Canada

PROJECT MANAGEMENT HANDBOOK

INFORMATION SYSTEMS MANAGEMENT

Regional Economic Expansion

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/Canada.

DEPARTMENT OF REGIONAL ECONOMIC EXPANSION

SYSTEMS DEVELOPMENT LIFE CYCLE METHODOLOGY

PROJECT MANAGEMENT HANDBOOK

OCTOBER, 1981

I N D E X

NOTE: It is recognized that all roles referred to throughout this document will be filled by persons of either sex. However, to maintain readability, personel pronouns of the male gender are used.

He should be read as he/she.

His should be read as his/hers.

Him should be read as him/her.

SYSTEMS DEVELOPMENT LIFE CYCLE METHODOLOGY
PROJECT MANAGEMENT HANDBOOK

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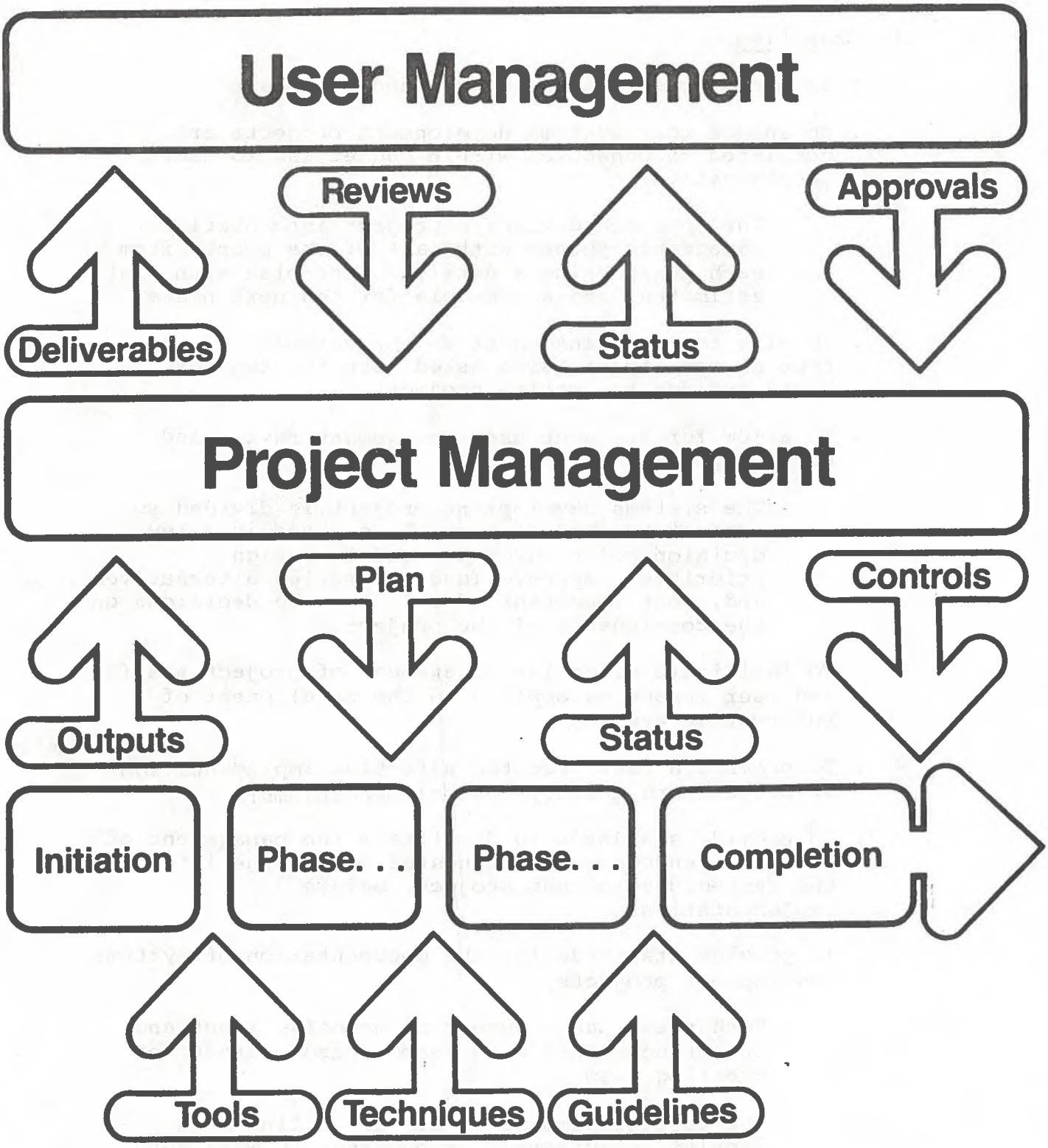
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1. INTRODUCTION

1.1 Objectives

This manual provides techniques and methods:

- To ensure that systems development projects are completed on schedule, within budget and to user specification;

  The approach divides a project into distinct, manageable phases with part of the output from each phase being a detailed work plan with cost estimates, and a schedule for the next phase.

- To give to user management an appreciation of the type of commitment being asked both for the next phase and for the entire project;

- To allow for frequent user management review and control points;

  The systems development project is divided so that at the end of each phase there is a key decision point which is used to assign priorities, approve funding, review alternatives and, most important of all, to make decisions on the continuance of the project.

- To facilitate effective management of project staff and user resources applied to the development of information systems;

- To provide a basis for the effective implementation of project and quality control mechanisms;

- To provide standards to facilitate the management of change, when change is requested during the life of the system development project, before implementation;

- To provide standards for the documentation of systems development projects;

  Each phase has a number of specific input and output documents with recommended methods for creating them.

  The process commences with an outline of a problem, requirement or opportunity with very broad time, people and cost estimates which become more detailed and more accurate as each phase is completed.

1.2 Overview

In order to effectively monitor and control information systems development projects, DREE has introduced a standardized approach for study, analysis, design, development and implementation. This approach describes project plans, activities and outputs, and identifies review points where senior user management decisions are required. To support this standardized approach DREE is providing a set of manuals which describes the activities, deliverables, review points and roles in the system development life cycle. This set of manuals is comprised of a Project Management Handbook which describes the project management role and all the components of a project life cycle. This essentially describes the "what" of a project and provides techniques on "how" to successfully manage it. It forms the umbrella to the other manuals, which are:

- Analysis Guide
- Design Guide
- Programming Guide
- User's Guide
- Deliverables Reference Manual.

These manuals describe "how" to successfully carry out each role within the project management framework.

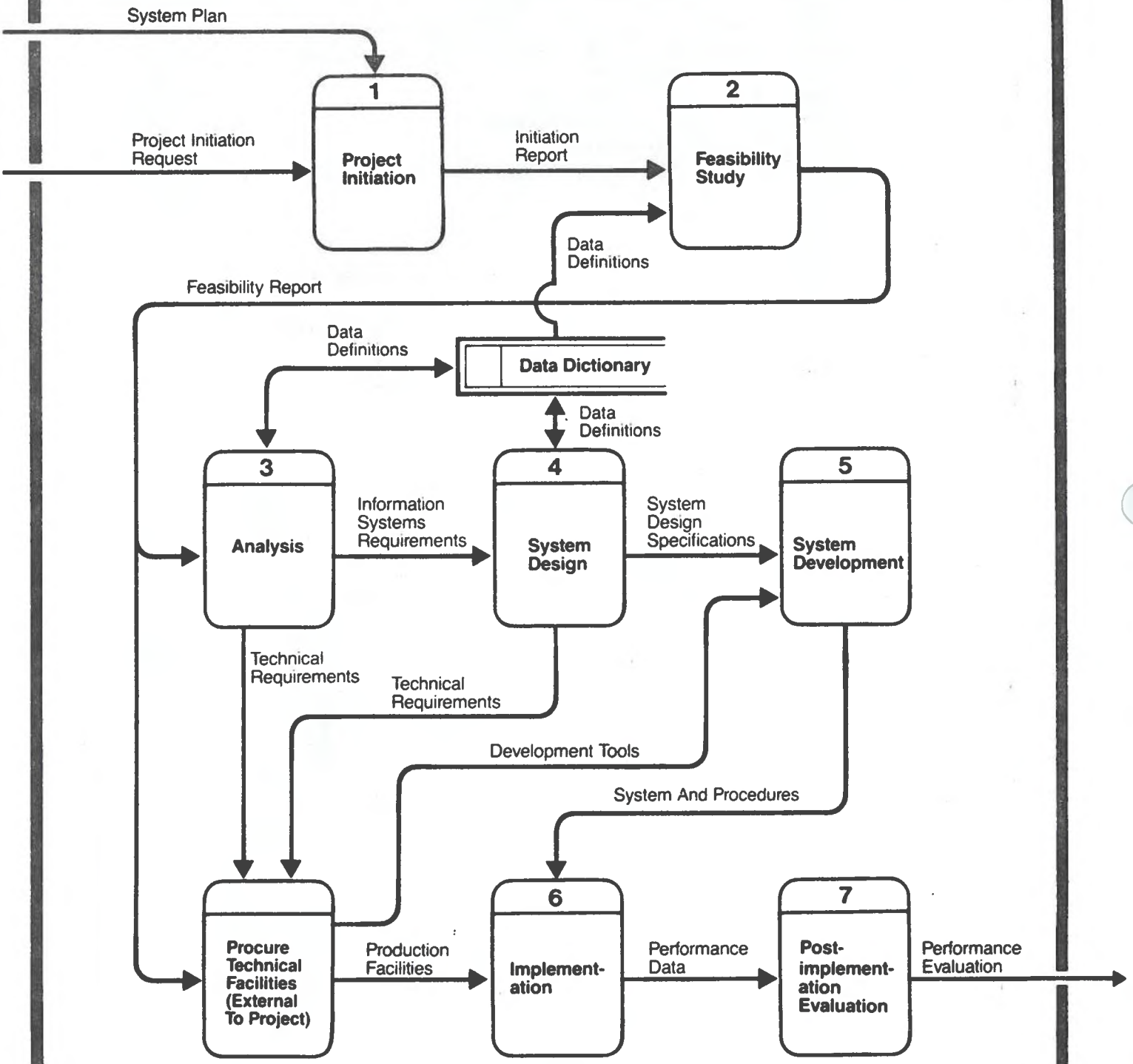
1.3 Scope

While this methodology is equally applicable to any information system whether it be a business or a technical system and automated or manual, its orientation beginning with the Systems Design phase, is unavoidably towards computer applications. In view of this, it is important that when system solutions are conceived both the status quo and manual systems be considered on an equal basis with automated systems.

Ideally this methodology should be used in the context of DREE's overall departmental systems planning process. Thus, this methodology has been developed with the assumption that a proposed systems development project will be evaluated in relation to the Department's Long Range Systems plan, which will make it possible to priorize systems development projects. It is also assumed that for significant projects, regular status information will be fed into the monitoring process of the Department's systems plan.

SECTION 2
SYSTEM DEVELOPMENT LIFE CYCLE

Systems Development Life Cycle



2. SYSTEM DEVELOPMENT LIFE CYCLE

2.1 Overview

The structured approach described in this handbook divides an information systems development project into seven distinct phases which are followed sequentially. Each phase has key decision points and sign-offs. This permits an ordered evaluation of the problem to be solved, an ordered design and development process and an ordered implementation of the solution. The seven phases are as follows:

1. PROJECT INITIATION
2. FEASIBILITY STUDY
3. ANALYSIS
4. SYSTEMS DESIGN
5. SYSTEMS DEVELOPMENT
6. IMPLEMENTATION
7. POST-IMPLEMENTATION EVALUATION

The data flow diagram on the preceding page provides a representation of the approach and the following pages provide a summary of the project activities and deliverables for each phase.

PHASE SUMMARIES

PHASE	ACTIVITIES	DELIVERABLES . Principal Components
1. Initiation	Screen Requests Document Details Planning Approval	Initiation Report . Initial Problem Definition . Proposed Approach . Feasibility Study Plan . Project Responsibilities
2. Feasibility Study	Data Gathering Analysis of Data Development of Alternative Solutions Evaluation of Alternative Solutions Conceptual Design of Proposed System Planning Preparation of Feasibility Report	Feasibility Report . Description of Business Processes . Evaluation of Existing System . User Requirements . Solution Alternatives . Conceptual Design . Cost/Benefit Analysis . Project Plan . Recommendations . Analysis phase Plan
3. Analysis	Data Gathering Analysis of Data Integration of Requirements within Departmental Framework Packaging of Requirements Quality Assurance Define Performance and Security Goals User Validation of Specifications Planning Approval	Information Systems Requirements . Revised Cost/Benefit Analysis . Functional Specifications . Performance and Security Goals . Technical Requirements . Revised Project Plan . Design phase Plan
4. System Design	Divide into Sub-system components Design Sub-system structure Design Detailed Components Design User Aids Design System Test Design Conversion Procedures Packaging of Systems Design Planning Approval	System Design Specifications . Revised Cost/Benefit Analysis . Revised Technical Requirements . EDP Design . User Aid Design . System Test Specifications . Revised Project Plan . Development Plan . Implementation Plan

PHASE	ACTIVITIES	DELIVERABLES
5. System Development	Detailed Module Design Software Coding Unit Testing System Testing Development of User Aids Conversion System Development Planning Approval	Program Module Documentation Application Software User Manual Procedure Manuals Training Manuals Computer Operations Manual
6. Implementation	Install Hardware & Equipment Acceptance Testing Conversion Training Operation Approval	Operational System and Procedures
7. Post-Implementation Evaluation	Planning Identify Evaluation Criteria Gather Data Evaluation Analysis Prepare Evaluation Report Approval	Post-Implementation Evaluation Report

2.1.2 MAJOR RESPONSIBILITIES BY PHASE

PHASE	DELIVERABLE/TASK	APPROVAL AUTHORITY	MANAGEMENT AUDIT	USER		PROJECT TEAM			
				MANAGEMENT	STAFF	PROJECT MANAGER	SYSTEMS ANALYST	SYSTEMS DESIGNER	PROGRAMMER
1. Initiation	Initiation Report	Approve	Approve	Approve	Participate	Prepare			
2. Feasibility Study	Feasibility Report -User Requirements -Conceptual Solution	Approve	Approve	Approve	Participate	Review	Prepare		
3. Analysis	Requirements		Review	Approve	Participate	Review	Prepare	Participate	
	Approval Authority Submission	Approve		Approve		Prepare			
4. System Design	EDP Design Specification		Review		Participate	Approve	Review	Prepare	
	Design of User Aids			Approve	Participate	Review	Prepare	Participate	
	Approval Authority Submission	Approve		Approve		Prepare			
5. System Development	Program Design							Participate	Prepare
	Program Code						Review		Prepare
	Program Test					Approve	Review		Prepare
	System Test		Participate			Approve	Prepare	Perform	Participat
	Operations Manual					Approve	Participate	Prepare	Participat
	User Manual			Approve	Participate		Prepare	Participate	
	Procedures Manual			Approve	Update		Participate		
	Training Manual			Approve	Participate	Review	Prepare		
	Approval Authority Submission	Approve				Prepare			
6. Implementation	Acceptance Test		Participate	Approve	Perform		Participate	Participate	Participat
	Conversion			Approve	Participate		Participate	Participate	Participat
	Production Operation				Perform				
	Approval Authority Submission	Approve				Prepare			
7. Post-Implementation Evaluation	Evaluation Report	Approve	Participate	Approve	Participate	Approve	Prepare		

2.1.3 Summary of Roles

Approval Authority

The Approval Authority for any information systems project may be a systems management committee, a project steering committee, the head of ISM (Information Systems Management) or a senior functional manager depending upon the nature of development project.

The Approval Authority acts on behalf of the user by approving each of the end-of-phase submissions, by allocating resources to each project phase, and by maintaining control over the project's progress. These responsibilities are exercised through periodic receipt of documents and submissions from both the Project Manager and the Systems Assurance Manager. Refer to the Departmental ISM policy manual for specific policies related to the approval process.

Business Systems Analyst

See: Systems Analyst

Data Analyst

A Data Analyst provides functional guidance and support to the project on matters related to the logical representation of data in project specifications. A Data Analyst is a specialist in data and data relationships. External to projects, he models the department in terms of its data for the purpose of developing efficient, cost effective data management facilities, e.g., data bases. In order to achieve this he must develop data models for each project application and synthesize them into the Departmental data model.

NOTE: The Data Analyst's role may not be a full-time staff position. The role may be filled by staff with other responsibilities.

Inspector

An Inspector reviews project specifications in order to assure their quality prior to release external to the project. In this regard he examines specifications for consistency in level of detail and style, and adherence to standards. He also looks for incompatabilities among related documents.

Depending upon the size of the project team and the volume of project deliverables, the Inspector may be one individual appointed for the duration of the project, or he may be any member of the project team

(for example, a Systems Analyst) appointed for the inspection of a single document.

An Inspector should not review specifications which he developed.

Programmer

A Programmer designs, develops and tests program modules using structured programming techniques. He may also be required to perform duties in system testing, acceptance testing, conversion and post-implementation support.

See Programming Guide for further details.

Project Manager

The Project Manager has overall responsibility for achieving the project goals through the day-to-day conduct of the project. In this respect, he develops operational plans and budgets, acquires the required resources, identifies and organizes the appropriate business and technical expertise, periodicaly submits plans, requests for approval and progress reports to the approval authority, coordinates with user management and the Systems Assurance Manager user participation in the project, conducts regular project management progress meetings and ensures effective quality control over project deliverables.

Steering Committee

See: Approval Authority

Systems Analyst

A Systems Analyst identifies, analyzes and specifies information systems requirements using structured analysis techniques. He may also carry out ancillary duties involving user interface such as development of user manuals, training, system conversion, and acceptance testing. Systems Analysts may be members of a user section or branch (Business Systems Analysts) or may be drawn from ISM staff.

See Analysis Guide for further details.

Systems Assurance Manager

The Systems Assurance Manager represents the departmental interest in a systems project and is responsible for ensuring that all user-related matters pertaining to quality control are addressed. Acting on behalf of the user, the Systems Assurance Manager:

- participates with the Project Manager in planning the commitment of user resources to the project;
- ensures that the appropriate level and quality of user resources are available to the project (i.e., that sufficently senior user personnel are assigned the key review and sign-off roles for all user-related deliverables produced by the project team);
- ensures that the user community's participation is comprehensive and active;
- verifies that the Project Manager has obtained user sign-off of all user-related deliverables (it is the responsibility of the Project Manager to obtain each sign-off);
- verifies that any changes to project plans which impact the user community have been agreed and approved by the user community;
- brings forward user concerns regarding the project to the Steering Committee for resolution if and when these concerns cannot be addressed through negotiations between the Project Manager and the user community;
- reports to the Steering Committee on user satisfaction with the project.

Ideally, the Project Manager and the Systems Assurance Manager should work cooperatively to support the successful execution of the project. Situations may arise, however, in which the Project Manager and the Systems Assurance Manager disagree (i.e., the Systems Assurance Manager may request, on behalf of the users, the expansion of the project scope, beyond the terms of reference understood by the Project Manager). The Project Manager and the Systems Assurance Manager are jointly responsible for making every effort to resolve any such disagreements to the mutual satisfaction of the project team and the user community. Disagreements should be brought forward to the Steering Committee only when resolution cannot be achieved through negotiation.

System Designer

A System Designer transforms information systems requirements, in the form of functional specifications, into system and sub-system design specifications using structured design techniques. Although a System Designer is normally the designer of the computer internals - system transactions, screens, files, input, output, etc. - this role may also encompas design of user aids such as training packages and user manuals.

See Design Guide for further details.

Technical Specialist

A Technical Specialist provides functional support and guidance to the project on matters of a technical nature. These would include hardware studies, telecommunications networking, technical feasibility of design alternatives, and acquisition and use of development tools.

He is considered "external" to any project and his abilities are shared on an organization-wide basis. This is to optimize the economic efficiency of using specialized technical staff.

User

The User's role in the Systems Development Life Cycle relates to those activities which have direct impact on him and his area of responsibility. These include:

. definition of systems subject matter;

. planning and provision of subject matter expertise;

. delegation of authority to staff assigned to participate in development activities;

. quality control over subject matter documented by the project team;

. training of staff;

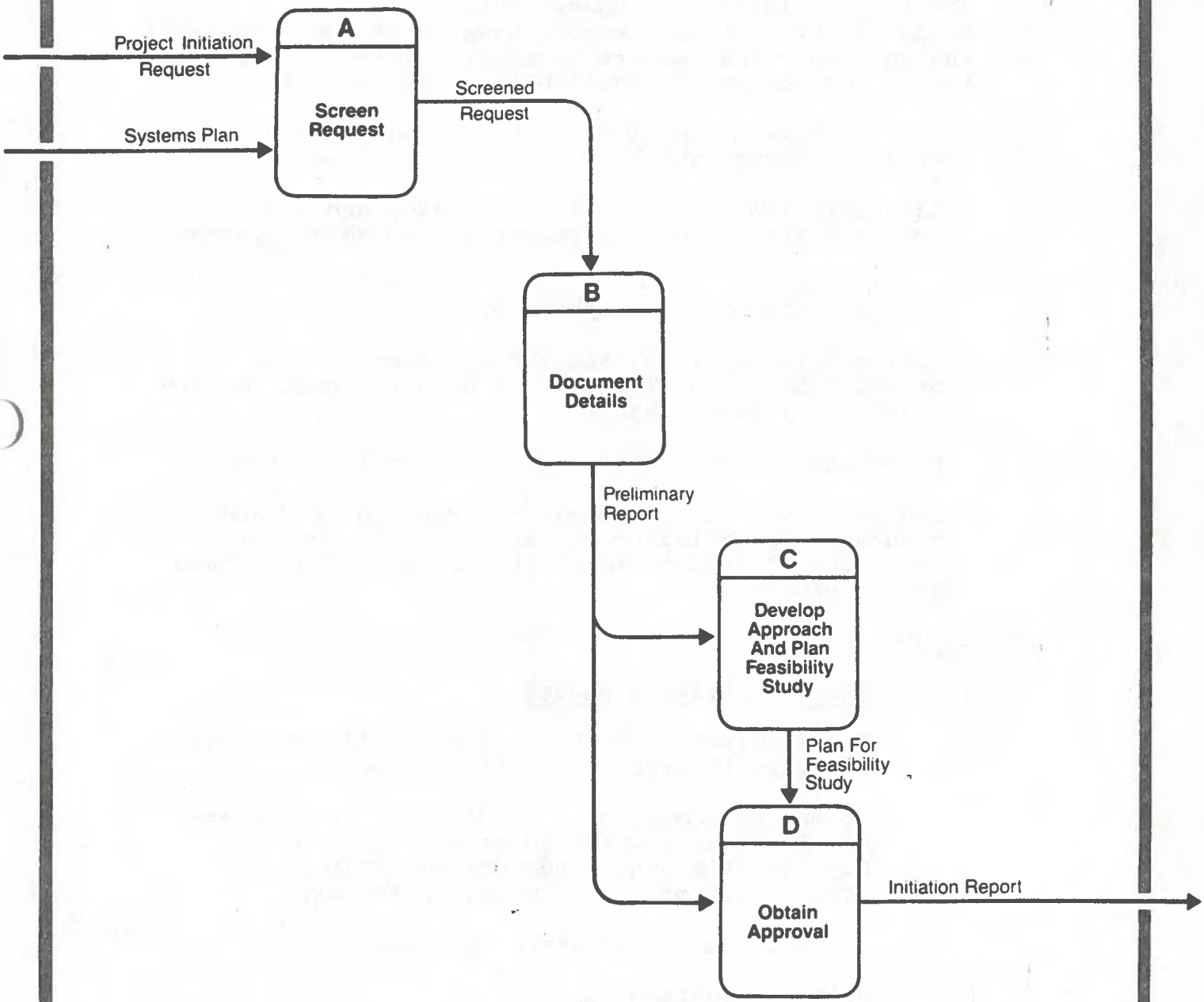
. preparation of administrative environment for system installation;

. approval and acceptance of project deliverables.

