear definition of the responsibility of AID in project identification. For example, the point at which the feasibility study should be performed and the scope of this study appear according to some MOs to be required as part of the project identification step; other references assert only that this study must be completed prior to the financing decision.

Second, during implementation there is no procedure to assure that project implementation reports are analyzed. When these reports are not analyzed, corrective measures which may be required may go unrecognized. Control by AID over the completion of the project is therefore reduced.

Third, there is no evaluation step which follows the completion of construction. This implies that there is no formal procedure to evaluate the results of an executed project against premises upon which the project was originally initiated.

Although many of the deficiencies noted above could be corrected by a re-writing of the Manual Orders, the solution to the final deficiency (8)

requires a new approach. The key elements in lack of logical structuring and order of decisions is to attempt to arrive at a reasonably firm estimate of cost before final design, plans, and specifications have been prepared and then attempting to decide whether a project with a given cost is economic rather than trying to determine the limits of cost within which a project would be economic and whether any projects can be developed within such limits. In addition, this lack of logical structuring and order of decisions compounds the problem of relating the specified information and analysis to the particular decision.

CHAPTER 5

ALTERNATIVE PROCESS

It has not been possible within the limits of effort of this study to develop an alternative system in detail. However, the subsequent sections outline a possible alternative approach which might be studied in detail and make some recommendations for improvement in the present system.

LOGICAL PROCESS

The process of capital project development and implementation seems logically to consist of the following 6 phases: (1) identification of activity possibilities; (2) project definition; (3) project design and planning; (4) final review for financing; (5) project implementation; and (6) project evaluation. The actual process is not, of course, quite so sharply divisible and some phases tend to merge. Nonetheless, the division of the process into its logical steps is useful for analytical purposes and provides a basis for phasing of inputs specifically related to decisions required to be made and for economy of effort. These six steps are illustrated in Figure 3.

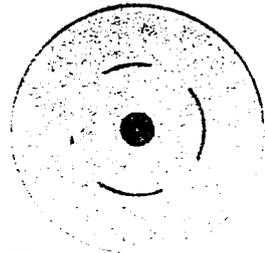
IDENTIFICATION OF ACTIVITY POSSIBILITIES

The task at this early stage of the process is that of identifying the activities most likely to offer economical and feasible opportunities for fostering economic growth and for carrying out the AID assistance strategy. The purpose is to select possible projects which appear to merit examination in depth. This task and purpose does not require any formal findings of economic or technical feasibility, a plan for implementation, or a reasonably firm estimate of cost. Instead, they require only the judgment that the likelihood of a project being developed which is

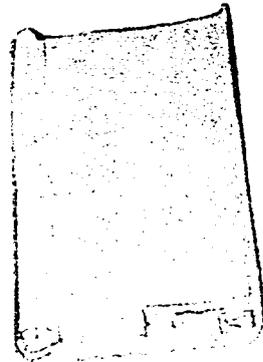
ALTERNATIVE PROCESS



Identification
of Activity
Possibilities



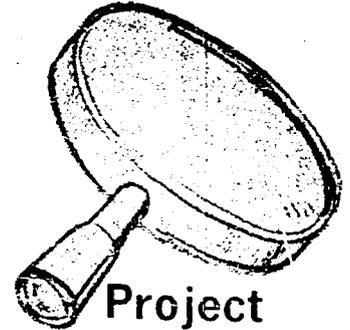
Project
Definition



Project
Design &
Planning



Final Review
For Financing



Project
Evaluation

Project
Implementation



FIGURE 3

economically and technically feasible and within a country's capability to bring into being and operate (with such help as may be appropriate) is great enough to warrant detailed investigation of the facts.

Facts necessary to support such a judgment seem to be of the following kinds:

Nature of the economy and its resources and where its comparative advantages seem to lie.

General demand and supply situation for product.

General technological situation and state of the art.

General knowledge of size of operation required for economical operation.

General knowledge of ranges of costs for particular types of projects.

Knowledge of special situations likely to raise serious technical problems.

Probably judgments on whether technical problems are likely to be insurmountable can be made by a competent engineer with knowledge of the country on the basis of a description of the project which identifies its purpose and product, its proposed size and capacity, and where it is to be located.

The same kinds of judgments are possible on the economic side by competent and knowledgeable economists based on the country plan, sector studies, or knowledge of the economy and the type of project being considered.

Such an examination should probably constitute the "preliminary review" which should not require the submission of an application for anything except the financing of the next stage of examination. The submission of a feasibility study should not be required in this preliminary review stage.

PROJECT DEFINITION

When possible projects of promise have been identified the next question to be addressed is probably not "Is the particular project economically and technically sound?" but instead "What are the parameters and bounds of a project which would be justified?" The job then is one of laying out the parameters and developing the outlines within those parameters of a project which would be economically and technically feasible. The study to be conducted should therefore be designed not to determine whether a project is feasible but instead to permit a reasonably firm judgment as to whether a project which is economically and technically feasible can be developed to serve the purposes intended. Such a study should be designed to:

(1) Develop a clear, specific, and unequivocal and operationally significant statement of the purposes of the project (e.g., perhaps to provide a means for moving goods and people between points rather than the building of a road from A to B).

(2) Determine the limits of costs within which a project would be economically sound.

(3) Consider alternative means for accomplishment of the purposes.

(4) Identify any unusual technical problems likely to be encountered in any of the means of accomplishment of the purposes.

(5) Provide order of magnitude cost estimates, based on standards, rules of thumb, past experience with similar projects, etc. of the various alternatives.

(6) Determine economically feasible alternative, if any.

At this stage for logical, practical, and legal reasons the project being financed should be defined as the study not as the undertaking which will be designed to accomplish the ultimate purpose. Thus there would be no necessity for full determinations at this stage as to the ultimate project.