In some sections or branches, user staff may also be engaged in carrying out development roles, such as systems analysis. These are not considered user roles.

See the User's Guide for further details.

Phase 1 — Project Initiation



2.2 Phase 1 - Project Initiation

Objectives

The overall objective of the Project Initiation phase is to identify the general nature and scope of the project. This is to facilitate a preliminary evaluation of the project for consistency with the Department's information systems development plans and priorities, and to secure resources to carry out the Feasibility Study phase of the project.

The Project Initiation phase would normally be performed by user management, however if not, ISM staff should ensure that points normally covered in the Initiation Report are available before proceeding.

Specific goals during this phase are to prepare an Initiation Report which:

- Identifies the project, its initiator and its relationship to the Department's Long Range Systems Plan.
- Outlines the perceived problem.
- Outlines the aims of, and the approach to, the proposed solution (including a detailed plan for the Feasibility Study phase).
- Recommends project development responsibilities.
- Indicates solution strategy - EDP or non EDP and requests approval from the appropriate level of authority to proceed to the Feasibility Study phase of the project.

Inputs

A. Project Initiation Request

- The submission of the Project Initiation Request triggers the Project Initiation phase.
- It may be completed according to a pre-determined schedule which forms part of the Department's Long Range Systems Plan or upon identification of an unanticipated need.
- It is normally submitted by a user.

B. Long Range Systems Plan

- This is used to determine whether or not the project forms part of the overall systems development plan of the Department either as an identifiable project or through the application of discretionary funding.

Activities

A. Screen Requests

- Ensure that the request is for development service and is properly authorized.
- Identify sources of funds and budgetary provisions and the project's relationship to the Department's systems plan.
- Perform a preliminary evaluation as to whether it is viable to proceed. Any decision not to proceed at this point should be made with the agreement of the user management which initiated the request.

B. Document Details

- Briefly outline the problem, the requirement or the opportunity. A description may already be in existence as a result of the Department's planning process.
- State project objectives in terms of outputs and anticipated achievements; these must be consistent with Departmental objectives.
- Define scope by identifying and defining the boundaries within which the project will be conducted; for example, in terms of geography, organizational units, business functions, management levels. The scope may be clarified by stating specifically what the project will not include.
- Briefly describe the anticipated tangible and intangible benefits. Quantify as much as possible.
- State the requested time frame for implementation and consequences of not obtaining the system within this time (this latter should be quantified if possible). State the feasible time range based upon known priorities, plans and resource availability.
- Define policies and constraints within which the project must operate. For example:

  - dollar constraints
  - resource availability
  - hardware/software policies
  - contracting policies
  - security and confidentiality

- computing philosophy, if any (real-time, on-line batch, decentralized, etc.)
- preferred disposition of current system(s) - whether to replace or upgrade.

C. Develop Approach and Plan Feasibility Study

. In some cases it may be anticipated that the feasibility study will consume minimal resources. In such cases, assuming that the definition of "minimal resources" can be quantified, formal planning for the feasibility study may not be justified. It may be a more efficient use of staff resources to proceed immediately with the study itself. When this occurs, the Feasibility Study Report should be prepared and accompany the Initiation Report for approval.

All projects categorized as major or minor projects pass through every phase of the Systems Development Life Cycle. On certain exceptional occasions it may be justifiable to combine phases (but still producing the mandatory deliverables). When such combining is planned, it must be identified and justified in the Initiation Report.

. A plan should present a detailed statement of the work to be carried out to complete the next phase of the project. It will be necessary to describe:

- the activities to be undertaken;
- the estimated person months required, including both user and development staff;
- the estimated costs that will be incurred and the source of funds;
- the estimated elapsed time it will take to complete the phase;
- the outputs (deliverables) from the Feasibility Study.

. Also identified in the plan are the individuals, management levels, and organizational units responsible for:

- Project Management
- Project Team Composition
- Management of User Participation
- Review and Approval Authorities

. The details of the approval process and project categories will depend upon specific policies and procedures of the section or branch. Refer to the Departmental ISM policy manual for specific policies related to the approval process.

D. Approval

. Submit the report to the user's approval authority and to Management Audit.

Deliverables

Initiation Report

. The Initiation Report documents the initial perception of the problem to be solved or opportunity to be exploited, and the initial agreement on the general nature and scope of the project in terms of:

- the reasons for the project
- its objectives
- the constraints upon it

. Additionally, the Initiation Report identifies project responsibilities and recommends a plan for carrying out the Feasibility Study phase of the project.

Quality Control

Successful management of any project requires planning, control and measurement of acceptability of the product. In measuring the acceptability of a report there are two factors to consider: the format and content.

As the Initiation Report serves as the initial agreement on the nature and scope of the project, all items on the report should be complete.

The Project Manager should ensure that the Initiation Report meets documentation standards and that the content of the report is acceptable to user management. However, the approval authority and Management Audit, acting on behalf of the user, will wish to analyze the contents of the report from the following perspectives:

. Are the objectives of the proposed project compatible with the objectives of the user?

. Is the rationale for the project clearly defined? In particular, is the urgency of the requirement or problem clearly defined?

- Is the consequence of not doing the project clear?
- Is the scope of the project clearly defined so that the working boundaries can be recognized?
- Is the workplan proposed for the next phase of the project reasonable in terms of the resources it will consume, the amount and type of control that will be available and the methodology that will be used?

The Project Manager should anticipate these questions and should be satisfied that they are answered by the report prior to its submission for approval.

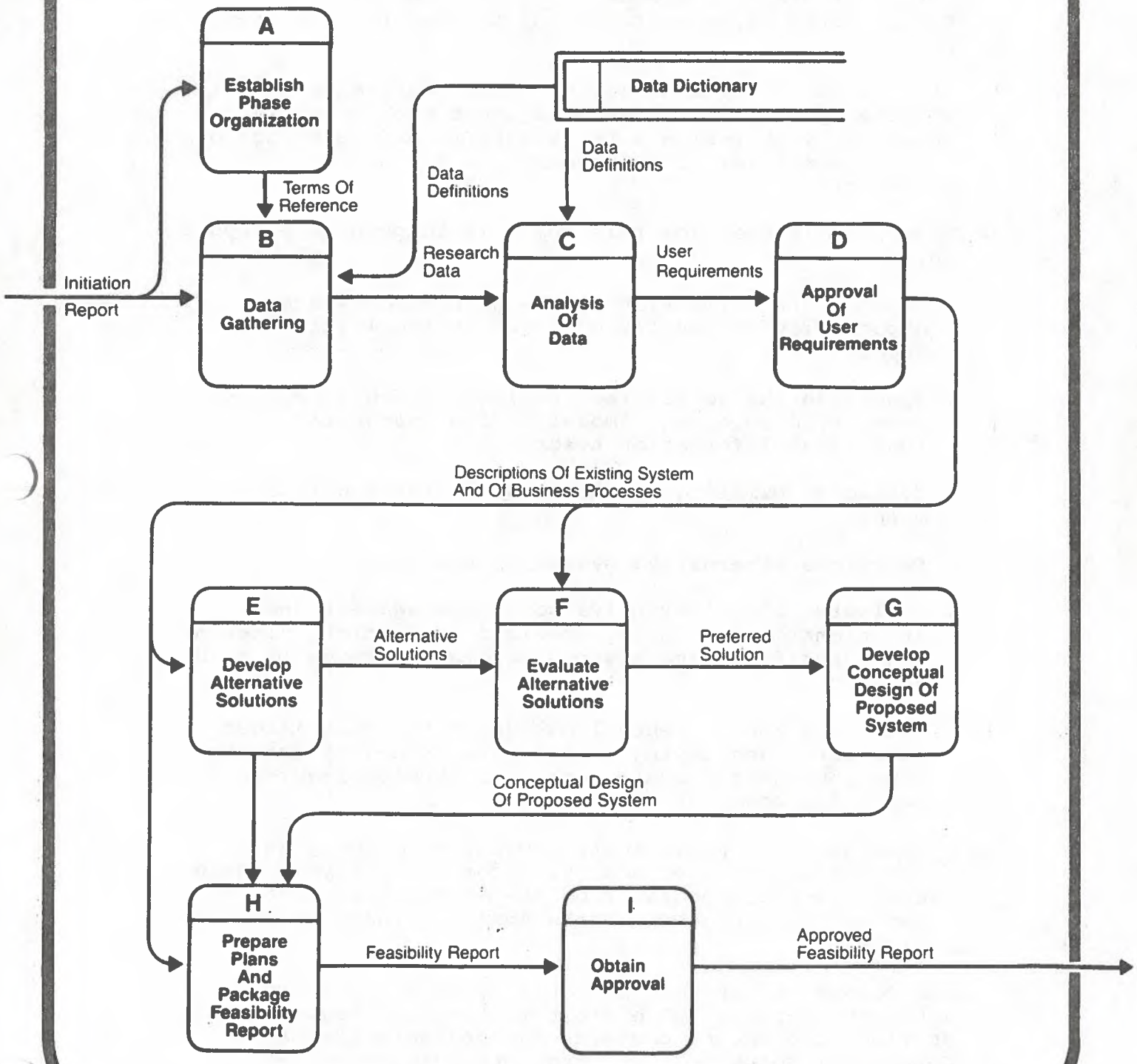
Project Control

It is during the Project Initiation phase that project control procedures are put into effect.

It is project management's responsibility to establish within the project team an approved phase plan prior to commencement of each phase. The phase plan forms the project management's framework for directing and controlling the project team's activities. It also provides criteria against which progress is measured.

When the Initiation phase is not merged with the Feasibility Study phase, a resource plan is developed for the Feasibility Study phase and submitted to the approval authority. Once approved, the plan is used as the basis for handing out assignments and setting targets for the project team. It is at this time that the phase tasks are identified for a control system and the project team members are made aware of their reporting responsibilities. Having established the control mechanisms for the project, the Project Manager can exercise his control duties and at the same time derive the information which he will report upwards as part of the overall management control of the information systems development process, and report sideways where related plans are potentially impacted.

Phase 2 — Feasibility Study



2.3 Phase 2 - Feasibility Study

Objectives

The overall objectives of the Feasibility Study phase are to develop for approval a conceptual design of a new system (or modification of an existing system) and to authorize the allocation of resources for carrying out an analysis of the detailed information requirements to be addressed by the new (or modified) system.

The review of the Feasibility Report during the final approval process provides management with an early opportunity to evaluate the viability and relevance of the project prior to the commitment of further resources.

The specific goal for this phase is to prepare a report which:

- Expands the definition of the problem or system opportunity originally outlined in the Initiation Report.
- Specifies the generalized business process requirements by developing a model of the integrated functional information needs.
- Evaluates existing systems against the functional model.
- Describes alternative system solutions.
- Evaluates the alternative solutions against the functional model, using specific evaluation criteria and identifying the advantages/disadvantages of each solution.
- Describes the conceptual design of the recommended solution; identifying preliminary technical requirements, organizational impact, conversion requirement, and cost/benefits.
- Specifies the preliminary project resource plan, details sources and schedules for the Analysis phase, and requests approval from the appropriate level of authority to proceed to the Analysis phase of the project.

The Feasibility Report is actually made up of two separate sections. The first is the User Requirements section, the second contains the presentation of a Conceptual Solution. In large projects these two

reports may be produced during two distinct sub-phases, with development and approval of the user requirements taking place prior to any development and evaluation of alternative solutions for meeting those requirements. In other cases, when the scope of the project is more restricted, both sections may be completed by the project team prior to the formal review and approval by the user.

Input

Initiation Report

- The Initiation Report represents the approved basis on which the Feasibility Study is carried out.

- It identifies project management project team composition, user and approval authorities and it is intended to establish a disciplined approach to systems development projects. This is an approach in which the principal participants can interact with clear understanding of each other's goals and responsibilities.

- The report contains a resource plan which lays out the basis for monitoring phase progress by the approval authority.

Activities - Step 1

A. Establish Phase Organization

The composition of the project team for the Feasibility Study will depend on the nature and scope of the problem and requirements identified in the Initiation Report. For some projects the team may initially be composed mostly of business analysts from the user area, with technical representation from ISM. A team with this composition would be responsible for producing the User Requirements Section of the Feasibility Report.

Later in the Feasibility Study phase, the composition of the team would change to include more technical analysts from ISM and fewer business analysts from the user area. A team with this composition would be responsible for transforming the user requirements into proposed alternative solutions, evaluating these solutions, recommending a preferred solution and preparing the work plan for the subsequent phases.

For other projects, the Feasibility Study team may consist of one person or be composed primarily of analysts from ISM, with user representatives. This team would be responsible for producing both sections of the Feasibility Report; User Requirements and Conceptual Solution.

If the project is of such a magnitude that a team is needed to carry out the Feasibility Study then it will be necessary to anticipate the co-ordination problems, inconsistency in interpretation and incompatibility of component deliverables that such a team approach could generate.

A solution to be considered is the conducting of a seminar with all members of the team present to introduce them to the project, to its objectives, and to the methodology to be applied. Each role within the phase would be reviewed in relationship to the other roles, and any ambiguities clarified.

The objective of this seminar from project management's point of view is to ensure that the team activities are co-ordinated, and that the products of each member's work are compatible with that of the others, and with the objectives of the phase.

Subjects to be covered would be:

. Overview of user area
. Overview of Systems Plan
. Review of the Initiation Report
. Review of individual roles
. Methodology
. Progress Reporting

B. Data Gathering

Data gathering is carried out to further clarify the problem, requirement or opportunity, to identify existing systems and to identify business processes within the scope of the study. Data gathered during this activity should not be very specific. It is only necessary at this time, to gather sufficient data to identify user requirements and to permit the evaluation of proposed alternatives. During the Analysis phase, additional data will be gathered to define in detail the user requirements and to permit a refinement of the selected solution.

The major part of this activity is achieved through planned interviewing of user management and staff. However, in order to maximize the use of time in interviews a certain amount of prior research of available written material should be carried out. Sources of information include organization charts and role statements, existing system documentation, the data dictionary, and current reports. A list of references should be maintained for use in the later phases of the project.

Interviews are planned to proceed "top down"; from the functionally higher levels of staff on down. Support from user management is essential and if prior management commitment has not been achieved through the planning process, then by initiating interviews at the highest level of management, another opportunity is provided to secure subordinate level involvement. This is in addition to the main purpose of the "top down" approach, which is to identify and understand the overall objectives of business processes before identifying the more detailed subordinate objectives.

The project manager ensures that the formal interviews are scheduled and carried out and that formal interview records are maintained.

A detailed description of the data gathering responsibilities is contained in the Analysis Guide.

Problems, Requirements and Opportunities

In analyzing the current system, special care should be taken to differentiate between problems, requirements, and opportunities. Definitions of these terms are presented below to facilitate differentiation.

A problem is an area of difficulty or concern with the present system, its processes or procedures. Difficulties that will occur in the future within the present system are also problems. Any description of a problem should include a statement indicating to whom it is a problem and should be supported by quantitative analysis.

A requirement is a characteristic of a new system that must be met by that system. Requirements typically arise because reporting or policy changes have occurred. A statement of a requirement should indicate the source of the requirement and an analysis of why the requirement cannot be met with the existing systems or procedures.

An opportunity is a chance to enhance a system by the inclusion of features which are desireable even if they are not essential. The opportunity will usually exist because the current manual or computer system is under examination and the individuals conducting the examination are aware of technological or procedural advances that may be too good to pass up. In about 50% of the cases, the opportunity represents a lower operating cost for obtaining the same information or benefit.

C. Analysis

Analysis during the Feasibility Study phase involves the organization, evaluation and representation of data which has been gathered.

The problems, requirements or opportunities are defined and the generalized business process requirements described.

If a team is involved in performing the study then "walkthroughs" (see Appendix A) of preliminary output and workshops to integrate material should be conducted. Staff responsible for the data administration function should participate in reviews where representation of data is examined. This is to ensure that there is a focus on data as a departmental resource and that there is an early consideration of the standards which apply to the definition of data in the Department's data dictionary, and to storage in the data base.

D. Approval of User Requirements

Once the analysis of the user requirements has been completed, these requirements should be packaged into a report for approval by the user, and for review by Management Audit. The specifications for the packaging of this report are given in section 3.2.1 of the Deliverables

Reference Manual. Any modifications requested by users as a result of the approval process should be incorporated into the documentation. If the modifications are significant then approval may be required a second time. If the modifications are minor, the documentation of the requirements can be submitted for final approval in Activity I.

Activities - Step 2

E. Development of Alternative Solutions

The composition of the project team may change at the beginning of this activity. This could happen if responsibility for project management is passed from a user area to ISM, or if technical analysts are added to the team to assist in the development and evaluation of alternative solutions. If the composition of the team changes it will probably be necessary to conduct a familiarization session to introduce the new members of the project team to the user requirements and the user environment.

Having analyzed the general business process requirements which represent "the problem" or what the system should address it is appropriate in the early stages of a project to conceptualize "a solution" or how the system will ultimately address the requirements. This provides the user sponsoring the project with the first opportunity to review the projected system and to make a business decision on whether or not to proceed.

The first step in this process is to develop a set of criteria to be used for the evaluation of proposed alternatives. The evaluation criteria should be developed in cooperation with users. These criteria should reflect the priorities and concerns of users and should be developed to permit as much as possible a quantitative and objective comparision of proposed alternatives. Possible criteria could be:

- The extent to which the proposed alternative meets the user requirements;
- The proposed development, conversion and operational costs;
- The potential cost savings and other direct benefits;
- The extent to which the proposed alternative supports the Department's Long Range Systems Plan;

- The elapsed time which would be required for developing and implementing the proposed alternative;

- The ease with which the proposed alternative could be introduced into the existing organizational and political environment;

- The possible staff increases or reductions which would result from introducing the proposed alternative;

- The technical requirements; and

- The degree to which the proposed alternative would permit enhancements or modifications to be introduced.

The second step in this process is to develop a number of potentially feasible alternatives. Each alternative solution is described in terms of the functions it addresses, its interfaces with other systems (planned or existing), its information flows, the manual and automated processes, its data transmission hardware, terminal and processing hardware, data base and systems support software, and any other special requirements.

Each alternative solution is associated with a cost/benefit statement suggesting its advantages and disadvantages. The cost benefit table should include the evaluation criteria developed during the first step.

If any of the solutions propose automated facilities then the project manager should ensure the involvement of technical expertise to endorse the technical feasibility of the solution.

F. Evaluate Alternative Solutions

Selection criteria compatible with the objectives of the project, are formally defined and used as a basis for evaluating the existing system and each alternative solution. These evaluations are documented and a preferred solution selected.

At this point an interim approval of the preferred solution should be obtained. This approval is particularly necessary if there are two or more equally viable alternative solutions. Once the preferred solution has been approved it is appropriate to prepare a conceptual design and the work plan for development of the proposed system.

G. Develop Conceptual Design of Proposed System

This activity involves further refinement of the preferred solution and the cost/benefit statement. The impact on the organization is analyzed and the system conversion requirements identified.

H. Planning

The Project Manager is responsible for ensuring the development of a preliminary project plan and co-ordinating the involvement of non-project personnel responsible for related plans.

Most of the information contained in the project plan will be derived during the cost/benefit analysis of alternative solutions. It is at this point that the project development costs are defined.

Covered in the plan will be a description of the project organization and responsibilities, a project schedule identifying activities by phase and estimates of all costs including:

- human resources, user development and contracted hardware and communication facilities;
- system and application software;
- development tools; and
- machine time purchases.

In addition to the preliminary project plan, a detailed statement of the work and resources needed to complete the Analysis phase is prepared. This will include:

- the activities to be undertaken;
- the estimated staff years required, including both user and development staff;
- the estimated costs that will be incurred and the source of funds;
- the estimated elapsed time it will take to complete the phase;
- the outputs (deliverables) from the Analysis phase; and
- the individuals, management levels and organizational units responsible for project activities, user participation and review and approval.

Once the plans for subsequent phases have been completed, the various components of the Conceptual Solution should be packaged. The specifications for packaging this portion of the Feasibility Report are given in Section 3.2.2 of the Deliverables Reference Manual.

I. Approval

Both the User Requirements and Conceptual Solution reports are submitted as the final Feasibility Report to the user's approval authority for permission to proceed. A copy should also be submitted to Management Audit.

Deliverables

Feasibility Report

The Feasibility Report makes two major proposals:

- it proposes a conceptual solution to the problem, requirement or opportunity presented in the Initiation Report;
- it suggests an approach to further developing and implementing the solution.

It documents the evidence and criteria used in selecting the proposed solution and identifies the alternatives considered. Thus, the documented results of the Feasibility Study should provide management with sufficient information to decide whether or not to proceed with the specific alternative selected.

It contains the detailed plan for carrying out the Analysis phase of the project.

Quality Control

The project manager must ensure that the Feasibility Report meets current documentation standards and that the content is acceptable from a number of perspectives, which are:

- Technical

  If the proposed solution contains an EDP component, ISM management staff should confirm that the solution is technically feasible within the cost and time constraints suggested in the proposal, and that the technical requirements are consistent with the strategy relating to the provision of hardware and software facilities.

- Data Administration

  Representatives from the data administration group or an analyst assigned the role of Data Analyst should approve the data configurations contained in the Feasibility Report.

- Functional Users

  Properly authorized representatives of primary users and users impacted by the proposed solution should review and approve the Feasibility Report.

- Departmental

  The approval authority and Management Audit, acting on behalf of users, will wish to analyze the report with the following questions in mind:

  - Are the proposals consistent with the objectives of the project and the user?
  - How do the proposals relate to the Department's Systems Plan?
  - Have sufficient alternatives been considered?
  - Is there evidence of active and comprehensive participation of users and support staff?
  - Are the projections of resources required for the project and the next phase reasonable?

  According to the size and priority of the project, it is project management's task to provide evidence that the involvement of users and other expertise in the quality control process has occurred.

Project Control

- Project management's level of monitoring and control of the Feasibility Study will be largely dependent upon the size of the project and the number of staff participating in the phase.

- Any activity or phase should be controlled through regular monitoring. Pre-requisite to this is the establishment through planning of key milestones with related cost and time objectives. The milestones may occur at the phase level or at phase-subordinate task level (depending upon projected costs). Since it is possible that other factors than cost may be considered, management discretion should be applied.

Small studies, intended to consume say less than fifteen days* probably do not justify being monitored on a task basis unless there are other considerations. Larger studies are to be monitored on an individual task basis in terms of cost and schedule. If any task is projected to exceed ten days* it should be broken down into component sub-tasks.

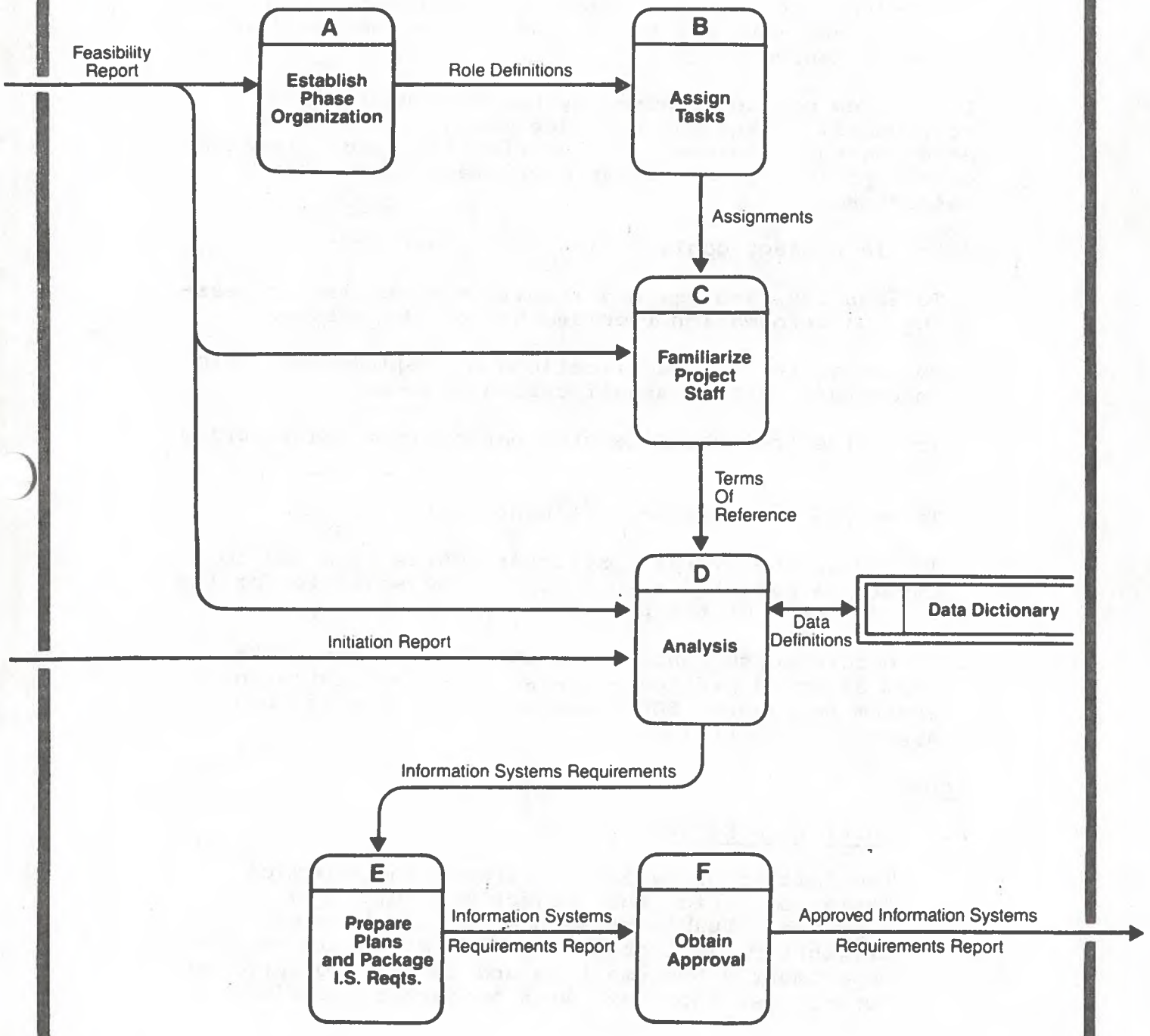
- A preliminary overall project plan is developed and forms part of the Feasibility Study. Once approved, the plan is used as the approval authority's framework for controlling and measuring progress of each of the project's phases.

  As a project progresses through each phase the degree of accuracy in estimating and scheduling increases. At the end of each phase the overall project plan is updated to facilitate review of the project's continuing viability.

- A detailed resource plan is developed for the Analysis phase and forms part of the Feasibility Study. Once approved, this plan is used as the basis for handing out assignments and setting targets for the project team. Additionally, it forms project management's framework for directing the project team's activities and provides criteria against which progress is measured.

* subject to agreement

Phase 3 — Analysis



2.4 Phase 3 - Analysis

Objectives

The overall objectives of the Analysis phase are:

- To define and approve the proposed system from a user perspective.
- To authorize the allocation of Departmental resources to proceed with the project as far as the detailed system design.

The review of the proposed system and the revised cost/benefit statement provides management with an opportunity to re-evaluate the viability and relevance of the project prior to the commitment of further resources.

Specific project goals during this phase are:

- To identify, analyze and specify the precise processing and information requirements of the system.
- To integrate the specifications of requirements into an overall systems specification framework.
- To define the overall system performance and security goals.
- To revise the cost/benefit statement.
- To revise the overall project resource plan and to develop a detailed resource plan and schedule for the Design phase of the project.
- To obtain concurrence for each of the items above from affected parties - users, data administration, system designers, EDP technical support staff and approval authorities.

Input

A. Initiation Report

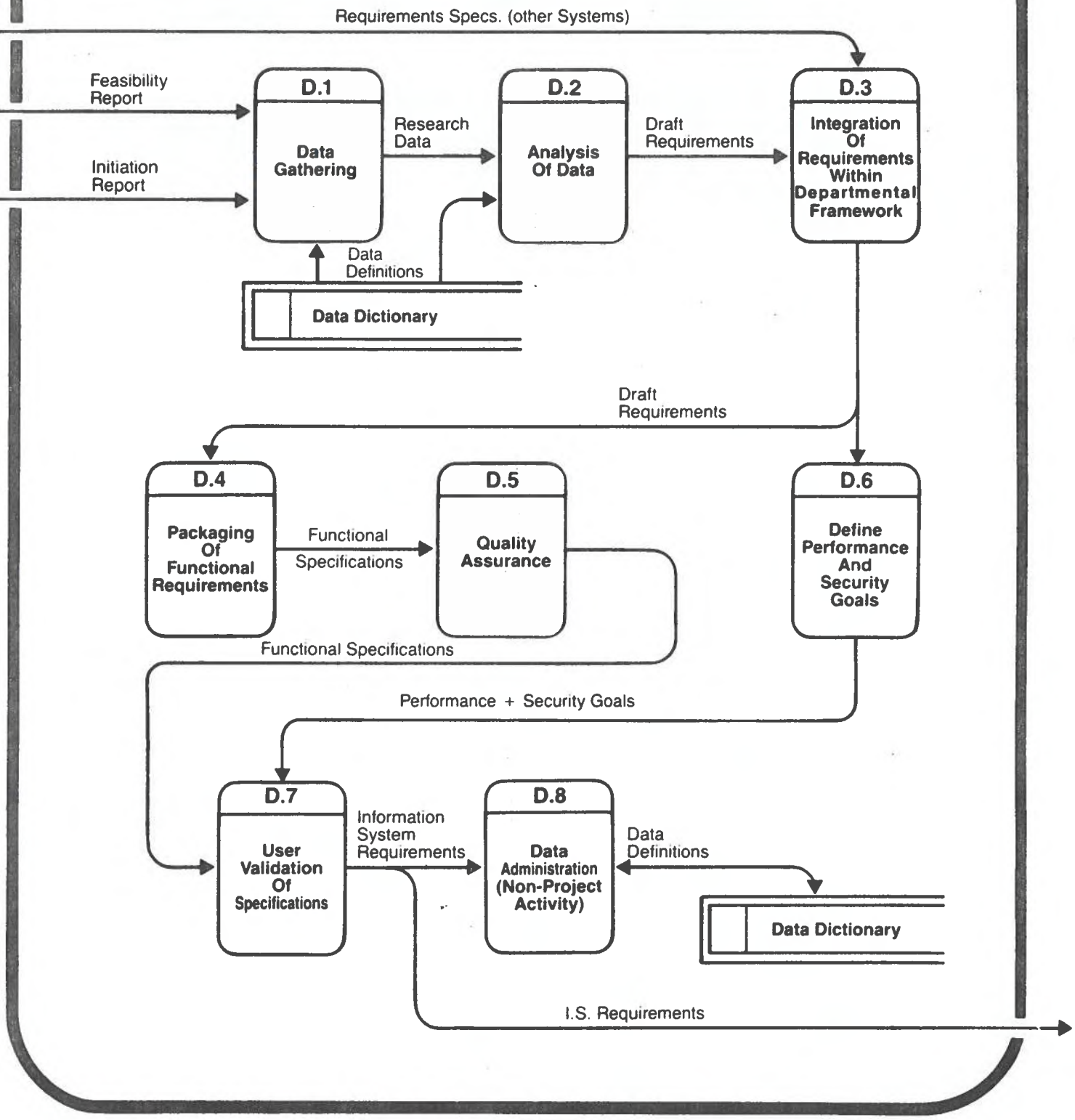
The Initiation Report represents the approved basis upon which the project was initiated and supplies valuable background information on original project objectives, relationship to the Department's Systems Plan and identity of approval authorities and those with project responsibility.

B. Feasibility Report

The Feasibility Report represents the approved basis on which the Analysis phase is carried out. It defines the problem, requirement or opportunity to be addressed by the system and specifies the general business process requirements which represent the functional boundaries for the analysis study. Additionally it outlines a conceptual system design which is further evaluated and refined into a proposed system for the user.

The report contains a preliminary resource plan for the project and a detailed resource plan for the Analysis phase which lays out the procedures for the approval authority to monitor the progress of the Analysis phase.

Activity 3.D — Analysis



Activities

A. Establishing Phase Organization

The project organization and staffing required to complete the Analysis phase will vary from project to project according to size, complexity, and proposed solution.

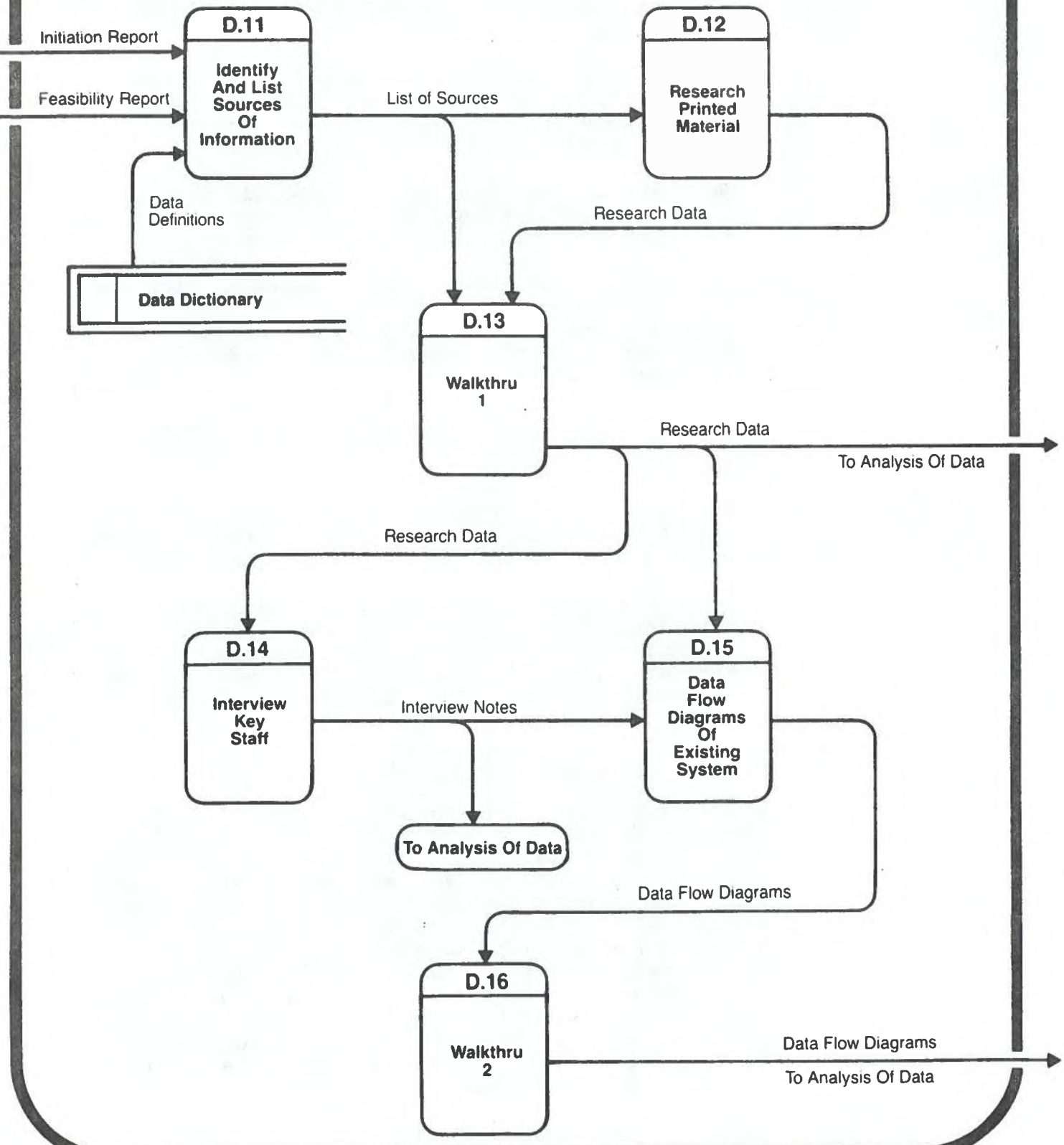
During detailed planning the skill requirements must be defined and subsequently matched by an appropriately staffed organization. Roles typically performed during this phase are:

- Business Systems Analyst is responsible for documenting Functional Specifications and/or for defining Performance and Security Goals.
- Data Analyst advises on data representation and is responsible for ensuring that the data representation in documents conforms to standards. Is also responsible for data dictionary update.
- Planner to perform the planning function and monitor phase plans on behalf of the Project Manager.
- Inspector responsible for examining and verifying that the level of detail and format of documents adhere to the documentation standards.
- Technical specialist advises on items of a technical nature such as data base, data communications, other hardware and system software; and is responsible for reviewing and approving the technical feasibility of the proposed system.

B. Assignment (of Analysis Tasks)

The hierarchical function charts (and description) from the Feasibility Report act as a graphical table of analysis tasks. Each of the lowest level business processes on the chart which are addressed by the project can be considered an analysis assignment. Each will require the development of a Functional Specification. A set of these specifications defines the total functional requirements of the system. The function chart defines the functional boundary of each module and provides project management with an excellent aid to delegating responsibilities among the members of large analysis teams.

Activity 3.D.1 – Data Gathering



C. Familiarization of Project Staff

The activities for this portion of the Analysis phase are:

- Prior to undertaking any substantive phase activity, analysis staff, and especially those contracted, are to be thoroughly familiarized with the project and the methodology and standards to be applied during the phase.
- Depending upon the team's prior level of expertise, seminars should be conducted to thoroughly familiarize phase staff with the project, the methodology, and the documentation standards in effect.
- For both users and other members of the project team, consideration should be given to conducting seminars on those aspects of the methodology and standards which are visible to these two groups.
- For projects where large numbers of end-user staff are participating, consideration should be given to distributing a project familiarization guide summarizing, for example the project, its objectives, the participants and the roles within the life cycle. This summary should be distributed with copies of the Analysis Guide.

D. Analysis

D.1 Data Gathering

The objectives of the data gathering exercise are:

- to assemble a comprehensive set of information and statistics before commencing any detailed analysis activity;
- to identify key users and sources of information for use in the present or future;
- for the analyst to demonstrate a broad understanding of the subject matter by diagramming the existing system in terms of its data flows.

The following summarizes the steps* analysts are to take in achieving these objectives:

- identify and list sources of information including publications, specifications, policy documents, key staff contacts.

* see also the data flow diagram on the next page.

- research printed material to familiarize analysts with subject matter in preparation for interviews with users;

- "walkthrough" with the team to examine and supplement researched material prior to interviews;

- conduct "top-down" interviews of staff. Project management should participate in interviews of executive and senior management staff;

- represent the existing system flows on data flow diagrams;

- "walkthrough" the existing system and review the working documents developed to date.

By the end of the initial data gathering exercise for any business process, the following documents should have been prepared:

- research data including a list of sources of information;
- records of interviews and "walkthroughs";
- a data flow diagram of the existing system.

Additionally other documents will be in a state of evolution:

- function charts (hierarchically representing business processes);
- logical data flow diagrams;
- data models.

D.2 Analysis of Data

The objectives of this step are to develop a graphical representation of the logical system and then to derive a model of the proposed user system (i.e. the system as perceived by the user or users) by adding to the logical system the real world of staff, machines, organization, geography, etc.

The model of the user system identifies what information requirements are satisfied by the system and what business processes are performed. That is to say, it identifies the general man-machine interfaces in the system.

The user system is represented on physical data flow diagrams.

Standards relating to these documents are detailed in Sections 3.2 and 3.3 of the Deliverables Reference Manual.

D.3 Integration of Requirements within Departmental Framework

Evolving requirements specifications are reviewed in relationship with other specifications in existence or under development to ensure that they integrate into the Department's overall systems framework. This is particularly important in that systems interfaces must reflect the network of information flows between business processes.

A workshop approach can be used where project management, system analysts, data analysts and users can resolve integration problems as a group effort.

D.4 Packaging of Functional Requirements

Having completed the data gathering, analysis and integration, the components of the functional specification module are finalized and packaged. Packaging is in accordance with Section 3.3 in the Deliverables Reference Manual.

D.5 Quality Assurance

Quality Assurance involves the review of requirements specifications from the points of view of:

- compatibility across functional boundaries;
- adherence to documentation standards;
- accuracy and level of detail of the content.

A Data Analyst vouches for the data contents of specifications, making sure they have been integrated across functional boundaries.

An appointed Inspector verifies that the level of detail is appropriate and that the format of the documents adhere to documentation standards.

Finally, the Project Manager or analysis team reviews and verifies the package of documents to verify that the work has been done and the product is consistent with the project objectives specified in the Initiation Report and Feasibility Report.

D.6 Define Performance and Security Goals

This activity can be carried out in parallel with the analysis of detailed functional requirements. It has as its objective the definition of a set of global performance and security goals which are generally applicable on a department-wide basis.

The specific goals to be defined are those relating to:

- System Availability;
- Recovery from Failure;
- Security;
- Response Times/Turnaround Times;
- Data Integrity;
- Retention of, and Access to Data;
- Audit Requirements;
- Growth Perspectives.

A survey of selected senior user staff should be carried out to obtain a concensus on what constitute reasonable goals. User policy papers on privacy and freedom of information, security and records management are additional sources.

D.7 User Validation of Specifications

The documented requirements consisting of:

- one or more Functional Specification reports; and
- the Performance and Security Goals;

are formally submitted to affected users for review and validation.

Prior to this review during the planning stages for the review, project management will have secured user management commitment and will have ensured that previously uninitiated staff are fully familiar with the purpose of the review activity and how each individual Functional Specification fits into the total requirements for the Information System. Project management will be soliciting formal approval of the documents

from user representatives and it will be achieved effectively only if participants are fully briefed on their role and responsibilities. The sequence of steps to achieve user validation of documents is:

- distribute copies of Functional Specifications and Performance and Security Goals to impacted users;
- users review documents and approve or formally request changes;
- requested changes are analyzed, discussed as necessary and consequential changes incorporated;
- updates are distributed and user representative requested to confirm approval;

D.8 Data Administration

The development of data models and the maintenance of a data dictionary to support the data administration function and to facilitate the design of data bases may not be a project responsibility. However, the performance of a system, and thus the success of a project, may be impacted by the effectiveness of any data administration function. Where applicable it is a project responsibility to secure data administration staff involvement in documenting data used by the system, on the Department's data dictionary.

An analyst from the data administration area or one assigned the role of Data Analyst would normally be responsible for review and approval of the data components (contained in sections 4 and 5) of the Functional Specifications (see Section 3.3 of the Deliverables Reference Manual).

E. Prepare Plans

The Project Manager is responsible for effecting the update of the overall project plan and developing a detailed statement of the work and resources needed to carry out the System Design phase.

F. Approval

A submission to the user's approval authority is required to secure approval to proceed to the System Design phase. Unlike the Project Initiation and Feasibility Study phases, it is not necessary to submit the total set of deliverables for approval. This is because the specifications forming the primary component of the Analysis output are at an inappropriate level of detail for the senior staff with approval authority.

The strategy for obtaining approval for the Analysis deliverables is to submit a summary report with evidence that the affected parties have reviewed and approved the details of the Information Systems Requirements. This submission then would contain the following components:

- Executive Summary;
- Revised Cost/Benefit;
- Revised Technical Requirements;
- Revised Project Plan;
- Detailed Plan for Design Phase.

A copy of these reports should also be submitted to Management Audit, if they have determined that their continued involvement in the development of the system, is necessary.

Deliverables

Information Systems Requirements

This deliverable has two major purposes:

- It describes in precise detail the information and processing requirements to be addressed by the system.

- It proposes a plan to further develop and implement the solution.

The Functional Specifications, which form the major component of this Information System Requirements report, represents the bridge between the user community which collectively defines the business problem, and the system designers who design a technical solution. The Analysis deliverable is the "what" of the system and forms the primary input to the design of the "how".

The Technical Requirements component of this deliverable facilitates the initiation of preliminary steps to acquire any additional system software, hardware or telecommunications facilities.

Quality Control

The Information Systems Requirements must be acceptable from a number of perspectives:

. Documentation Standards/Level of Detail

  On major projects it may be necessary to appoint an Inspector with the responsibility of reviewing all documents to ensure adherence to current documentation standards. In addition, where analysis is a team effort, the Inspector would ensure that the level of detail and the written style is reasonably consistent throughout.

. Technical Perspective

  If the solution contains an EDP component, the ISM staff should confirm that it is technically feasible within the cost and time constraints and approve the Revised Technical Requirements component of the document.

. Data Administration (where applicable)

  Representatives from the data administration area or an analyst assigned the role of Data Analyst should approve the data configuration in the Functional Specifications.

. Functional Users

  Properly authorized representatives of primary users and users impacted by the proposed solution should review and approve the Functional Specifications and the System Performance and Security Goals.

. Design

  Design management should review the Information Systems Requirements for omissions and ambiguities prior to acceptance into the System Design phase.

. Departmental Perspective

  The approval authority and Management Audit (if they have requested a copy of the Information Systems Requirements report), acting on behalf of users, will wish to analyze the report with the following questions in mind:

  - Are the proposals consistent with the objectives of the project and the user?

- Is there evidence of active and comprehensive participation of users and support staff?

- Are the projections of resources required for the project and the next phase reasonable?

- Is the project still viable according to the revised cost/benefit?

According to the size and priority of the project, it is the project management's task to provide evidence that involvement of users and other expertise in the quality control process has occurred.