Based on such a study, decision could be made as to whether to proceed with detailed design, preparation of specifications, and development of a detailed implementation plan for a specific project.

Engineering inputs at this stage should not be beyond (I) of M.O. 1221.1 but including consideration of the present status of the project (if applicable); the planned capacity and anticipated output over time; the tie-in with transportation systems; requirements for and the source, availability, costs and reliability of utilities, raw materials, construction materials, and manpower; preliminary operating and organizational plans; and a plan for obtaining the engineering services required in the design and planning stage. They would not include construction and funding schedules or construction plans.

AID engineering review would then be directed to making a judgment as to whether the project as defined is likely to encounter insurmountable technical problems and whether it is likely to be able to be accomplished at a cost which is within the limits of economic feasibility.

During this phase, AID would prepare the general project description dealing with the availability of materials, labor, transportation, etc. On the basis of this a decision would be made as to whether to proceed to financing of detailed design, engineering, and planning.

PROJECT DESIGN AND PLANNING

Given a finding that the project as defined is likely to be capable of accomplishment within the limits of economic feasibility, the next stage in the process becomes that of detailed design and final engineering of the project, preparation of specifications, and development of a specific plan of implementation. Based on these, AID can make a reasonably firm estimate

of cost and the required findings as to economic and technical feasibility and as to the existence of requisite plans for implementation. [A question arises at this point as to whether this stage should extend to preparation of bid documents and actual receipt of bids as the best way of arriving at a firm estimate of cost. The logic of the situation seems to be that a finding of economic and technical feasibility should be made before the project goes to bid. On the other hand bid prices have so frequently exceeded estimates, even those based on final plans, as to suggest that actual bids may be required. Probably in practice the point of finding should vary from case to case depending on the confidence in the estimate which might vary by country, type of project, etc.]

At this stage the engineering inputs should consist of those outlined in detail in the M.O.'s that define the preparation of a construction plan and the completion of funding schedules. This would involve selection of the A&E firm which would be responsible for these activities and for preparation of bid documents, evaluation of bids and construction supervision.

FINAL REVIEW FOR FINANCING

This stage should consist of the AID review required to make all the revisions necessary to the required findings, the making of the findings, the preparation of the implementation letters and the financing agreement, completion of the Capital Assistance Paper, determination of the amount and specific terms of assistance, and final approval of financing. The phasing of activities as suggested would eliminate many of the engineering type conditions in loan agreements.

PROJECT IMPLEMENTATION

This phase should include preparation of bid documents, receipt and evaluation of bids, award of the construction contract, and actual construction.

The AID activities should consist of the necessary reviews and the monitoring of construction. The detailed breakdown of cost of bid submission and construction contract (M.O. 1442.2) probably serves little useful purpose.

PROJECT EVALUATION

Upon completion of a project there should be an analysis of the experience with the project based on a completion report such as that contemplated by the M.O.'s. Central engineering should be given responsibility for the analysis of that report and on the basis of such analysis should be able to develop standards and guidelines for engineering inputs and reviews related to actual accumulated experience. In addition there should be provision for reporting over some period of time the actual operating results and the direct and indirect benefits accrued to permit both comparison of anticipated and actual results and accumulation of data which would permit development of greater knowledge of how various projects contribute to development. This latter information should be supplied to the Program Coordination Office. This alternative process is summarized in Table 2.

Table 2
ALTERNATIVE PROCESS

Step	Purpose	Major Responsibilities	Information Required	Results
1. Identification of Activity Possibilities	To identify the activities most likely to offer economical and feasible opportunities for fostering economic growth	Host Country and AID		Preliminary Review Activity Possibilities
2. Project Definition	To lay out parameters and develop the outlines of a project within those parameters which would be economically and technically sound	Host Country and AID	Application for Project Definition Study Activity Possibilities	Project Definition
3. Project Design and Planning	To prepare detailed design and final engineering of project, prepare specifications, and develop a specific plan of implementation To make firm estimate of cost and determine economic and technical feasibility	Host Country AID	Application for Design Study Project Definition	Bid Package Application for Capital Project Feasibility Study Recommendation on financing to the Administrator
4. Final Review for Financing	To complete all findings, prepare financing agreement and implementation letters and to make final approval of financing	AID	Recommendation Application	Decision (not) to finance construction

Table 2, (Continued)

Step	Purpose	Major Responsibilities	Information Required	Results
5. Project Implementation	To prepare bid documents, award construction contracts, and conduct actual construction	Host Country	Loan/Grant Agreement Implementation Letters	Completed Project
	To approve bid documents and contract awards	AID		
6. Project Evaluation	To evaluate the experience with the development of the project and to evaluate the operating results over some period of time	AID	Completed operating project	Evaluation Reports

04

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B. LIST OF INTERVIEWEES

1. Kenneth F. Vernon - Director, Office of Engineering
2. Frank DiMatteo - Construction, Office of Engineering
3. Jerome I. Levinson - Deputy Director, Bureau for Latin America
4. Frank B. Kimball - South America Lending Division, Bureau for
Latin America
5. Karl O. Kohler - Engineering Division, Bureau for Latin America

6. Theodore H. Lustig - Director, Office of Capital Development
and Finance, Bureau for Near East and
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7. John G. Lightfoot - Engineering, Bureau for Near East and
South Asia
8. Miles G. Wedeman - Director, Office of Capital Development and
Finance, Bureau for Africa
9. Dan F. Miller - Engineering Division, Bureau for Africa
10. Selig A. Taubenblatt - Director, Office of Capital Development
and Finance, Bureau for East Asia
11. Bruce Johnson - Director, Engineering Staff, Bureau for East Asia
12. Edwin R. Kinnear - Deputy Director, Engineering Staff, Bureau for
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