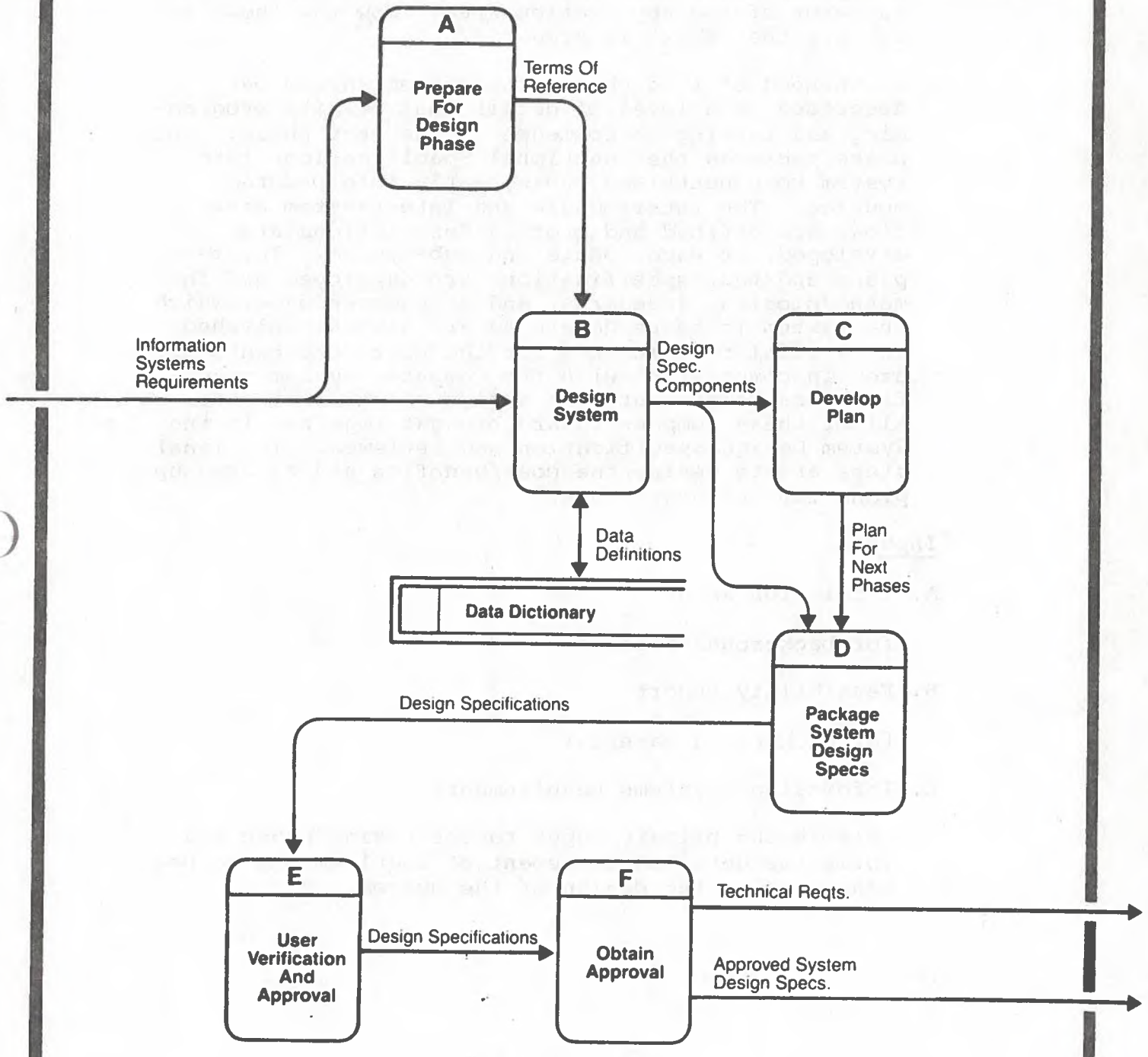
Project Control

. As described in the Feasibility Study, activities should be monitored at a task level by establishing key milestones with related cost and time objectives. Control of project activities increase in importance during the analysis phase since there is usually substantial interdependence between the project and non-project staff. The Project Manager establishes working relationships with user management, staff responsible for data administration, ISM technical specialists, suppliers, and ISM operations management through regular reviews to ensure early detection of deviation from plans.

. The overall project plan is revised and forms part of the submission to the approval authority.

. A detailed resource plan is developed for the System Design phase and forms part of the submission to the approval authority. Once approved, this plan is used as the basis for handing out assignments, and setting targets for the project team. Additionally, it forms project management's framework for directing the project team's activities and provides criteria against which progress is measured.

Phase 4 — System Design



2.5 Phase 4 - System Design

Objectives

- The major objective of this phase is to translate the requirements into a working design. During the Analysis phase, the "what" of the system was defined in terms of the application area. Now the "how" to achieve the "what" is prepared.

- At the end of this phase, the system should be described to a level of detail that permits programming and testing to commence in the next phase. This phase packages the Functional Specifications into system components and subsequently into program modules. The inter-module and inter-system data flows are defined and process descriptions are developed for each module and sub-system. The test plans and test specifications are developed and the methodologies, standards, and procedures under which the system is to be developed are also established. The initial requirements for the user components are used in combination with the computer system specifications to generate the design of the user aids. All of these components are brought together in the System Design Specification and reviewed. The final steps are to revise the cost/benefits and to draw up plans for the next phase.

Inputs

A. Initiation Report

for background material

B. Feasibility Report

for background material

C. Information Systems Requirements

This is the primary input to the Design phase and forms the detailed statement of requirements to be addressed by the design of the system.

A. Prepare for Design Phase

At the start of this phase, the basic ground rules have to be decided upon and documented so the Design Team has a firm framework. This involves establishing the criteria for design, and the guidelines, standards and conventions to be followed.

The guidelines, standards and conventions to be followed in the Design phase would cover items such as: Data names; File names; Database interfaces. Refer to DREE's Database Administration Guidelines for specific standards.

Organization and staffing will vary from project to project according to size, complexity and proposed solution.

During detailed planning, skill requirements are defined, matched by an appropriately staffed organization and, where necessary, contracts placed with suppliers.

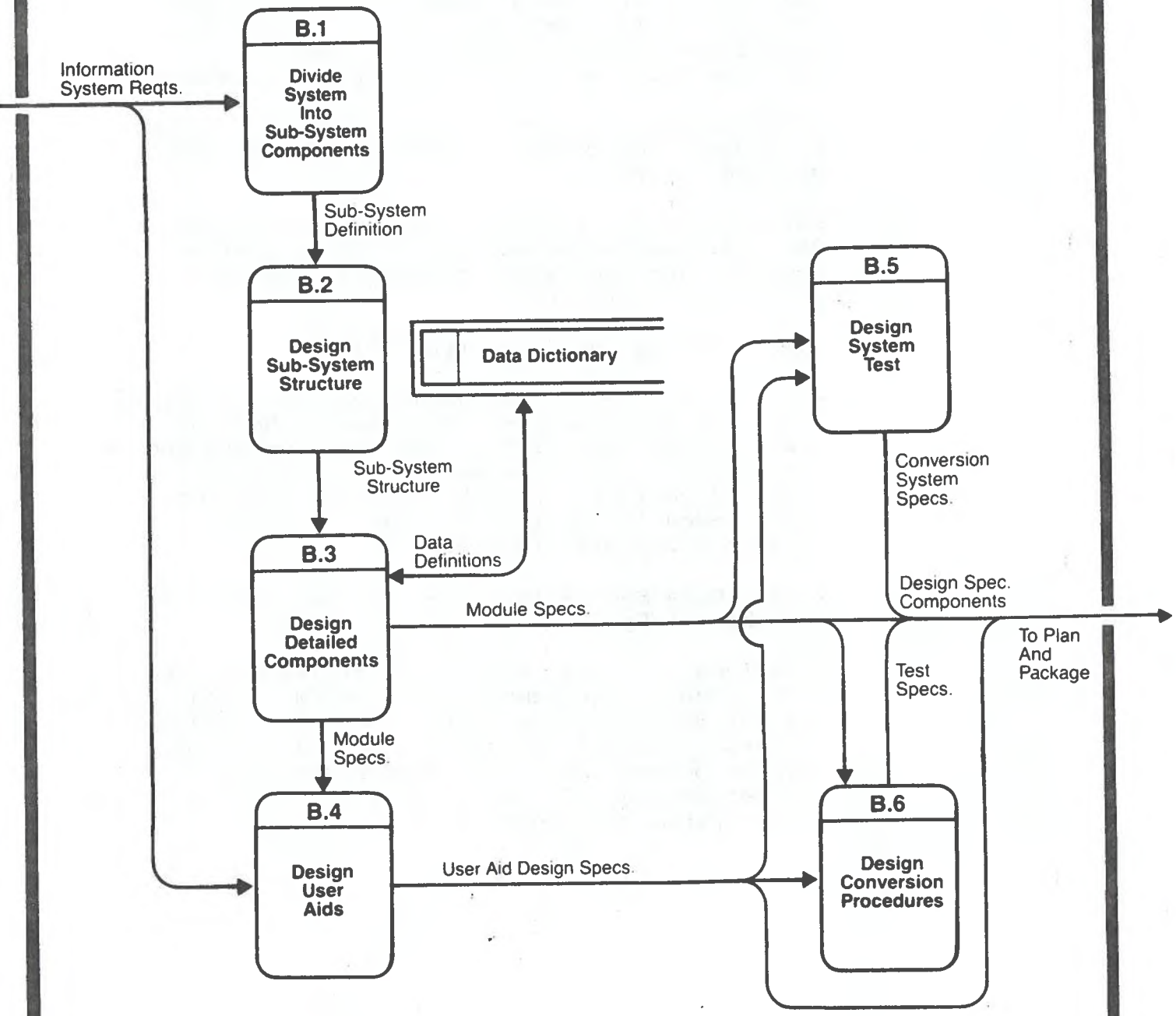
Main staffing needs are typically:

- System Designers - knowledgeable in the art of systems architecture. They should have an understanding of functional requirements and be capable of transforming them into design specifications. A high degree of technical knowledge is required in order to design technically efficient systems.

- Data Base Specialist) may not be members of
- Technical Specialist) project team.

- Designers of User Systems - for transforming functional requirements and system design specifications into design specifications of an appropriate set of user procedures and aids. These persons must have a comprehensive understanding of the office environment in which the system will operate.

Activity 4.B – Design System



. Analysts - from the previous phase to interpret and provide guidance, and act as ongoing interface with users.

Once having established a phase organization, staff (especially those contracted) are to become thoroughly familiar with the project, its phase methodology, reporting requirements and administrative practices.

B. Design System

B.1 Divide the System into Sub-System Components

This step defines the overall architecture of the computer system, the components of the sub-systems and the interfaces. It is the first time that the computer portion of the logical system is translated into physical form (see example on next page).

The first task is to divide the overall logical system as defined in the Functional Specifications. The output is a set of separate computer sub-systems. It is critical that the user reviews and fully understands the implications of this process as it affects all future systems developments. The decisions made at this time - on-line, batch, background processing, etc. - will directly impact the costs of processing user requests and the response times to be expected.

Subsequent tasks define inputs, screen layouts, forms, dialogues, outputs, reports and files; and draft the sub-systems onto system flow charts for presentation.

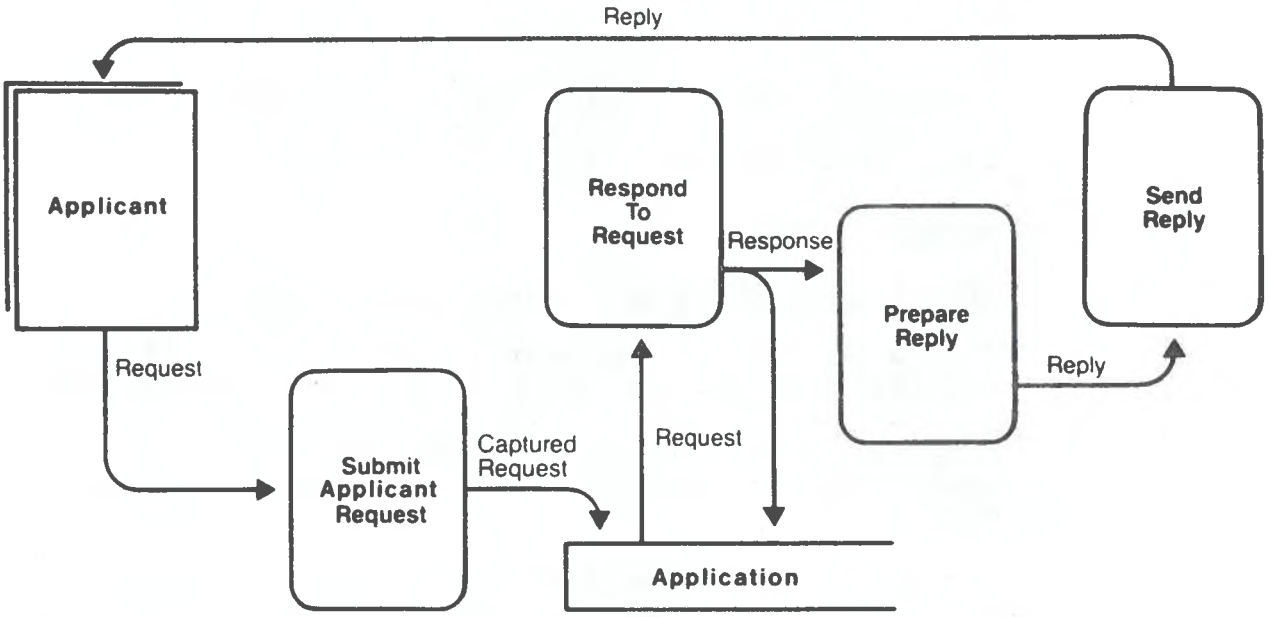
A formal review is then conducted to ensure completeness and to verify the technical feasibility of the sub-system division.

B.2 Design Sub-Systems Structures

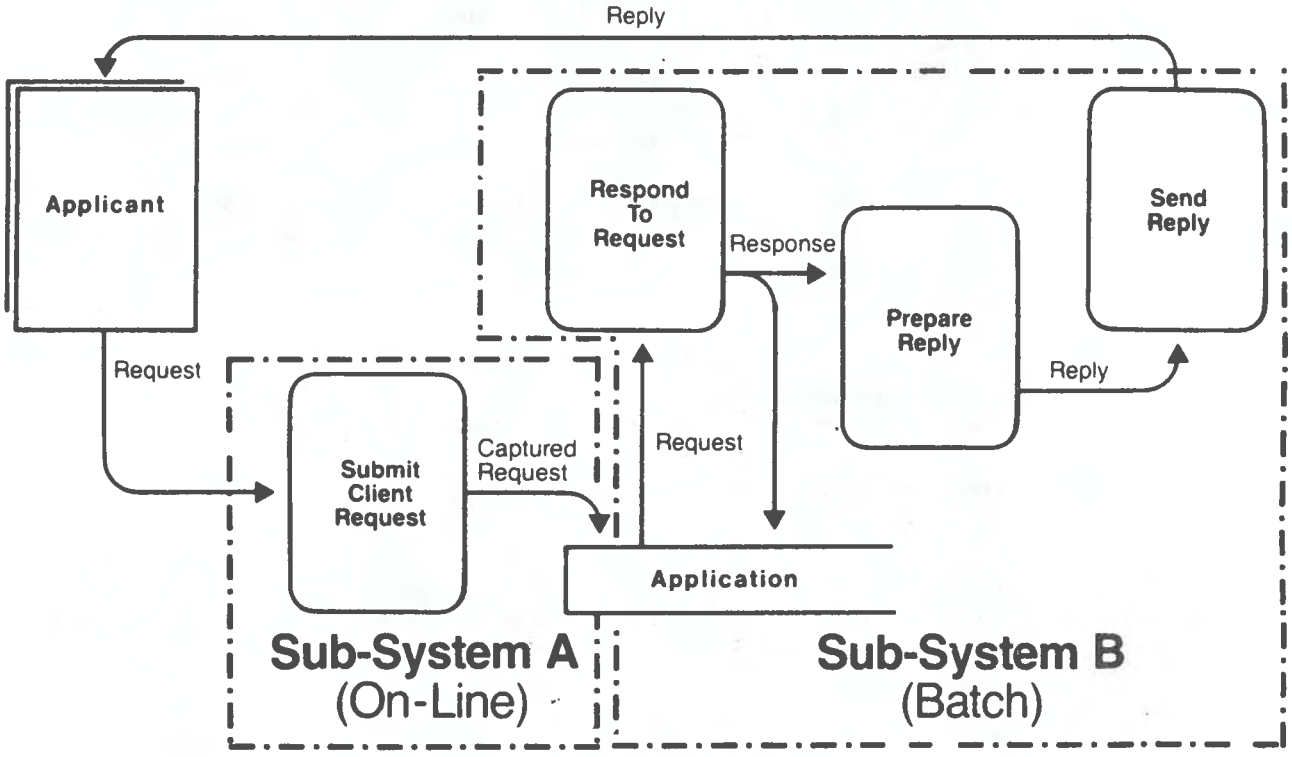
The previous step broke the computer system into component sub-systems and defined the sub-system interfaces. This step breaks each sub-system into its module sub-structure and defines the module interfaces.

The first activity is to break down the functional computer design to a preliminary structure. This involves the structured techniques of transform/ transaction analysis. The end product is a structure chart giving functional hierarchies, some indication of control and sequence, and a top-level definition of communication flows between modules.

Data Flow Diagrams
Example of System Division



Logical Representation



Physical Representation
Division Into Subsystems

This initial design is then reviewed and refined by the project team. This refinement is carried out so as to place the logical structure into the physical environment in which the system will run.

The next step is to define in terms of data, the communications between modules. Data dictionary entries must be completed as each new element or structure is defined.

The final step is the verification of the design through walkthroughs. Due to the hierarchical nature of Structured Design, walkthroughs can be restricted to parts of the structure if there is a requirement to limit the time for these walkthroughs.

B.3 Design Detailed Components

This is the last level of detail for the system design specifications. The actual program modules are defined from the refined structure chart, the detailed physical interfaces are defined and related to the corresponding data entries in the data dictionary. The procedures for each module are written, and all of them are completely verified. The end product is a complete set of verified program specifications (section 4.18 of the EDP System Design Specifications as shown in Section 3.4 of the Deliverables Reference Manual).

B.4 Design User Aids

The Design phase includes the design of the material to assist the end user in working with the system. The activities include refining the manual requirements, defining the manual operations, choosing and designing the aids, and testing them.

The manual operations are an integral part of the overall system and are developed with the same precision as any EDP component. As it is normally designed in parallel with any EDP component, close management and coordination of the two design activities are essential.

The user aids could consist of any or all of:

- User Manuals
- Operator's Manuals
- Training Manual
- Procedure Manual (updated as required)
- Conversion Procedures.

The choice of what to use is dependent upon the scope and size of the new system and the resources allocated to the development of the system.

The outputs of this activity should consist of:

- refined user requirements based upon the system design specification
- choice of user aids to satisfy the requirements
- detailed Table of Contents of the User Aids

B.5 Design System Test

The objective of testing a system before implementation is twofold. The first is to determine if it does what it was designed to do and the second is to determine how well it does it.

In order to determine if a system does what it was designed to do, develop test specifications by identifying specific conditions and features to be tested. These test specifications should be developed in two stages. The first is to develop a list of things to check for in the system. For example, are the control tables correct? The second is to develop a list of checks to be made as the testing is proceeding. This is done through a test coverage matrix.

For each test specification or group of specifications, identify the conditions to be tested, the method to be used in the test, the actual inputs, expected results and actual outputs. These must be documented.

In order to determine how well the system is performing, the Performance Goals developed in the Analysis phase must be considered.

Develop a test plan which includes the following information:

- testing overview - this is a brief description of the general testing approach or of the different test phases

- requirements - identify staff and resources required for testing

- responsibilities - describe the responsibilities of the individual(s) involved in the system testing

- schedule - develop a chart identifying the activities for the individual(s) listed above.

During this phase, the initial preparation for Acceptance Testing is also done.

In conjunction with the user, develop a set of acceptance tests. The format of the acceptance test specifications may follow that of the system test specifications. In addition, criteria for the acceptance of the system by the user should be developed. It should be noted that for less complex systems, system test and acceptance test specifications may be the same.

This step could be done in conjunction with the development of conversion procedures outlined below.

B.6 Design Conversion Procedures

Once the new system has been designed, it will be necessary to design a set of procedures to convert to the new system.

A conversion strategy must be determined.

Four possible strategies for changing over from one system to another are:

- Parallel conversion - both systems run in parallel with the outputs being compared item by item until all discrepancies are resolved.

- Pilot conversion - a stand-alone subset of the final system or if the same system is to be installed in a number of locations, one location is installed. The resources of the project team can then be concentrated on that pilot system until the system proves to be satisfactory.

- Phased conversion - only certain sub-systems of the new system are installed. The basis of choice of the sub-systems could be on time cycles (end-of-month processing) or on functions (data capture) or on the department's organizational lines.

- Immediate conversion - if none of the other methods is suitable, the only alternative is to end the old system one day and begin the new one the next.

Once having established a strategy acceptable to user management full system specifications covering the conversion will be required.

Comparison of System Conversion Methods

method	relative costs	user effort required	team effort required	impact of damage if failure occurs
PARALLEL	High	High	Low	Low
PILOT	Medium	Low	Medium	Medium
PHASED	Medium	Medium	Medium	Medium
IMMEDIATE	Low	Medium	Low*	High

* if successful, otherwise very high.

C. Develop Plan for Following Phases

The detailed plan as prepared for the Development and Implementation phases has taken into account the completed systems design and testing plans. Plans for the tools, methodologies, standards, etc., to be used in the development phase must be prepared. These plans will shorten the learning curve of the development team and minimize the time required for initial start-up.

D. Package System Design Specifications

The following activities are critical to the success of a system.

Identify all system controls, audit trails and interrelationships. The Functional Specifications give the requirements for these control aspects. Some time during the refinement of the structure, these considerations must be built into the system.

Refine the software, hardware and communication environment of the system from the Analysis phase. For the software environment identify the following:

- package name
- characteristics of the package

For the hardware environment, identify the following:

- equipment name
- characteristics of the equipment
- quantity of each type of equipment

In identifying the communications environment, for each type of equipment, whether existing or to be acquired, identify the following:

- modems, communications lines
- quantity of each type of equipment

Identify the communications network environment with the following information:

- required baud rate
- dedicated, multi-drop, package switch lines
- communications protocol
- line quality

Define the system recovery procedures. Examples of items to be considered are:

- off-site processing requirements
- off-site storage requirements
- legal implications
- hardware
- communication lines
- data entry equipment

At this stage, the system design and the completed specifications for the technical environment, plus the development phase plan and schedule should be taken into account to update the Cost/Benefit calculations of the new system. Any major changes are to be identified. Then, all the components of the System Specification are to be packaged in preparation for transition to the Development phase.

E. User Verification

As the Design phase progresses, each of the final inputs, user procedures, turnaround times and outputs are verified and approved by appointed user representatives. Project Management must ensure that evidence of user approval is retained and ultimately submitted to the approval authority when obtaining end of phase sign-off. It is not necessary to submit specifications for the internal system architecture; to users.

F. Departmental Approval

A submission to the approval authority is required to secure approval to proceed to the System Development phase. It is not necessary to submit the total set of deliverables for approval as they are at an inappropriate level of technical detail for the senior staff with the approval authority.

The strategy for obtaining approval for the Design deliverables is to submit the planning aspects and evidence that the affected parties have reviewed and approved the Design specifications. This submission then would contain the following components:

- Executive Summary
- Revised Cost/Benefit
- Revised Technical Requirements
- Revised Project Plan
- Detailed Plan for Development and Implementation phases

A copy of these reports should also be submitted to Management Audit, if they have determined that their continued involvement in the development of the system is necessary.

Deliverables

System Design Specifications

. Executive Summary
. Revised Cost/Benefits
. Revised Technical Requirements
. Revised Project Plan
. Detailed Plan for Development and Implementation phases
. EDP System Design Specification
. User Aid Design Specification

The Revised Technical Requirements component finalizes the system software/hardware environmental requirements and facilitates the completion of the acquisition of any additional equipment.

Quality Control

The System Specifications must be acceptable from a number of perspectives:

. Documentation Standards/Level of Detail

On major projects, it may be necessary to appoint an Inspector who is assigned the responsibility of reviewing all documents to ensure adherence to current documentation standards. In addition, where design is a team effort, the Inspector would ensure that the level of detail and the style is reasonably consistent throughout.

. Data Base

The Department's Data Base group (where applicable) must concur with the data aspects of the specification and confirm that the data storage and access facilities can be satisfied.

. Users

Properly authorized representatives of primary and impacted users must review and approve finalized inputs, screens, reports, and the User Aid Design Specifications.

. System Development

Development management should review the total set of deliverables prior to acceptance for system development.

. Departmental

The approval authority and Management Audit (if they have requested a copy of the Design Specifications), acting on behalf of users, will wish to analyze the report with the following questions in mind:

- Are the proposals consistent with the objectives of the project and the user?

- Is there evidence of active and comprehensive participation of users and support staff?

- Are the projections of resources required for the project and the next phase reasonable?

- Is the project still viable according to the revised cost/benefit?

According to the size and priority of the project it is project management's task to provide evidence that involvement of users and other expertise in the quality control process has occurred.

Project Control

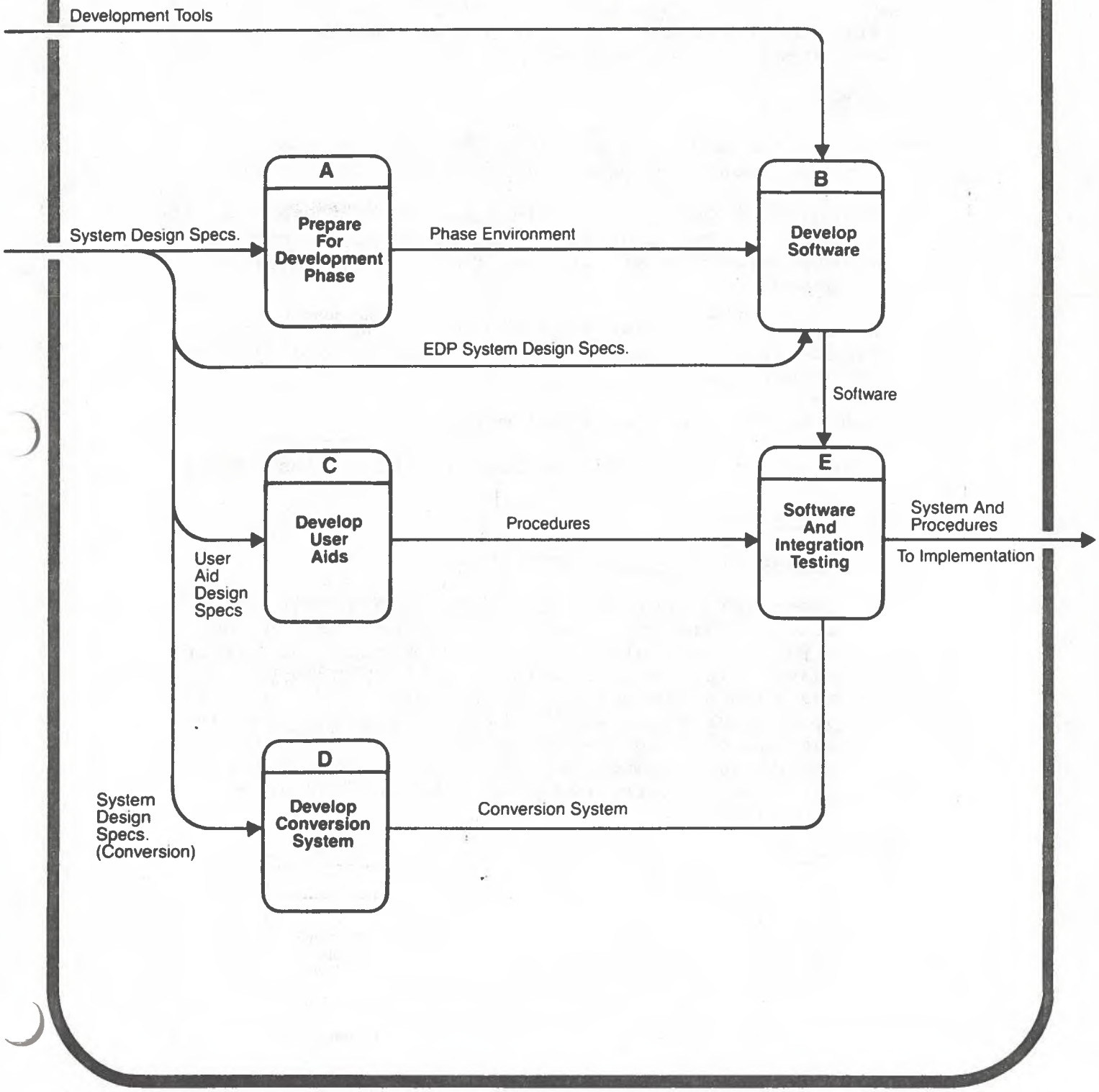
. As described in the previous phases, activities should be monitored at a task level by establishing key milestones with related cost and time objectives. Control of project activities further increases in importance during the Design phase since there is usually substantial technical interdependence among

system components. The Project Manager maintains working relationships with user management, staff responsible for data administration, Department's Data Base group, ISM technical specialists, suppliers, and ISM operations management through regular reviews to ensure early detection of deviation from plans.

- The overall project plan is revised and forms part of the submission to the approval authority.

- A detailed resource plan is developed for the System Development phase and forms part of the submission to the approval authority. Once approved, this plan is used as the basis for handing out assignments and setting targets for the development project team. Additionally, it forms project management's framework for directing the project team's activities and provides criteria against which progress is measured.

Phase 5 — Systems Development



2.6 Phase 5 - Systems Development

Objectives

The objectives of this phase are to develop and test all of the components of the system according to the system design specifications.

This involves coding the program modules, completing the system and user manuals, linking all of these components through a series of steps into the complete system and rigorously testing all components and sub-systems at each stage.

Inputs

- All of the inputs into the system design phase to provide background and clarification if required.
- EDP Systems Design Specifications giving the complete computer system specifications down to the computer module level for all inputs, outputs, storages and processes.
- Development and Test Plan giving the sequence and timetables for the programming, testing and linking of components.
- User Aid Design Specifications.
- Development Tools (Pre-processors, Utilities, etc.)

Activities

A. Prepare for Development Phase

Pre-development activities are those that must start before application development begins but which are not always completed during the Design phase. The objective is to build a good working environment to get the Development phase off to a productive start with as few delays as possible. Special care is needed when contracting out development work; mandatory use of development tools or any other constraints should be written into contracts.

The activities include:

- Preparing Administrative Environment
  - work space
  - technical documentation manuals, etc.
  - supplies, papers, etc.
  - time reporting and other administrative procedures
- Hardware Installation
  - terminals, printers, CPU's, etc., must be installed and tested
- Software Installation
  - prepare and load test files
  - prepare support software: preprocessors, back-ups, utilities, system related command procedures, file dumps, etc.
- Establishment, publication and dissemination of development standards, guidelines and conventions.
- Development team selection.
- Development team familiarization.
- Acquisition of External Services
  - service bureau contracts
  - establishment of account codes
  - contracting of external staff, if required

B. Develop Software

This involves the conversion of module design specifications into detailed logic and then into code with testing at the module and sub-system level. The complete details plus methods of unit (module) testing are given in the Programming Guide.

Before a module is released into the production library, it must be thoroughly tested and documented according to ISM standards. The project management must ensure that adequate internal quality assurance mechanisms are established. These are to address both format and content.

C. Develop User Aids

User aids are prepared as part of the Development phase but are initiated during the Design phase of the project. This involves close cooperation and participation of users to ensure relevance of any material to be used in user areas. The User Aid Design Specification selected and outlined the User Aids to be developed for the system. The Project Manager now ensures that the details of each aid are developed and finalized according to the specified requirements and standards applying to format and presentation.

D. Develop Conversion System

The conversion system alters the components of the existing system so that they can be integrated into the new system. This would include the computer sub-system to convert existing files to the new formats, or the development of manual procedures to allow both the existing and the new system to run concurrently. Its development is similar to any other system.

The outputs from the Design phase identify all components, procedures, files, etc., that need to be converted to run under the new system.

For large conversions, a plan for error testing and correction should be developed.

Additional staff may have to be used to handle the large volume of data to be converted, especially if the existing data is not in machine-readable format.

Some points to note on file conversion are:

- prepare detailed conversion procedures, times, workflows, for user staff and management

- begin conversion early - procedure, programs and manuals for conversion should all be in place before the start of conversion

- "freeze" the files to be converted and convert them

- control all amendments to files after the "freeze" date so that the converted files can be updated before volume testing and parallel running commence

- control all numeric fields and carry out record counts before and after conversion, and at every intermediate step - if the number of existing records is not known or cannot be determined accurately, develop other reconcilation procedures

- use the conversion programs when creating files for volume testing and parallel running - live conversion should not be the only run of the conversion system.

Included in the conversion development are procedures to correct and re-enter those existing data items rejected initially by the conversion system. The Implementation Plan is updated to reflect conversion strategy.

E. Software and Integration Testing

The objective of system testing is to ensure:

a) that the system functions as a whole according to the Functional Specifications; and

b) that the performance and security requirements of the system are met.

The system test package, including test cases, implementation strategies, schedules and timetables provide the framework for testing the systems.

Steps to be performed are:

- finalizing system test plan/test cases

- team orientation to plan

- scheduling of test times according to test plan, development plan and implementation plan

- development of procedures, libraries containing test cases that may cover the following tests (depending on the size, complexity and sensitivity of the system):

  Function test
  Volume test
  Stress test
  Performance test
  Recovery test
  Useability test
  Security test

Storage test
Configuration test
Compatibility test
Reliability test
Serviceability test
Documentation test
Procedure test
Execution of tests and recording of results

- development of regression libraires - a collection of test cases for the testing of all functions not changed by this system to ensure that in fact they are unchanged.

- detailed log of all problems, bugs, etc. The change control procedures should be followed and should distinguish between problems and enhancements.

- plans for verification of results including arranging for expert user personnel to assist in the checking.

Staff from the user area and from Management Audit should be involved in the test of the system. Their satisfaction with the delivered system will be reported to the approval authority as part of the approval process.

Deliverables

. Tested and documented computer system

  - see Deliverables Reference Manual for details on documentation

. Detailed Implementation Plan

. Documented and Tested User Aids

. System Test Results (including users comments on the outcome of the tests)

. Application Software (in machine-readable form)

Quality Control

The System developed during the System Development phase must be acceptable from a number of perspectives:

- Software

  The coding of the modules must be inspected to ensure that the code conforms to the specifications defined during the Design phase. The code for each module should also be tested with the specified test data and the test results verified with the expected results. Finally, the documentation in each program module should be checked for accuracy and clarity.

- Operations

  The program modules must be assembled into sub-systems and into the operational system. The computer operations staff must verify that the software is performing as specified, with appropriate response times, and is not adversely affecting the performance of other systems which may be in operation on the same machine or which may interface with the system being developed.

- Users

  Properly authorized representatives of primary and impacted users must be involved in the preparation of test data and in the performance of the tests. They must also review and approve the user aids which should consist of: user manuals, procedure manuals and training material.

- Departmental

  The approval authority and Management Audit, acting on behalf of users, will review the operational system to ensure that it performs as expected from a Departmental perspective and that the impacted users are satisfied with their involvement in the system testing and development of user aids. If the approval authority is satisfied that the system is complete, from a departmental perspective, he will recommend that approval be given to proceed with the Implementation phase.

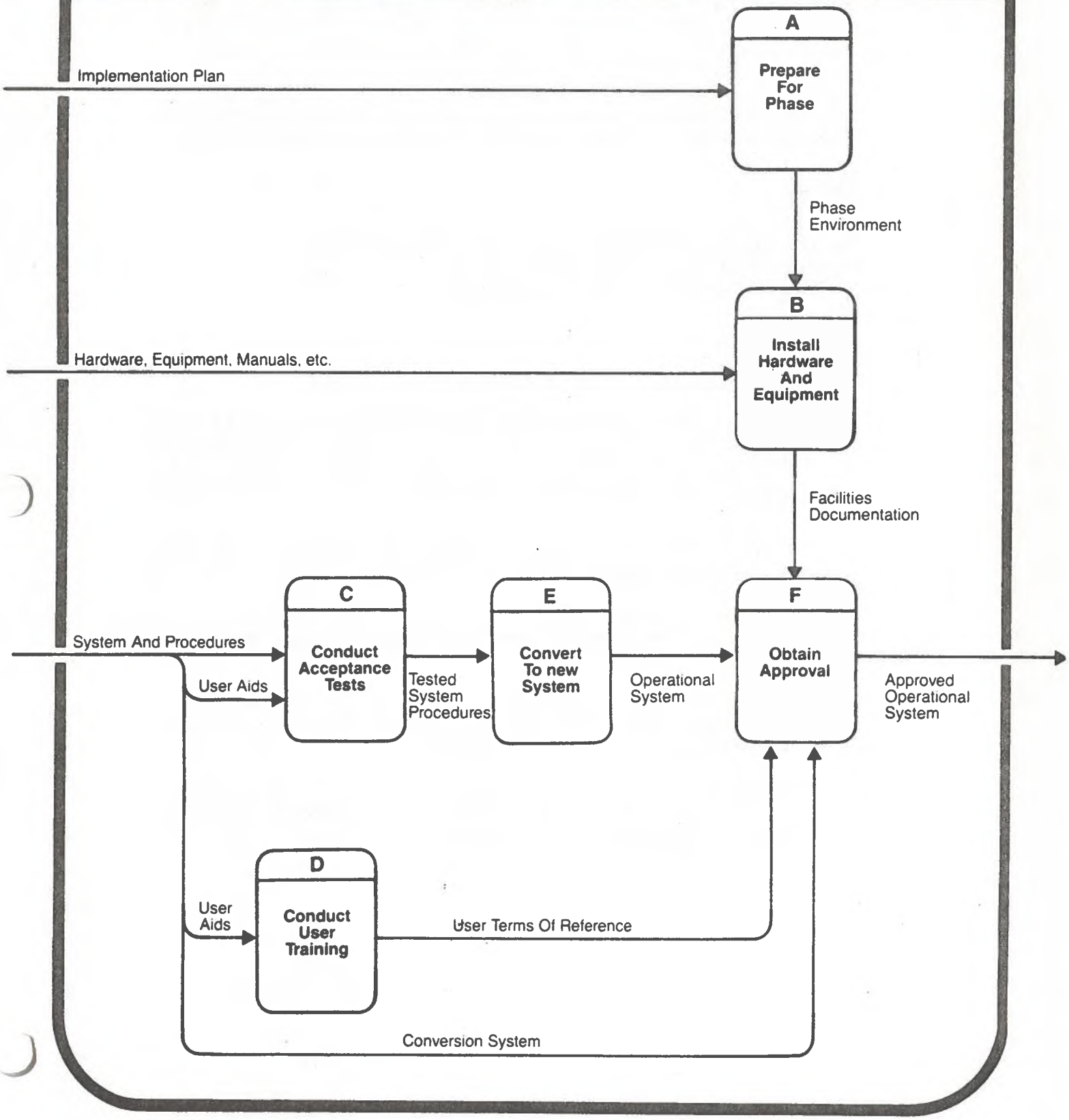
Project Control

- Activities are planned at a task level by establishing key milestones with related cost and time objectives. Tasks are assigned to the development teams or individuals and the Project Manager monitors conformance through regular reports and progress meetings. The goal is to anticipate deviation from plans and schedules so that the Project Manager can initiate corrective action.

Delay during the Development phase is likely to have a considerable ripple effect in the user area, where preparation will be on-going to accept the system. Any deviations which cannot be resolved without impact on dependent plans must be communicated to those responsible for the plans as early as possible.

- During this phase there will be substantial dependencies on activities outside the direct control of the Project Manager. These include data base development which may be performed by staff responsible for data administration or the establishment of a Data Base, availability of machine time for program development, word processing services in preparing user documents and other material, and acquisition of special technical facilities or development tools.

Phase 6 — Implementation



2.7 Phase 6 - Implementation

Objectives

In this phase the working procedures and programs developed are made operational. Users are trained, and operate the new system with the support of the team that developed the system. The support required will initially be significant but will decrease as time passes. Data files are converted from old media to new media and the new system is installed. Tuning of the system will occur during this phase. Parallel running, when applicable, takes place during Implementation.

Inputs

Application Software
User Aids (including Conversion Procedures)
System Test Specification
Software/Hardware Documentation

Activities

A. Prepare for the Implementation Phase

This is the phase with the highest risks with very heavy penalties to the user (in cost, organization and business terms) if it goes wrong. Thus it is imperative that proper preparation goes into this phase.

Ensure that all documentation is brought together including vendor supplied material.

Review dependencies on outside suppliers of hardware, software, machine time, office supplies and other equipment.

Organize briefings for project staff and ensure that user participants are prepared for conversion and trained for system operation.

The organization and staffing for this key phase will vary from project to project according to the size, complexity and scope of the system and the conversion.

The main staffing needs are typically:

- A project leader - used on larger projects to handle some project management responsibilities as well as acting as an advisor to the conversion team(s). This person is normally an analyst or designer who has been involved with the development of the system or sub-system and is familiar with all aspects of it.

- Programming staff - normally at a Senior Programmer level, to assist user computer personnel in taking over the computer system and to act in a trouble shooting mode on problems that arise.

- Computer operating staff - to operate the computer system.

- Technical specialists - to install, break-in and monitor the hardware and/or communications systems (if required).

- Training staff - development team and/or users, to refine and present the training programs.

- User Staff

  - at a senior level, to monitor the impact of the new system on the organization
  - at a supervisory or line management level, to carry out and validate system acceptance tests and to assist in staff training
  - at the operational level, to assist in the conversion

B. Install Hardware and Equipment

The hardware, system software and related equipment for running the system tests, customer acceptance tests and production systems are to be installed.

Arrangements must be made for the following:

- floor space plan for all hardware and equipment
- electrical requirements
- air conditioning
- physical security
- acquisition and storage of forms and other consumable materials

All external agencies who provide the equipment must be informed of what they are expected to do and by when, preferably on a contract basis.

C. Conduct Acceptance Tests

The purpose of the acceptance test is for the users to become satisfied that the system works according to the standards specified in the acceptance test cases. To achieve this, run test data and possibly production data through the entire system (computer and manual).

Ensure that the criteria for ending the acceptance test is clearly defined in the specifications, e.g. two successful productions or one month from the start of production.

Assist the user to generate the test data by having:

- notes kept on different kinds of transactions which occur over a specified time period;
- a small representative sample of master records records; and
- a variety of the kinds of transactions which have occurred.

D. Conduct User Training

Depending on the scope and complexity of the new system, and the operations of the new system, user staff require formal training to be effectively introduced to it.

The training program could be done in four steps:

. STEP 1: General instruction in methods to be used in the new system. This will be aimed at managers, supervisors, and key operations personnel. This could include for example, explanations of the advantages and disadvantages of working on-line, or demonstrations of equipment and visits to other installations using similar techniques if applicable.

. STEP 2: Formal presentation of why the new system is being introduced, a description of how the new system works, and the user's specific role in it.

- STEP 3: Formal instruction in the operating procedures of the new system, together with practical sessions: filling in forms, coding input, operating terminals, and so on.

- STEP 4: On-the-job training, running the system under controlled conditions, as in parallel running.

Training in the actual use of the new system should include:

- general discussion of system logic and where each user fits into the overall picture
- advice on completing input
- practice in completing input
- interpretation of output
- limitations and constraints of the system
- conversion requirements
- best actions on receiving error indications
- practice using test data and test files

Some notes on training:

- All training plans must be documented in the Implementation phase plan in conjunction with the user.

- Procedure manuals from the Development phase must be available during detailed training in the use of the new system.

- Preferably do not mix management with clerical staff in one group; each group will have different training requirements so separate sessions should be held.

- Do not schedule training sessions to coincide with system testing, file conversion, or during peak business times.

- Include "hands-on" practice with forms and equipment whenever possible.

- Follow-up after implementation to see whether additional sessions would be useful.

- Training should cover standby and recovery procedures.

E. Convert to the New System

The changeover from the old system to the new should not proceed unless it has been tested, accepted and the user staff fully briefed and trained.

The following conditions must be satisfied in order to schedule and publish the start of production operations:

- system logic testing is complete and comprehensive test data exists for each procedure
- acceptance testing is complete and signed-off
- all manual procedures are complete
- operating procedures are complete and accepted
- all equipment is installed and working; external agencies have been tested
- interfaces with related systems have been tested
- all files are converted and up-to-date
- user organizational changes are in place, training material is ready, and the operational staff have been trained
- security procedures relating files, programs and documents have been followed
- all essential program amendments are complete and tested - these program versions will be frozen except for errors found in parallel running. All other amendments will be handled as maintenance.

In shutting down the old system using a parallel implementation strategy, the following points should be taken into consideration:

Determine how long the old system will run with the new system in a "live parallel" period.

Consult with the auditors and establish:

- which reports need to be produced on the last day of running the old system (e.g. copies of files in old and new state);
- which files need to be retained and for how long from the old system;

- how long obsolete computer programs should be retained on the source library;

- what archives, photocopies, microfiche need to be created from the old system.

Ensure that all obsolete procedure manuals and input forms are withdrawn on the agreed date for closing down the old system. Determine what action will be taken if the NEW SYSTEM fails during the "live parallel" run.

Have a contingency plan available if the OLD SYSTEM fails during the "live parallel" run.

Establish with the users which system represents the "official" one during "live parallel" running.

Warn the user staff of unusual or temporary conditions that will occur during conversion such as:

- a higher than normal incidence of errors
- an initial slow response on an on-line system due to the unusual heavy load during system start-up.

Monitor the reaction of the user staff carefully to determine whether or not there are any problems.

Establish one trouble-shooting point of contact between user staff and the project team to simplify the monitoring and controlling of any changes. Inevitably, there may be technical "start-up" problems such as residual "bugs" in software and problems with new hardware as it settles down.

F. Obtain User and User Management Approvals and Sign-offs

Project Management must ensure that user approval is obtained for all components of the system and for the system as a whole.

Deliverables

Operational System

Quality Control

The completed operational system must be acceptable from a number of perspectives:

- Functional

  The system does what it is supposed to do as outlined in the Information Systems Requirements Document.

- Documentation Standards

  Documentation is complete and that it is useable and readable by its intended audience.

- Technical

  The performance requirements are satisfied.

- Operational Perspective

  The on-going operational and cost requirements are satisfied.

- User's

  Properly authorized user representatives must review and approve all components of the system.

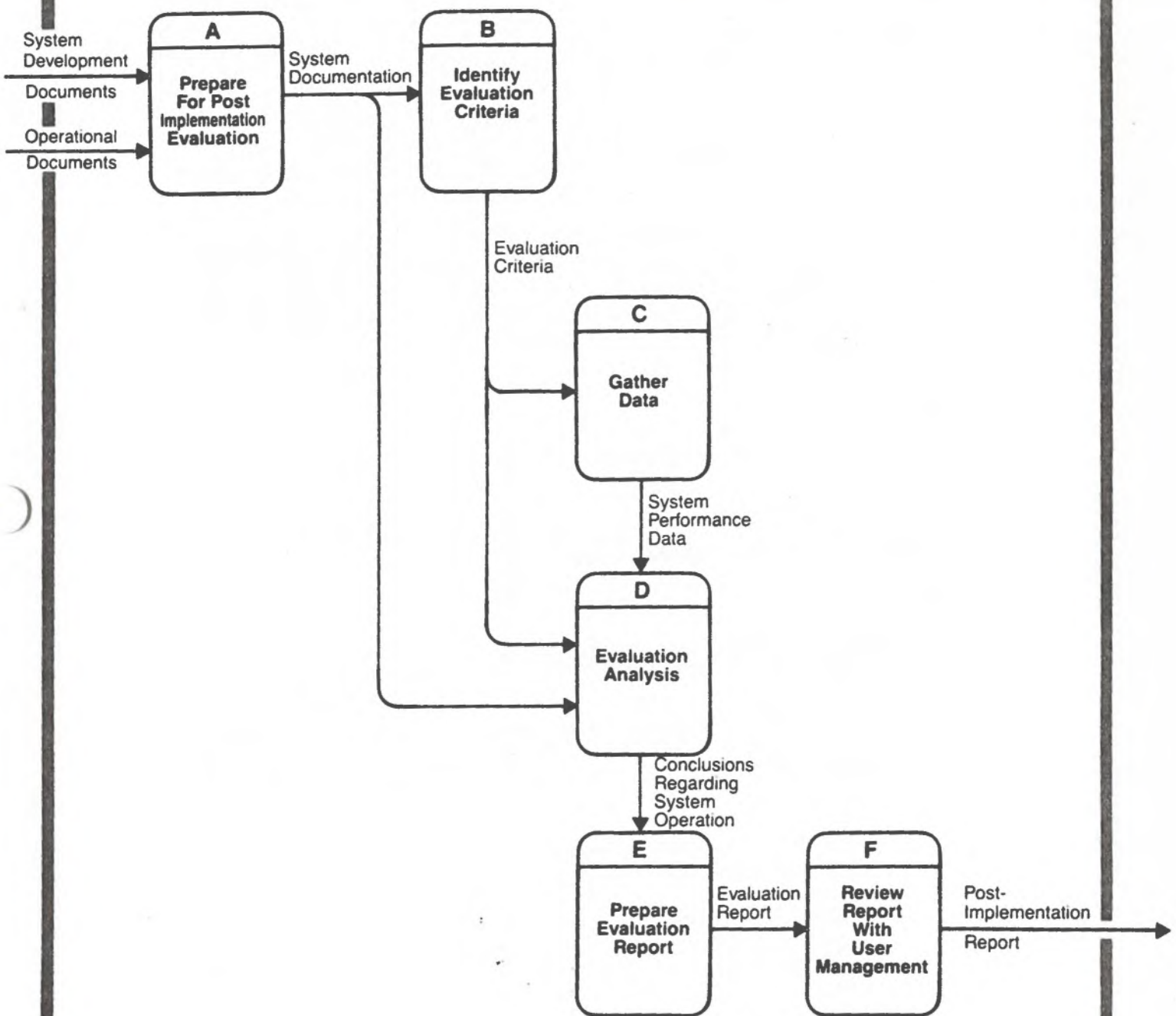
- Departmental

  All of the above criteria have been proven to be satisfied.

Project Control

Activities should be monitored at a task level by establishing key milestones with related cost and time objectives. Control of project activities is critical in this phase as it is the amalgamation of all system components (hardware, software and manual) into a working operational system. There are crucial time dependencies in the preparation and conversion of the system so all tasks in this phase must be closely monitored through regular reviews with all parties concerned to ensure early detection of deviations from plans.

Phase 7 — Post-Implementation



2.8 Phase 7 - Post-Implementation Evaluation

Objectives

The Post-Implementation Evaluation phase is the concluding phase of the System Development Life Cycle. It is usually conducted some months after the system has become operational. During this phase, the conclusions and recommendations of the study group reviewing the system are developed and presented in a Post-Implementation Report. The report is based on the performance of the system after it has been in operation for a reasonable number of months. In addition, the report should supply background information on the development of the system, the measurement criteria applied, and the data upon which the conclusions and recommendations are based.

There may be an optional objective as well, to determine the extent to which the systems development and implementation processes were successful with respect to approaches, problems, estimates and project team satisfaction. Based upon these, areas of future improvement should be suggested.

Inputs

- All of the documentation prepared for the development process,
- Operational documenation generated during the system's operational life.

Activities

A. Prepare for Post-Implementation Evaluation

- Appoint a person responsible for delivering the report. Ideally, a senior analyst not previously involved on the project, a person from Management Audit or a senior member of the user staff.
- Identify senior project staff to provide information on the project.
- Organize users and operations staff to collect system performance data over a planned period, and to evaluate the operational and procedural aids.

B. Identify Evaluation Criteria

List measurements to be used in assessing extent of achievement:

- original performance and security goals
- cost/benefits
- functions addressed
- development targets - costs/schedules
- qualitative performance of project staff - in-house/contracted
- productivity of project staff - in-house/ contracted - performance of development tools
- technical requirements specified

C. Gather Data

Conduct a detailed analysis of how well the project and system performed in respect of each of the criteria. Evaluate each quantatively if possible and report conclusions separately for system performance components and project development process components.

For benefits, identify unanticipated benefits as well as achievements in regard to original benefits.

For costs, prepare a matrix of planned versus actual costs for development and operations. Explain significant variances.

D. Evaluation Analysis

Identify any problems that currently exist, which fall within the scope of the system. These problems will typically fall into four categories:

- problems which existed prior to system implementation, but were not recognized;

- problems which existed prior to system implementation and which were recognized but have remained unsolved;

- problems which have arisen following system implementation, as a direct result of system installation;

- problems which have arisen following system implementation, but not as a result of the system.

The impact of each of the problems should be fully explained and they should be arranged in order of importance.

Evaluate the system support by comparing actual to planned. Deviations should be explained. Support should be analyzed from the point of view of adequacy and future requirements.

E. Prepare Report

Conclusions regarding system operational efficiency, viability, development and need for improvement should be presented. If action is required to effect improvements, recommendations along with a proposed implementation plan should be developed. Any recommendations concerning the development process should be highlighted.

F. Review with User and Senior Management

Deliverables

Post-Implementation Report

- Executive Summary
- Introduction
- Background
- Evaluation Criteria
- Analysis of Accomplishments
- Problem Areas
- Evaluation of On-Going Support
- Conclusions and Recommendations

Quality Control

The Post-Implementation Review Report must be acceptable from a number of perspectives:

- Factual

  Attention must be paid to the factual reliability of the information gathered and used in the preparation of the report. Wherever possible, quantitative data should be used.

- Users

  Properly authorized representatives of primary and impacted users must review and approve the results.

- System Development Team

  Review and approved by Project Manager.

- Departmental

  Sign-off by Approval Authority and Management Audit acting on behalf of the user.

Project Control

As with all other phases, activities should be monitored at a task level by establishing key milestones with related cost and time objectives. The Project Manager must ensure that all components required to produce the report are completed within their resource allocations.

SECTION 3

DELIVERABLES SUMMARY

3. DELIVERABLES

Introduction

This section provides a list of deliverable and their tables of contents. For a complete description of each of the deliverables refer to the Deliverables Reference Manual.

3.1 Initiation Report

1. Project Identification
2. Problem/Requirement or Opportunity
3. Approach
4. Project Responsibilities

3.2 Feasibility Report

3.2.1 User Requirements

1. Executive Summary

2. Introduction

3. Description of Business Processes

    3.1 Overview
    3.2 Business Process 1
        3.2.1 Function Chart
        3.2.2 Function Descriptions
    3.3 Business Process 2, etc.

4. Evaluation of Existing Systems

    4.1 Overview
    4.2 Business Process 1
        4.2.1 Physical DFD
        4.2.2 Process Descriptions
        4.2.3 Observations
        4.2.4 Evaluation
    4.3 Business Process 2, etc.

5. User Requirements

    5.1 Overview
    5.2 Business Process 1
        5.2.1 Logical DFD
        5.2.2 Process Descriptions
        5.2.3 Requirements Notes
        5.2.4 Preliminary Data Definitions
    5.3 Business Process 2, etc.

3.2 Feasibility Report

3.2.2 Conceptual Solution

1. Executive Summary

2. Introduction

3. Solution Alternatives

   3.1 Evaluation Criteria
   3.2 Solution 1
   3.3 Solution 2, etc.
   3.n Selection of Preferred Solution

4. Conceptual Design of Proposed System

   4.1 System Objectives and Scope
   4.2 System Overview
   4.3 System Components
   4.4 Technical Requirements
   4.5 User Impact
   4.6 Conversion Requirements

5. Costs and Benefits

   5.1 Summary
   5.2 Cost Estimates
   5.3 Benefits
   5.4 Assumptions

6. Preliminary Resource Plan

7. Recommendations

8. Detailed Plan for Analysis Phase

3.3 Information System Requirements - Contents

This set of documentation is made up of the following components:

1. Executive Summary
2. Revised Cost/Benefit
3. Functional Specifications*
4. System Performance and Security Goals
5. Revised Technical Requirements
6. Revised Resource Plan for Project
7. Detailed Resource Plan for Design Phase

* These are documented on a modular basis according to the number and size of business processes being studied.

Each module will have its own reference number which should be assigned as part of the department's information system network. The table of contents for the Functional Specifications follows:

FUNCTIONAL SPECIFICATIONS

1. Introduction

2. Principal Recommendations
   - 2.1 System Design
   - 2.2 Policies
   - 2.3 Other

3. Description of Existing System
   - 3.1 Function Charts
     - . Overviews
     - . Detailed
   - 3.2 Data Flow Diagrams
   - 3.3 Narrative Description
   - 3.4 Trends

4. Description of Logical System
   - 4.1 Logical Data Flow Diagrams
   - 4.2 Narrative
     - . Objectives
     - . Description
   - 4.3 Data Dictionary

5. Description of Proposed Business System
   - 5.1 Physical Data Flow Diagram
   - 5.2 Process Descriptions
   - 5.3 Data Flow Descriptions
   - 5.4 Data Store Descriptions

6. Effect on Existing Systems
   - 6.1 Manual Systems
   - 6.2 EDP Systems

7. Conversion Considerations

3.4 System Design Specification

This is comprised of a collection of documents, as follows:

1 Executive Summary

2 Revised Cost/Benefit

3 Revised Technical Requirements

4 EDP System Design Specification*

5 Design Specification of User Aids*

6 System Test Specification*

7 Revised Project Plan

8 Detailed Plan for Development and Implementation Phases

* These are specification documents. Their tables of contents follow.

EDP Systems Design Specifications

4.1 System Description

4.2 System Flow

4.3 Data Element Dictionary

4.4 Index of Files

4.5 File Definitions

4.6 Index of System Inputs

4.7 System Input Definitions

4.8 Index of System Outputs

4.9 System Output Definitions

4.10 Index of Program Communications Areas

4.11 Program Communication Area Definitions

4.12 System Interfaces

4.13 System Controls and Audit Trails

4.14 Software, Hardware and Communication Environment

4.15 Contingency Plans

4.16 Conversion

4.17 Index of Programs

4.18 Program Specifications

4.19 System Maintenance Considerations

Design Specification of User Aids

- User Manuals
- Operators Manuals
- Training Materials
- Procedure Manuals
- Conversion Procedures

System Test Specifications

6.1 Test Plan

- 6.1.1 System Narrative
- 6.1.2 Testing Overview
- 6.1.3 Resource Requirements
- 6.1.4 Responsibilities
- 6.1.5 Schedule
- 6.1.6 Test Case Coverage Matrix

6.2 Test Specifications

- 6.2.1 Purpose
- 6.2.2 Method

6.3 Performance Evaluation Criteria

3.5 Program Module Documentation

1. Detailed Module Specification

2. Program Source Listings

3. Unit Testing

    3.1 Module Test Plan
    3.2 Test Data
    3.3 Test Results

3.6 User Manual

1. Introduction
2. Maintenance and Distribution of Manual
3. Procedure for Obtaining System Support
4. Responsibilities for Various Organizational Units
5. System Overview
6. Overview of Tasks
7. Task Indices and Frequencies
8. Task Instructions
9. Input Indices
10. Input Descriptions
11. Output Indices
12. Output Descriptions
13. CRT Screen Index
14. CRT Screens

Appendices

3.7 Procedure Manual

Table of contents varies according to user needs and should be determined for each system and for each organizational unit.

3.8 Training Manuals

1. Introduction
2. Training Responsibilities
3. Examples of Processing Cycles
4. Examples of Coding
5. Examples of Balancing
6. Examples of Tracing
7. Examples of Features
8. Required Training

APPENDIX A - Original Training Plan

3.9 Computer Operations Manual

1. Introduction
2. System Overview
3. Schedule
4. Job Submission
5. Report Distribution
6. Restart/Recovery Procedures
7. File Retention Schedule and Disposition

3.10 Post-Implementation Report

1. Executive Summary
2. Introduction
3. Background
4. Evaluation Criteria
5. Analysis of Accomplishments
6. Current Problem Areas
7. Evaluation of On-Going Support
8. Conclusions and Recommendations

SYSTEMS DEVELOPMENT LIFE CYCLE METHODOLOGY
PROJECT MANAGEMENT HANDBOOK

SECTION 4

CHANGE CONTROL

4. CHANGE CONTROL

4.1 Objectives

During the development life cycle:

- to ensure that any requested change to a component of the system is properly documented, justified and authorized;
- to obtain approval for any recommendation to proceed with the change;
- to effect the change and modify documentation and plans accordingly.

N.B. Change control should only be effected when significant changes are proposed. Minor adjustments and amendments should be accomodated through application of good sense and reasonable flexibility as long as all documentation is amended to reflect the change. Bureaucratic excess is not intended.

4.2 Input

Project Change Request

- Project Identification
  - Project Name
  - Originator/Section or Branch

- Details of Change
  - Identity of document to be revised (Initiation Report, Functional Specification, etc.)
  - Description of Change

- Justification

- Approval Authority

Change Control Log

4.3 Activities

- Project manager screens request and verifies that the request is properly documented and authorized.

- If it is evident that the impact on the project is insignificant, at his discretion, the project manager may have the change effected immediately, and dispense with formal change procedures.

- All other Change Requests are logged and their status recorded.

- If required, an analyst is assigned to determine the impact of the requested change and to document the effect on:

  - project schedule and budget;
  - operations costs;
  - project documentation; and
  - the organization.

- The impact is evaluated and a recommendation as to the action to be taken is made. If significantly affecting the project budget or schedule, the recommendation is submitted to the project approval authority.

- Once approved, the recommended action is effected and the log of Change Requests is updated.

- Amendments to the specifications and other project documents are distributed to holders.

- The originator of the Change Request is formally advised of the action taken.

4.4 Deliverables

Impact Report identifying impact on:

. project;

. plans;

. costs/benefits; and

. organization, with recommended action to be taken.

Revision to appropriate formal project documents.

Change Control Log.

4.5 Quality Control

Technical support staff should verify the technical feasibility of any EDP change.

The user community should verify changes to documents previously approved by them.

The Project Manager should assign a member of the project staff to log requests, to ensure appropriate analysts, designers and programmers participate in the impact analysis, and to monitor action taken.

4.6 Management Control

The Project Manager ensures that the project plans are amended and custodians of impacted plans have been consulted and are aware of decisions affecting them.

Potentially impacted are:

. Users;

. Other project managers;

. Suppliers;

. Contractors; and

. Departmental Long Range Systems Plan.

4.7 Change Control Log

Purpose

To maintain a chronological record of requested revisions to the system during the life of the development project.

Preparation and Maintenance

The project manager should ensure that the log is maintained and all formal requests for revisions are recorded and controlled.

Contents

1. Reference No. - number applies to Change Request documentation

2. Description of change (Summary)

3. Dates:
   - Received
   - Planned Implementation
   - Implemented

4. Author of Request and Organization

5. Revisions effected by (list those project staff responsible).

SYSTEMS DEVELOPMENT LIFE CYCLE METHODOLOGY
PROJECT MANAGEMENT HANDBOOK

SECTION 5

PROJECT DOCUMENTATION AND RECORDS

5. PROJECT DOCUMENTATION AND RECORDS

A set of well ordered project records and documentation is essential to efficient management of any project. For really large projects producing substantial volumes of information, it may be appropriate to appoint a project librarian to manage and control the documentation function and, for EDP projects, to interface with the documentation library where master copies of system specifications and current system production documentation is retained.

A set of project documentation is organized into four groupings:

A. Approval Records

This group contains the Project Initiation Request, a chronological set of formal approval records and supporting material related to the approval process. This group would contain reference type material and be fairly dormant.

B. Project Management Documents

These are working documents for the purpose of managing the project on a day to day basis and subsequently form a record of the project management process. This group contains:

- Project and Phase Plans;
- Budgets;
- RFP's and Tenders;
- Contracts and Agreements;
- Project Organization;
- Role Definitions;
- Personnel Information.

- Dependent Plans:

  - User Community HQ and Regions;
  - Data Administration;
  - Technical Facility Procurement;
  - Department's Long Range Systems Plans;
  - Administration, Personnel, etc.;
  - External Services - Service bureau, Leasing;
  - Other Support Services.

- Project Diary, a chronological log of important events during the life of the project. This would include meetings, distribution of major documents, walkthroughs, completion of milestones, etc.;

- Bring Forward System for follow up action;

- Change Control Records;

- Correspondance and Records of:

  - interviews with users;
  - inspections and walkthroughs;
  - project management and other meetings;
  - important telephone conversations.

- Status Reports, to approval authority and from project team;

- Project Time and Cost Reports:

  - Time Sheets;
  - Resource Utilization.

- Phase working documents;

- Any other special tools and aids;

- Other administrative records.

C. Production Documents

These are the documents which initiate and support the production system process:

- System Conversion Procedures;

- Training Manuals and Aids;

- User/Procedure Manuals;

- System Operation Manuals.

With the exception of the System Conversion Procedures all are maintained during the life of the production system.

D. System Development Documentation

This group contains the formal specifications essential for orderly development and maintenance of the system. Each of the documents is a point of reference for linking one development activity to another, and for subsequently examining any proposed change to the system or its requirements.

This group is comprised of:

- Initiation Report;
- Feasibility Study;
- Information Systems Requirements*;
- System Design Specifications*;
- Conversion Specifications;
- Programming Specifications and Source Listings*;
- Program and System Test Specifications.

* these documents are maintained during the life of the production system.

SECTION 6

PROJECT MANAGEMENT TECHNIQUES

6. PROJECT MANAGEMENT TECHNIQUES

6.1 Categories of Projects

Depending upon the user's specific requirements, it may be necessary to categorize projects for the purpose of monitoring and determining which are subject to life-cycle processes. Typical categories are:

- New Development
- System Enhancement
- Maintenance
- Repairs

These may be further categorized by estimated cost and impact.

6.2 Organizing Staff Resources

Project Managers should tailor the project organization to the specific goals of the project. A project organization with clearly defined roles, responsibilities and relationships will ease the task of selecting the staff to match the skill requirements.

Project Staffing Considerations

Project staffing at best, is a compromise between:

- availability of people
- the suitability of their skills and personalities
- the desire to meet individual career objectives

There are four categories of people required on systems development projects:

- people with strong project management skills
- people with good experience in, and knowledge of, the application subject matter
- people with strong technical experience and knowledge; and
- people with disciplined analysis, design and development skills.

For example, on a large mainframe development project in a batch environment, we might rate the relative importance of the four skill sets as follows (on a scale of 1 to 10):

Project Management	10
Subject Matter	5
Technical	3
General Systems	8

On a project to do an equipment/software evaluation, analyzing products on the market and making a recommendation, the mix would be different:

Project Management	8
Subject Matter	2
Technical	10
General Systems	6

Hence, an up-to-date skills inventory for the available resources is an essential ingredient in project staffing.

Communication Planning

For projects where large numbers of staff are directly or indirectly involved, a communication plan is required to address the problem of dissemination of information about the project during its life cycle.

This has two purposes:

- To familiarize staff with the project, with their roles and with the standards and guidelines at the time they are inducted into the development process.
- To communicate periodic project status reports of a general nature to the user community which may have to wait extended periods of time between visible project activity, e.g. between approving functional specifications, and implementation activity.

Consideration during planning should be given to:

- developing familiarization material
- providing seminars
- issuing newsletters and relevant articles
- giving demonstrations (for example, as a by-product of successful system test)

Styles of Leadership

TELL — The authoritarian Project Manager. Because of the negative motivators normally associated with this style, it tends to be ineffective when used with creative, highly intelligent professionals.

JOIN — The Project Manager as "one of the boys"; the so-called "country club manager" whose style is to produce such a feeling of camaraderie in the team that people are loved into doing their best work. While not effective as an on-going strategy, this style can be very effective with a small group of self-motivated professionals on a project with a short time span and tight delivery constraints where it becomes a challenge to people's maximum abilities to meet all project objectives.

SELL — The Project Manager as "super-salesman", whose talent lies in making people believe that meeting all project objectives, both short-term and long-term is in the best personal and career interests of every member of the project team. This stye is quite effective, but can only be used by Project Managers with superb natural selling skills.

CONSULT — Probably the most effective leadership style for the average Project Manager. It recognizes the fact that the Project Manager is not filling his role because he is a superman, or has fantastic management skills, but simply because the job (managing the team and the project) has to be done by someone, and he was selected this time around. Recognizing that every member of the project team is an expert in his particular assignment area, the "consult" Project Manager makes decisions by getting opinions from each team member who can bring some experience to bear on the problem (or non-team members, if the experience is not contained within the project team) and integrating all available information.

There are other styles of leadership, and there are styles which are combinations of two or three of these "pure" styles. And there are good arguments for changing one's leadership style as required to suit the particular environment of each project. The best Project Managers are ones who recognize the importance and visibility of their style of leadership, both in terms of being effective and in achieving their own career goals, and in terms of developing the people in the organization that they have been assigned to manage. Recognition is the necessary first step in improvement.

Motivation

How motivated are the staff in your group? If they appear somewhat sluggish at times, quit too early, complain often, or partake in on-the-job retirement, perhaps their motivation could be improved. The Project Manager's accomplishments relate directly to his ability to use resources in motivating his staff to accomplish organizational goals.

Motivation can be defined as the activation and direction of behaviour. Motivation must come from the individual, but the external situation produces conditions that affect the quantity and quality of the individual's motivation. Motivating conditions can be

viewed as positive (the carrot) or negative (the stick). For instance, using the stick, an avoidance form of motivating produces motivation just as using the carrot, an approach form does. Both activate behaviour; both direct behaviour. The results, however, over a period of time may be quite different.

Research has shown that the stick is less effective than the carrot in democratic and semi-democratic organizations. The stick works only as long as its implied threat of punishment can be readily wielded. In non-democratic organizations, e.g., the armed forces, it can be highly effective because the threat is real and continual.

The following factors are usually motivators:

True Motivators	Management Implications
Achievement	Offer continuous opportunity to perform by setting of meaningful and challenging objectives.
Recognition	Continuously reinforce achievement as a desired behaviour through the efficient use of sound supervisory practice.
Possibility for growth (professional growth)	Diversify the experiences and responsibilities of staff by changing job functions systematically.
Advancement	Provide challenge and opportunity for personal movement within the organization.

Knowing what motivates staff is not enough. This knowledge must be used to achieve organizational goals. The Manager is concerned with getting the job done as efficiently as possible, not about motivating staff per se. Motivating staff is a means to an end, not an end in itself.

Motivation Through Job Enrichment

A very significant evolution has taken place over the last ten years in the nature of every job in the data processing community. Our jobs are constantly becoming more enriched, both horizontally and vertically, as our systems development methodologies become more sophisticated and as our professionalism matures.

The Project Manager's job has become enriched vertically, as he has pushed the responsibility for day-to-day technical leadership of the team down to a Senior Systems Analyst who acts as Project Leader, and in turn, he has been freed to take on true management tasks from his superior. The job of the Systems Analyst has become richer, both vertically and horizontally: vertically, because of his assumption of the team leader role, and his handling of tasks previously handled by the Project Manager, such as estimating and scheduling; horiziontally, because of his greater responsibilities in user liaison.

The largest single problem of our industry today is the "programming problem": how do we improve the programmer's attitude, get his commitment and improve his productivity? As the level of sohpistication of our hardware, software and methodologies continues to increase, the programmer perceives the creativity of his task being constantly eroded. In many shops, the programmer has become nothing more than a coder with a multitude of repetitive, insipid clerical tasks to perform.

It will be the Project Manager's major challenge over the next ten years to find ways to enrich the programmer's job. This can be accomplished through:

(a) Horiziontal job enrichment. The temporal scope of the programmer's job can be broadened to include responsibilities in a number of project phases from Design through to Implementation. By letting the programmer play an important part in the creation and delivery of a product from start to finish, we can increase the motivating factors in his environment.

(b) Vertical job enrichment. The programmer has matured to the point where he is ready to take on higher level tasks such as time and manpower estimating and supervision or coordination of specific tasks and more junior people. Giving the programmer such opportunities will promote programming as a career in itself, rather than simply an intermediate function to be tolerated until a "promotion" to Systems Analyst comes along.

6.3 Estimating

During the project life cycle, time and manpower estimates have to be produced or revised at the end of every phase. The Project Manager and the team are expected to be able to provide very accurate estimates for the next project phase, and fine-tune estimates for all subsequent phases.

There are two phases during which the estimating task is particularly difficult:

- at the end of the Feasibility Study phase, when very little information about the proposed system is available, but nevertheless estimates must be produced for the entire development and implementation effort.

- at the end of the Systems Design phase, when very accurate estimates must be produced for the Systems Development phase - a phase which often consumes 50% of the total project resources.

These two important estimating stages call for different techniques.

Feasibility Study

During the Feasibility Study, two techniques have emerged:

1) Table Method

   - decide which factors affect systems development time in your shop. Examples:

     - size of system (number of programs)
     - system complexity
     - on-line requirements

   - set up a matrix using historical data which lists typical systems development times or costs for each combination of project size (to the nearest five programs), complexity (simple, medium-complex, complex) and on-line vs. batch requirements.

     This method provides a very rough approximation of development costs. Normally, it is not sufficiently accurate to be useful as an estimating technique in itself, although it may be used to check the accuracy of estimates made using a different method. The biggest problem with this technique is the difficulty of collecting a sufficiently-large data base of information on past projects to build a comprehensive matrix.

2) Parametric Method

Number of man-days = P x SC x FA x FM x FS
where SC = (DM + FR + AC + CC) x OL x PL

P = Anticipated number of programs to be written

FA = Is this the first computerized application for this user? Yes = 1.2, No = 1

FM = Is this the first computerized application for this particular application? Yes = 1.2, No = 1

FS = Is this the first application to be placed on this computer? Yes = 1.2, No = 1

DM = Anticipated amount of data manipulation in the system - assign weighting factor in the range 2 to 8

FR = Anticipated amount of file re-structuring necessary - assign weighting factor in the range 0 to 4

AC = Anticipated complexity of arithmetic calculations - assign weighting factor in the range 1 to 5

CC = Anticipated complexity of condition checking (editing) - assign factor in the range 1 to 7

OL = Is any part of the system on-line? Yes = 1.5, No = 1

PL = Anticipated complexity of program linkages = P/20 (Equal to 1 for P less than 20)

This formula produces surprisingly accurate results, but many people feel the assignment of weighting factors is a totally subjective activity and liable to produce widely varying estimates. Most of the parameters in this formula are self-explanatory, but many are described more fully in a later discussion.

System Design

Estimating - A Parametric Technique

This technique can be used to produce accurate estimates of manpower requirements for the Systems Development phase.

Step 1		Step 2		Step 3		Step 4
Program Complexity	x	(Programming Know-How	+	Programmer) Job Knowledge)	=	Program Development Time

Step 1. Program Complexity

Step 1A. Weight Program Input and Output Characteristics

Assign weights to input and output as shown in the Weighting Guide - See Appendix D.

Step 1B. Weight Program's Major Processing Functions

The processing functions which occur within a program fall into several or all of the categories shown below. Keep in mind that these categories are general in nature. When written, the program will comprise a series of logic and arithmetic coded instructions which implement these functions. When estimating program development time it is not known of course, which, or how many, of these coded instructions will be needed. By a consideration of functions rather than number of program steps, the program's complexity can be more accurately gauged.

The estimator must first determine whether a function applies to the program he is estimating; second, if it does apply, he must determine whether its function is simple, complex, or very complex.

For example, a program may involve one complicated calculate routine and may rate a "complex" calculate. On the other hand, another program might involve many simple calculate routines but also be rated "complex". A function within a program, such as calculate, would always be viewed as a whole when determining weighting points. For example, if a function will perform five simple calculates, the total of its weighting points is equal to that of one simple calculate, or that of one complex, or of one very complex calculate, and not five times the weight of a simple calculate.

On occasions, table values have been selected between simple and complex or between complex and very complex. This is to emphasize that these weightings are not precise and are not intended to preclude the use of judgement.

The categories of processing functions are listed and described as follows:

- RESTRUCTURE DATA

  Combining, condensing, rearranging, or deleting data. Do not consider building output formats as this consideration is provided for under I/O Weightings.

- CONDITION CHECKING

  Control checks such as header and trailer label routines, reasonableness checks, limit checks, and error routines associated with these procedures.

- DATA RETRIEVAL AND PRESENTATION

  File search, table lookup, randomizing techniques for record access, and indexing associated with these activities.

- CALCULATE

  Arithmetic computations of all types excluding simple steps taken in connection with one of the other categories (for example, add 1 to a counter).

- LINKAGE

  Program overlay routines, check point and restart procedures, routines required to permit a program to interface with a programming system or with another program or program module.

Step 2. Determine Programming Know-How

This step in the estimating technique is an attempt to recognize the degree to which staff experience affects program development. Each Programmer assigned to the project should be assigned an experience factor based on the type of program(s) he will be responsible for writing. When the estimator does not know the individuals who will be assigned, he will have to use a group average.

Step 3. Determine Programmer Job Knowledge

Job knowledge, as used in this context, refers to the degree to which the Programmer must understand the subject to be programmed.

Step 4. Determine Program Development Time

. Hardware Specific Programs

Program development time is determined by multiplying the program complexity weightings from Step 1 by the man-day factors for programming know-how + job knowledge, developed in Steps 2 and 3.

For example:

Run XXXXX	Weighting		Man-Days Per Program Weighting Points
Input (Step 1A)	2	Programming Know-How (Step 2)	1.00
Output (Step 1A)	4	Job Knowledge (Step 3)	1.25
Processing Functions (Step 1B)	8		
Total	14	Total	2.25

Programming time = 14 x 2.25 = 32 man-days

. Transferable Programs

Programs which are to be plugged into the system represent a special estimating challenge. The future indicates that transferability will be used with increasing frequency. So far, the technique has not dealt with these programs to any great degree, but the following is a way for the estimator to handle them.

First, estimate the programming time as though the program were to be installation-written. Go through Steps 1, 2, 3 and 4 above.

Second, assume the degree to which the program is transferable. This will vary from completely transferable (100%) to only logic transferable, with some changes required (25%).

Third, combine these two estimates by means of the following tabulation:

Assume Degree of Transferability (per cent)	Percentage of Step 4 Program Time to be Used
100	10
75	25
50	50
25	75

Summary of Programming Activities

A generally-reliable allocation of time for programming activities is:

Defining Program Logic	35%
Coding and Developing Test Data	25%
Testing and Debugging	35%
Final Documentation	5%
Total	100%

These percentages apply to installation-written programs only. General purpose and "package" programs do not necessarily fit this pattern. The above percentages, in conjunction with Lost Time Factors (Step 6) and Non-Project Lost Time Factors (Step 7), can be used to develop schedules for the Programmers.

Step 5. Determine Other System Development Time

This step expands programming time into the productive man-days required to complete the following project tasks:

Project Management and Planning
Design Analysis
Development Other than Programming
Test the System
User Education and Documentation
Installing the system and follow-up

Experience indicates that other development time ranges 70% to 110% of programming time. Factors which will push this toward the upper range include:

- Need to prepare extensive clerical instructions.

- Extensive system analysis and design because of a lack of established guidelines.

- Lack of close coordination with other groups and attendant delays while waiting for approvals.

- A large amount of project staff training because of the degree of job knowledge needed.

- Difficult conversion process. When the new system must be phased in as replacement for an existing system, the conversion problems are more complex than if the new system is a "first-time process".

One-time and special-study programs frequently require very little system development time. When input is clearly defined (usually because it is already in existence) and output formats are simple, a 20% relationship would be more realistic.

Because of limited experience with this estimating technique, a way to apportion time for analysis, design, development, testing, installation and follow-up has not been developed. The estimator may wish to estimate the time for each of these related activities, and the total becomes the "other development time".

Step 6. Apply Loss Factor

The project loss factor is designed to recognize Programmer/Analyst time devoted to the project but consumed by activities which do not directly help the project toward completion. These include the following:

- Administrative tasks such as explaining the new system to users and management.

- Programmer turnover.

- Job changes which require work to be redone.

- Non-availability of computer time because of heavy workloads.

- Incorporating revisions to software programs.

- Inability to coordinate with another group until a particular individual is available.

- Program test performed incorrectly.

- Slow and incorrect clerical support.

- Time sheet preparation.

- Coffee breaks.

A reasonable estimate for lost time would be 10% of the time spent on the project. When new equipment and programs are being used this can go as high as 20%. In practice, lost time is reported and charged to the project. It is too closely entwined with all project activities and cannot be reported separately on a time sheet in any meaningful way. The fact that it cannot be easily measured does not mean it isn't real; and so it must be included in the estimating technique as a loading factor.

Step 7: Complete the Estimate of Project Duration

Steps 1 through 5 identify the components of the estimating technique. Step 7 puts them together to form a complete estimate in man-months.

Selecting Programmers for the Project Team and Matching their Capabilities to the Work to be Done

From the most-commonly-used parametric method of activity time estimating, it can be seen that the two factors which influence the development time are:

- the complexity of the task, and
- the capabilities of the person who will do the work.

The complexity of the task is a fixed quantity over which we usually have no control. On the other hand, we usually have some control over the person who will be assigned to the work.

Let us assume that we know which Programmers will be available for the System Development phase before our estimates have to be made (if we don't, our estimates will have an extremely low confidence level and thus the entire discussion is wasted). Our task is to create a manpower plan.

Since the development time is most affected by the Programmer's experience and his knowledge of the application area, the ideal situation for the shortest possible elapsed time would be to have a Senior Programmer with detailed knowledge of the application area for each task to be done. The probability of this happening would be very low indeed.

Project "Lost Time" Factors

1) Related project work which is ignored in producing the estimate:

   - refining the requirements, design modifications inter-departmental coordination, training the members of the project team, dependence on other groups or people, etc., are known to add 25% to 120% to the development time. 100% is about average.

2) Project lost time factor:

   - employee turnover, computer unavailability, time spent on administrative tasks, etc., are known to take as much as 20% of total project time.

Partitionable vs Unpartitionable Tasks

NOTE: According to Fred Brooks, Project Manager for IBM's OS development project, cost varies as the product of the number of men and the number of months. Progress does not.

Men and months are interchangeable only when a task can be partitioned among many workers with no communication required between them. This type of situation exists when the task is picking berries. It does not even approximately exist when the task is information systems development.

- When a task cannot be partitioned because of sequential constraints, the application of more people to the task has no effect whatsoever on shortening the elapsed time to completion. In fact, beyond the optimum manpower assignment, adding more people to the job will actually increase the elapsed time as well as the cost, since the communication requirements will detract from the process.

- In tasks that can be partitioned but which require communication among the sub-tasks, the effort of communication must be added to the amount of work to be done. The best that can be done is somewhat poorer than an even trade of men for months.

The burden of communication is made up of two parts: training and intercommunication. Each new person on a project must be trained in the technology, the project goals, the overall strategy and the work plan. This training cannot be partitioned, so this part of the added effort varies linearly with the number of people on the team.

Intercommunication is worse. If each part of the task must be separately coordinated with each other part, the effort increases according to the formula.

$$I = \frac{N\ (N-1)}{2}$$

Where I is the magnitude of the intercommunication and N is the number of people on the team. For a team of three people, I = 3. For a team of six people, I = 15. Doubling the size of the team has multiplied the magnitude of the intercommunication by a factor of 5.

Since systems development is inherently an exercise in complex interrelationships communication effort is great and it quickly dominates the decrease in individual task time brought about by partitioning.

In other words, adding more manpower lengthens, not shortens, the schedule.

Regenerative Schedule Disaster

What does one do when a critical development project falls behind? Add manpower, naturally.

Suppose a task is estimated at 12 man-months and assigned to 3 people for 4 months, and that there are measurable milestones which are scheduled to fall at the end of each month.

Now, suppose the first milestone is not reached until two months have elapsed. What are the alternatives?

1) Assume that the task must be done on time. Assume that only the first part of the work was underestimated. Then, 9 man-months of work remain, and two calendar months, so 4.5 men will be needed. Add 2 men to the 3 originally assigned.

2) Assume that the whole estimate was uniformly low. Then, 18 man-months of effort remain, and 2 calendar months, so 9 men will be needed. Add 6 men to the originally assigned.

3) Reschedule. Allow enough time in the new schedule to ensure that the work can be carefully and thoroughly done, and that rescheduling will not have to be done again.

4) Trim the task. This tends to happen anyway, and where the secondary costs of delay are very high, it is the only feasible action. It is not trimmed formally, it will be silently trimmed by hasty design and incomplete testing.

BROOK'S LAW:

Adding manpower to a late systems development project makes it later.

WHY TIME/MANPOWER ESTIMATES HAVE TO BE REVISED

1) Initial estimates were faulty.

2) Change in availability of resources.

3) Departmental policy changes.

4) Changes required to meet legal constraints.

5) Change in objective and/or scope of project.

6) Recognition of system improvements which it has been shown will be cost-effective to incorporate.

7) Initial requirements inadequately defined.

8) Initial requirements become obsolete.

Documenting Estimates in a Way that Clearly Displays the Inaccuracies Inherent in Them

	CONFIDENCE LEVEL		
	75%	95%	99%
Total system cost	$1.5 - $1.7 M	$1.3 - $2.3 M	$1.2 - $2.9 M
Total system benefit	$3.8 - $4.0 M	$3.0 - $4.1 M	$2.8 - $4.1 M
Man-months of work	120 - 140	110 - 160	110 - 175
Completion date	June/78	Oct./78	June/79

From this matrix, we can see that the estimator is 95% certain that the maximum costs for the project will be $2.3 million and that the minimum benefits will be $3.0 million.

To a 99% confidence level, the costs may be as high as $2.9 million and the benefits as low as $2.8 million. The possibility of both of these limits being reached together is less than 1%. Is this possibility of a $100,000 loss ($2.9 million - $2.8 million) on the project enough to cause the user to decide not to proceed? This is a management decision and, using this type of display, the estimator has provided sufficient information for a good decision to be made.

To Summarize

To repeat: there is no such thing as a one-shot approach to estimating, or one "right" estimate. Any estimate is valid only within the context of a plan, which is subject to change; and estimating is an iterative process which is not complete until the work is complete.

IMPROVING TIME AND COST ESTIMATING

1) Use more than one estimating technique.

2) Use more than one estimator.

3) Evaluate the performance of the estimator.

4) Develop professional estimators.

5) Plan on a module basis from Analysis through to Implementation.

6) Use the System Development Life Cycle activities and a set of standard tasks as the estimating base.

7) From good documentation on older system, develop and use a personal standard error factor in estimating.

8) Get project team members involved in the estimating process, and get a commitment from them.

6.4 Project Scheduling

Overview

There is no single "best way" to do project scheduling and control, but it must be done, and documented. Project scheduling requires drawing up a plan of action and monitoring the implementation of those actions. These plans or schedules must be properly documented, and have regular reviews so the project team and management can have the best means of communication on the performance and accomplishments of the project.

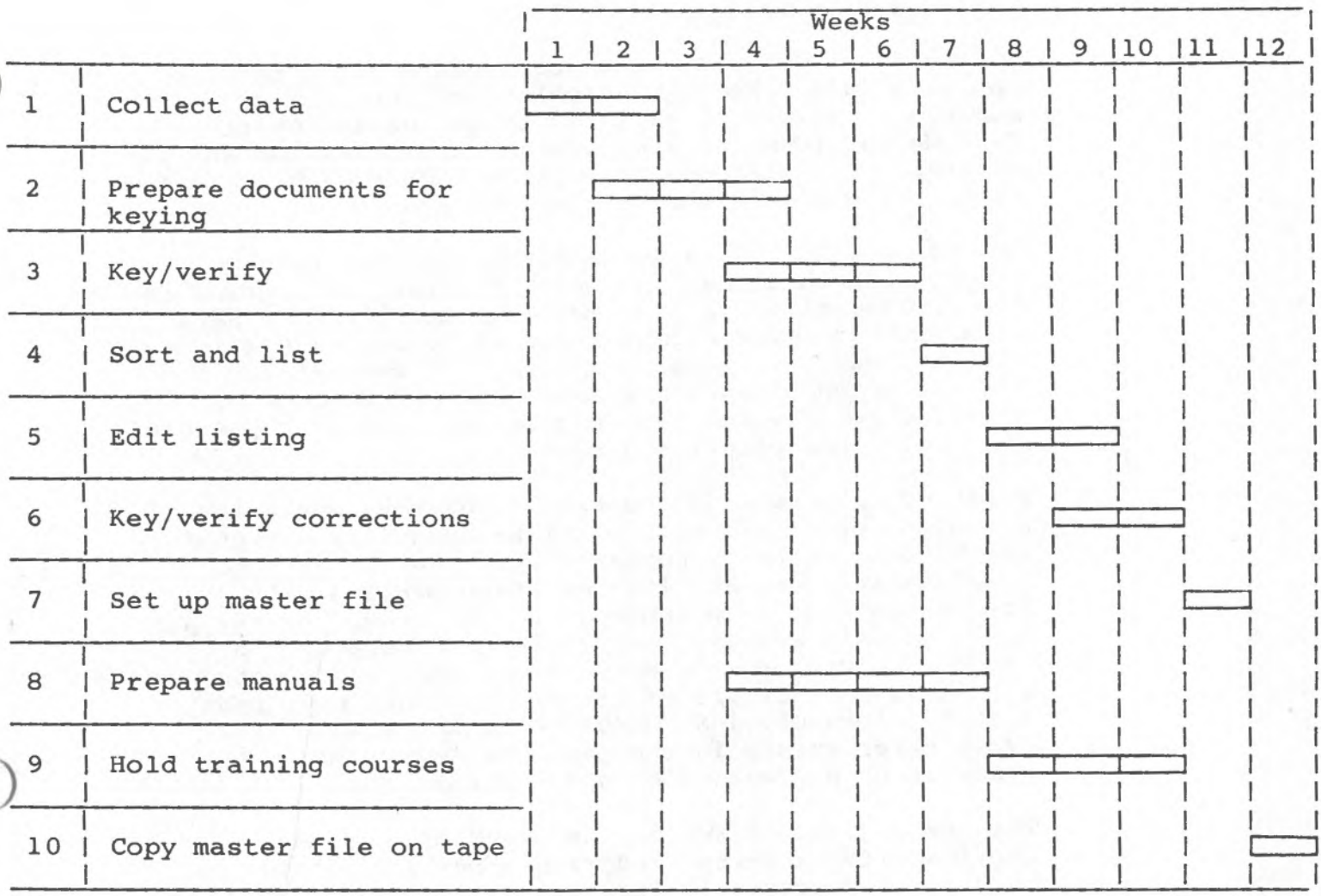
An important ingredient in project scheduling and control is the selection of milestones. All projects, especially those in data processing, requires some end product which can be seen, measured, and reviewed. This means that a "98 percent complete task" is still not done. By setting up these milestones the Project Manager will have some means of measuring the progress of the project.

One of the first developed aids to project planning and control was a bar chart technique developed by H.L. Gantt. These Gantt charts are an excellent method of keeping track of project activities over time.

Gantt Chart

In the Gantt Chart, activities are listed in the left-hand column, and a time scale is drawn across the top. Against each activity, an open oblong is inserted in that part of the relevant row to indicate the estimated length of time the job will take. The start of the oblong is positioned below the date on the time scale which corresponds to the planned starting date for the job. As tasks are completed, the appropriate oblongs are shaded in. A ruler or a piece of cord are placed in the current date position and it can be easily seen from the unshaded portions of bars which jobs are behind or ahead of schedule.

The basic disadvantage of Gantt Charts lie in their inability to show clearly and unambiguously interrelationships and the dependence of one task on another. Networks overcome this disadvantage as their function is to show interrelationships, although the time scale is abandoned.



A Sample Gantt Chart

Critical Path Method

In the late 1950's Du Pont developed applied network analysis to a scheduling problem and obtained very successful results. This technique, called Critical Path Method (CPM) is a management tool that can analyze complex interrelations of a large number of activities which are components of a complete project.

The concept of CPM is quite simple and may best be illustrated in terms of a project graph. The graph is not an essential part of CPM; computer programs have been written which permit necessary calculations to be made without reference to a graph. Nevertheless, the project graph is valuable as a means of depicting, visually and clearly, the complex of jobs in a project and their interrelationships.

First of all, each job necessary for the completion of a project is listed with a unique identifying symbol (such as a letter or number), the time required to complete the job, and its immediate prerequisite jobs. For convenience in graphing, and as a check on certain kinds of data errors, the jobs may be arranged in "technological order", which means that no job appears on the list until all of its predecessors have been listed. Technological Ordering is impossible if a cycle error exists in the job data (e.g., job a precedes b, b precedes c, and c precedes a).

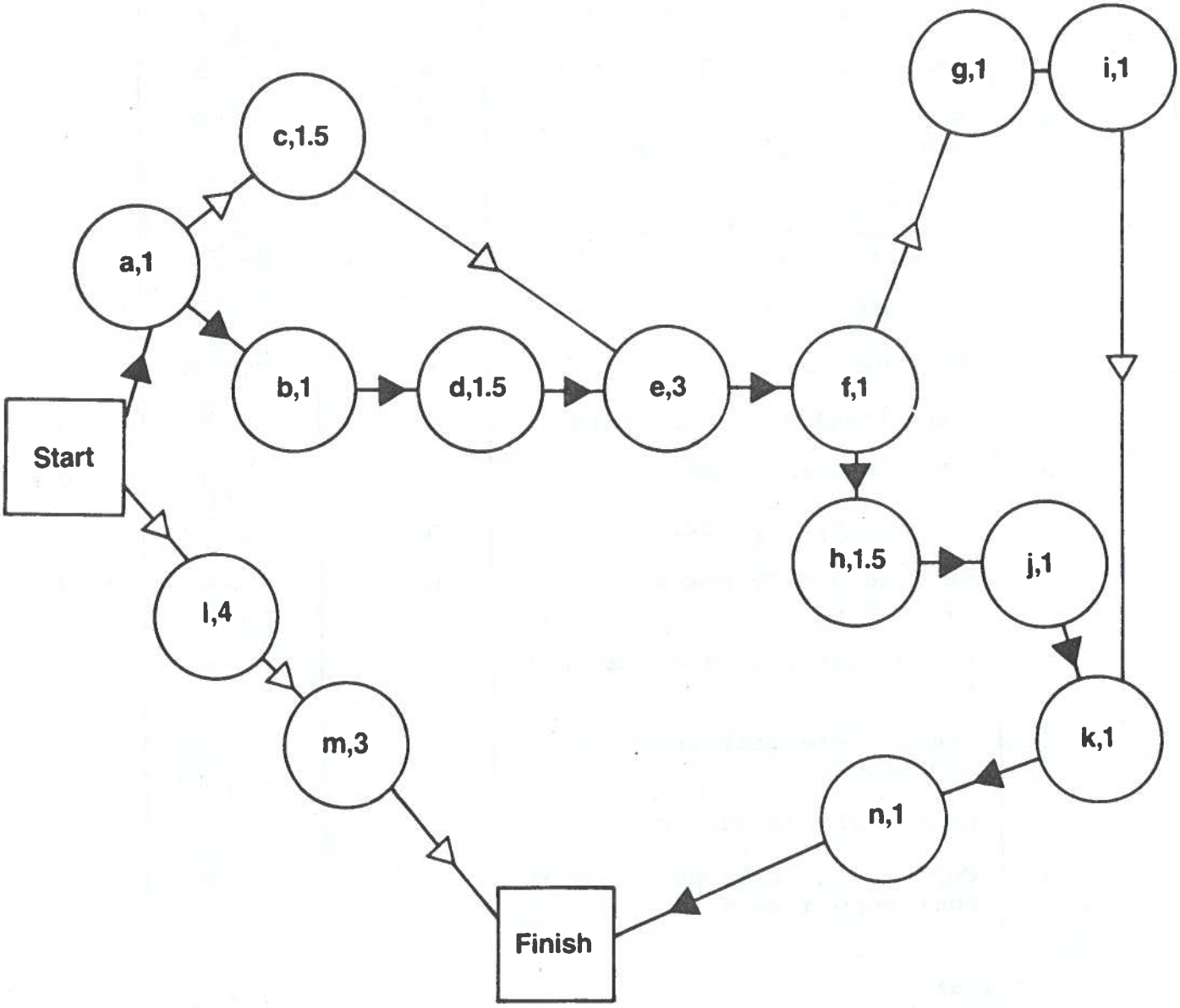
Then each job is drawn on the graph as a circle, with its identifying symbol and time appearing within the circle. Sequence relationships are indicated by arrows connecting each circle (job) with its immediate successors, with the arrows pointing to the latter. For convenience, all circles with no predecessors are connected to a circle marked "Start"; likewise, all circles with no successors are connected to a circle marked "Finish". (The "Start" and "Finish" circles may be considered pseudo-jobs of zero time length.)

Typically, the graph then depicts a number of different "arrow paths" from Start to Finish. The time required to transverse each path is the sum of the times associated with all jobs on the path. The critical path (or paths) is the longest path (in time) from Start to Finish; it indicates the minimum time necessary to complete the entire project.

Event	Description	Event No. Prior	Event No. After	Weeks to Complete
a	Collection of 50% of data	S	b	1
b	Collection of balance of data	a	d	1
c	Preparation of documents for key entry of first 50%	a	e	1.5
d	Preparation of punching documents for balance of key entry	b	e	1.5
e	Key and verify	c/d	f	3
f	Sort and list	e	g/h	1
g	Edit listing - first part	f	i	1
h	Edit listing - balance	f	j	1.5
i	Key and verify corrections	g	k	1
j	Key and verify corrections to balance	h	k	1
k	Setup master file on magnetic tape	i/j	n	1
l	Prepare clerical operating manuals	S	m	4
m	Hold training course	l	F	3
n	Copy master file onto individual record cards	k	F	1

S = Start
F = Finish

Table of Events



Key: → Critical path

c,1.5 where c = job identification
1.5 = job time

Network Diagram

Pert/Cost

The PERT (Program Evaluation and Review Technique)/COST Technique was introduced in 1958 with the U.S. Navy Polaris program. The following steps summarize the methods of using it.

(1) Network preparation is the graphic depiction of a carefully developed plan of action related to the project. Specifc events are selected as milestones to be attained, and they are graphically represented by a circle. An activity goes from one event to one other, from one event to several others, or from several events to one.

After the plan for accomplishing the entire project is available, a network is prepared as shown in the figure without considering the time element. The length of the lines used is not relevant.

(2) Network timing is accomplished after careful review of the completed network. If it appears advisable, the event relationships may be modified, and events may be added. Network timing is based on estimates of the time needed to perform each activity between two events.

One of the more controversial issues regarding PERT is whether or not statistical probability should be used. PERT involves three time estimates for each activity: the optimistic (to), the most likely (tm), and the pessimistic (tp). The expected (te) is then computed using the formula:

$$te = \frac{to + 4tm + tp}{6}$$

If the optimistic evaluation for the activity between A and B is completion within 3 weeks and the pessimistic evaluation is completion within 11 weeks but most likely within 4 weeks, the expected time will be computed as follows:

$$te = \frac{3 + (4x4) + 11}{6} = \frac{30}{6} = 5 \text{ weeks}$$

In some environments, the estimators provide only one time estimate, neither optimistic nor pessimistic.

The decision to select one formula or the other is closely related to the psychological climate of operations. It is advisable to use only one time estimate if there is a clear understanding that the schedule is not an absolute commitment and that technical performance is the number one goal. Otherwise, the three-time-estimate method is more acceptable as it discourages the use of cushions which tend to present distorted pictures. The lower diagram on the next page shows the network with timing.

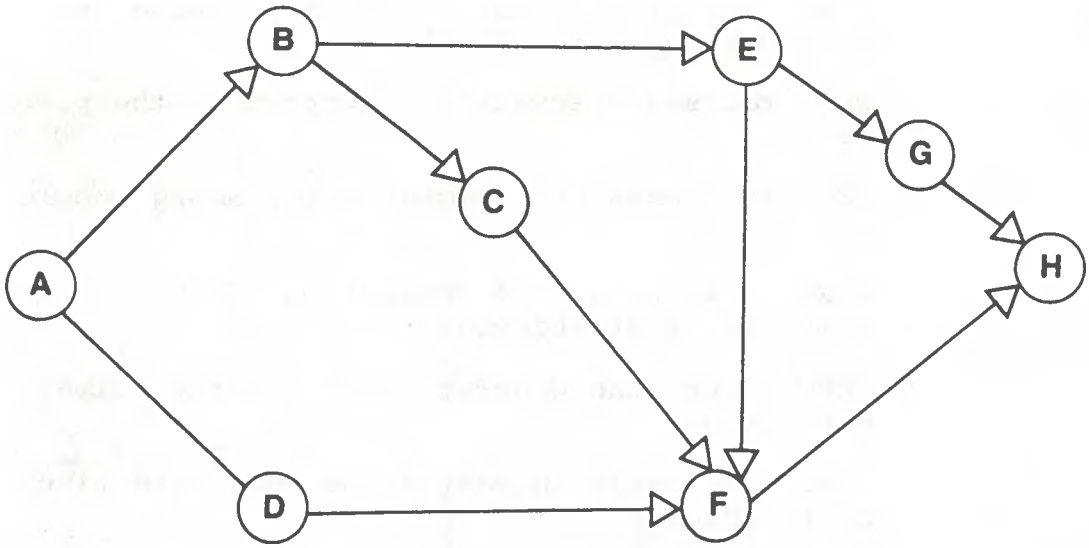
(3) Critical path identification and completion date and considerations are the third step. As shown in the lower diagram it takes 19 weeks to complete the activities which go through events B, E, F, to H. This is the longest path in terms of expected time; it is called the critical path as compared to the others, the slack paths.

A reduction in the critical path must be considered if the expected completion date does not meet the requested or required date. This can be accomplished by transferring some manpower from the slack paths, by replanning the network to eliminate certain tasks, or by performing more activities in parallel. The great advantage of using PERT is that at this point an evaluation can be made of the probability of meeting a required date and that the network focuses attention on those areas where corrective action is needed most.

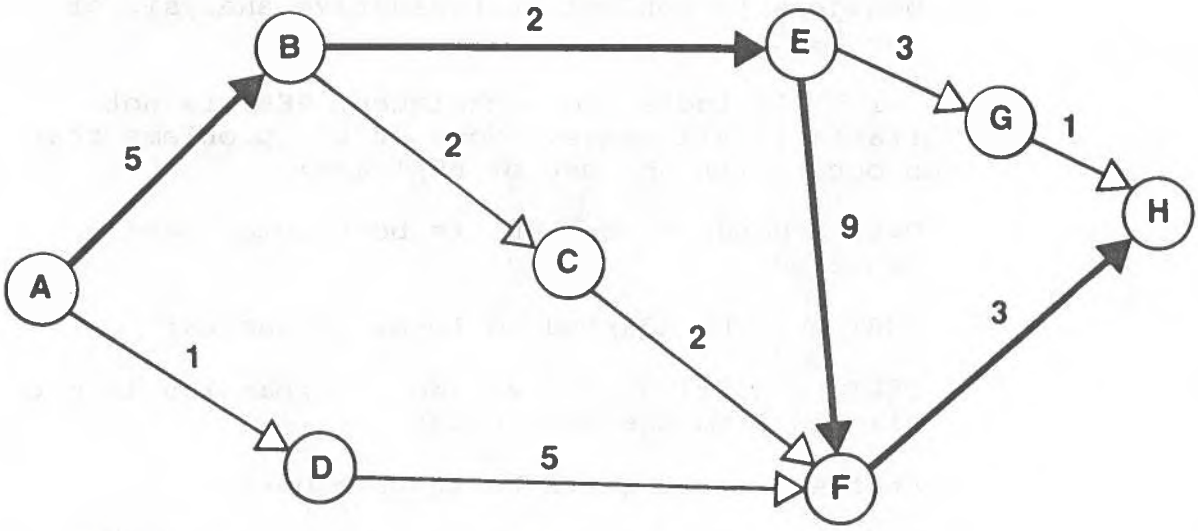
(4) Network costing is the fourth step. The network is translated into man-hours of a given type. Viable alternatives can be considered if there may be a decision to spend more money to reduce the length of the critical path. This might be desirable, either to meet the requested completion date or to avoid the loss of other specialists whose work is related to the slack paths. The translation of the total time into dollars, activity by activity, would be used to develop a budget for the entire project.

(5) Follow-up is the fifth step. Actual performance should be compared to the expected time and expected cost, activity by activity. Special attention should be given to the critical path to decide whether to work overtime or shift manpower as soon as it appears that the required completion date cannot be met.

The advantages of using PERT tecnique in an information systems development environment are:



PERT Network Without Timing



PERT Network with Timing and Critical Path

Key: Critical Path ⟶

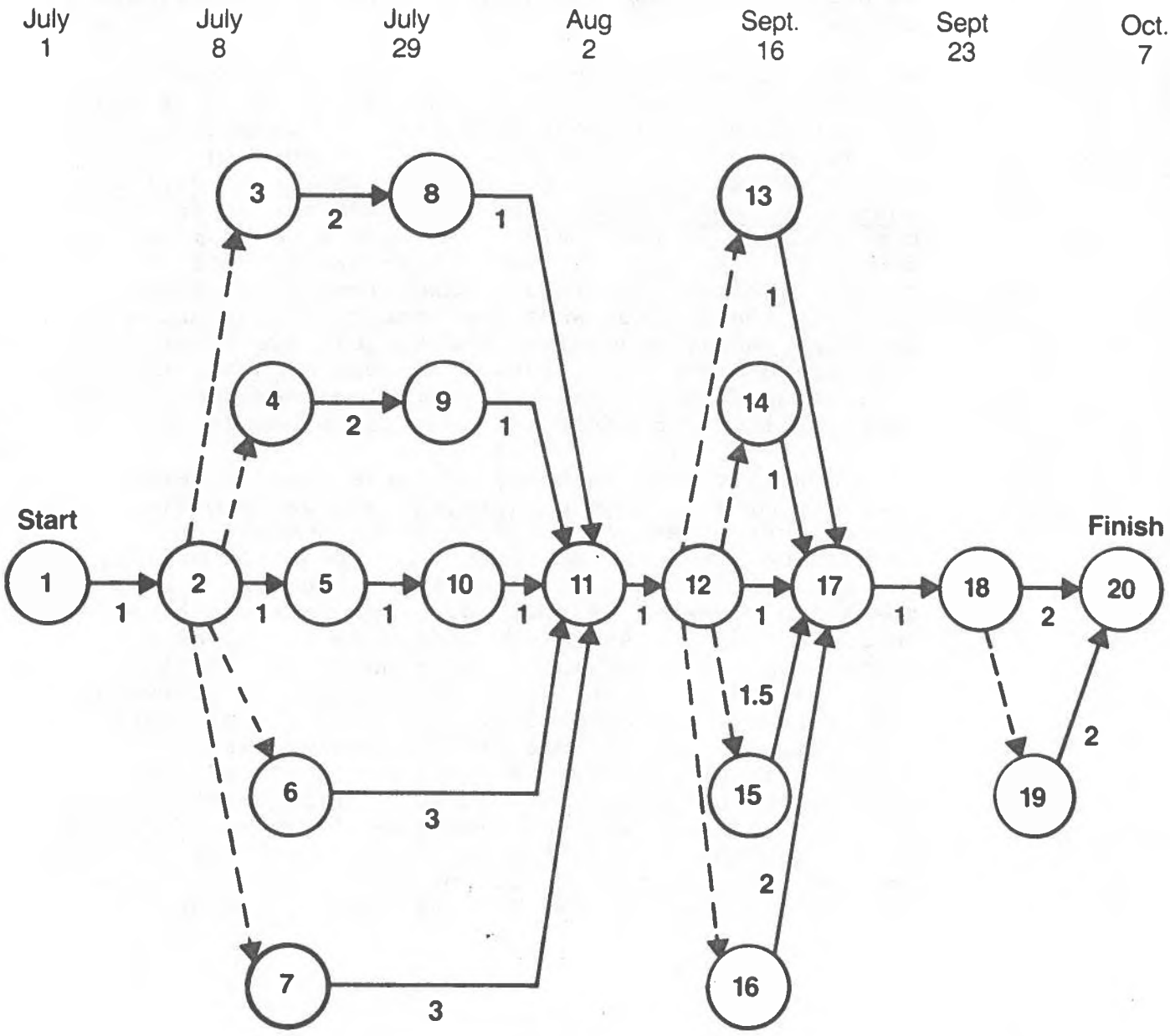
- PERT aids significantly in the planning and progress reporting functions;
- PERT focuses everyone's attention on the problem areas;
- PERT increases the communication among people and groups;
- PERT provides a good prediction of the probability of success;
- PERT forces the generation of accurate time estimates;
- PERT can assist in making the most effective use of resources;
- PERT permits changes in the project to be incorporated easily;
- PERT permits correction action to be taken when needed, and allows the effects of corrective action on the project to be foreseen; and
- PERT forces Analysts, Programmers, and Project Managers to conduct an exhaustive analysis of the task.

As with all tools and techniques, PERT is not suitable in all cases. Some of the problems that can occur with the use of PERT are:

- Over-dependence on PERT is both common and dangerous;
- PERT must be adapted to local resources;
- PERT is difficult to expand if expansion is not planned from the beginning;
- Status reporting can be troublesome;
- Accurate time estimates are still very difficult to obtain; and
- Top management support is necessary for the successful implementation and use of PERT.

RAP Charts

Resource Allocation Planning (RAP) Charts are a combination of bar charts technique (Gantt Charts) and Network Techniques (CPM or PERT). As illustrated below they show the dependencies and interrelations of one task to another within a time frame. By careful arrangement of the network diagram and through the use of dummy activities, the calendar times can be shown on a time scale at the top of the diagram.



A Sample RAP Chart

6.5 Project Status Reporting

General Method

For the purposes of this handbook, project status reporting is defined as providing the report(s) in which scheduled and actual performance are related to planned events for the purpose of providing a control mechanism. Scheduled and actual (cost) performance data are usually included in status reports which are common today; however, little effort is expended to formulate performance reports. Usually performance data is transmitted verbally because it is difficult to measure.

Quality maintenance is one of the most important elements of project control and the one which is most often dissipated in many installations because emphasis is placed on completion dates. In attempting to stay within schedules and budgets, achievement is evaluated instead of performance, and this information is communicated to the staff. Many times compromises and shortcuts are taken, often without the Project Manager's direct knowledge, which result in delays later in the project when the user complains about quality. While schedules, and budgets are important, they are short-range guides. The end product, however, will be used for years, and it is the user who endures poor quality long after the project is completed.

It seems illogical that any of these three elements would be missing from any project status reporting system, yet attention is often only focussed on completion dates and cost, at the expense of quality. The inherent weakness of focusing attention on only these two elements is obvious. A project can be within its budget but seriously behind schedule, or a project can be on schedule but running considerably over its budget by utilizing extra manpower or using computer time for debugging. The elements of cost, schedule, and performance are interwoven, and a decision to change any one should be realized and approved by an appropriate level of management. Users are becoming more and more involved in change decision mainly because, as previously stated, they are required to live with the results and because there is a growing trend to charge the user for the resources consumed.

A number of methods are used to report project status. There are a number of software packages available from various organizations for this purpose. However, besides these packages there are other methods:

1) Computer reports for items such as labor and material usage and some project cost systems;

2) Network analysis systems;

3) Narrative reports;

4) Informal reporting; and,

5) Specially-staffed control rooms.

Computer reports are useful; however, they present only one view of a project from the top down. It is apparent that this fact has escaped many companies since computer reports are their only information source. This has led some companies to abandon the reports, whereas proper action would be to supplement the reports with reports which have the purpose of relating to problems which are pointed out and are not apparent from the computer report, and which call attention to potential problems.

One limitation of many computer reporting systems is that they are either inflexible, or they require such a level of detail that they are too costly or cannot be operated in a timely manner. Computer reports are valuable if they are understood and are not relied upon too heavily. One of the most valuable attributes of computer reports is that they contain summaries at different levels.

Network analysis is utilized by a number of companies. The detailed network diagrams and computer print-outs are valuable in assessing the consequencies of falling behind schedule and in studying alternative courses of action. In most cases, however, the time consuming tasks of redoing the network and the volume of new data required, which makes it difficult to determine sensitive areas, cause many companies to cease to update their networks.

If the regular computer reporting system and the network programs can interface, the combination can be extremely valuable to management. When they do not interface, however, the voluminous data required for input and output is of little value to user management.

Narrative reports are not used as extensively as computer print-outs and personal briefings; however, the number of companies which are using them effectively indicates that the value of written reports has been underestimated. One technique utilized, requires that the Project Staff include a statement describing the three most critical problems and the three most critical potential problems. Besides a definition of the problems, the report must include an assessment of the consequence, assignment of responsibility, and a plan to overcome the problems.

Narrative reporting forces one to look ahead or plan. Most status reporting systems have a tendency to report history whereas a functional portion of a narrative report is the inclusion of specific plans for overcoming potential problems. Compared to verbal reports, narrative reports also have the obvious advantage of providing documentary evidence which can be of value in project and individual performance review. Narrative reporting is a bottom-up technique which provides information that complements computer print-outs. It is important, however, that the reports are specific; they are not to contain vague statements such as "significant progress was made".

Informal reporting, while as widespread as the status reporting technique, is the method most subject to inept use. While this approach encourages a free and rapid flow of information, it is also most often subject to signs of omission or inclusion of only the favourable problems (problems for which the solution is already evident). At the other end of the spectrum, however, the establishment of overbearing and formal procedures may stifle accuracy and the presentation of detailed information which can result if there is a free information exchange.

Although the "control room" technique is often used, it is nothing more than a specific spot utilized to employ the techniques already discussed. It does, however, give a psychological boost to the project team and usually results in increased interest in planning and a better coordination of effort.

There are two major problems associated with most reporting systems: timeliness and the measurement of progress. Delays create two penalties, namely, cost increase and an undermining of the system itself. For example if the report presents information which dictates corrective action but is received too late for execution, the information is meaningless. After-the-fact problem discovery does not further progress or promote solutions.

One of the biggest problems already mentioned is estimation of the amount of effort required to finish a task. Too often a change is not made to estimated completion date until the task is 90 percent complete. Why is this so difficult? Probably the most consistent reason is that the individual has a natural tendency to want to catch up, and he does not want to change his schedule and be forced to explain the reason. This situation is probably caused because of the apparent negative attitude associated with the process of changing a schedule. The fact that schedules which are based on rather nebulous estimates become almost sacred, and causes people reporting status to be reluctant to change schedules early in the process.

In summary, project status reporting systems are intended to provide information for the purpose of control. They should, but often do not, supply data on schedules, cost, and performance. Most companies rely too heavily on computer reports and underestimate the value of written progress reports. The best reporting systems include a combination or a variety of techniques and produce a series of reports aimed at different management levels. It is as important to look forward as it is to look backward.

Collection of Data

The need to plan and schedule in such a manner that data can be collected, reported, and evaluated against the plan and schedule has been discussed previously in this handbook. The fact that there should be a physical event connected with each phase/stage/task of the system development life cycle has also been noted. This physical event provides tangible evidence for evaluation and substantiation of progress.

Quantity and quality analysis are required whether reporting is accomplished at task completion or at interim points during the task. In order to report on actual performance and work status, it is necessary to collect data on what actually occurred within the project organization and to determine actual performance status as measured against stated objectives and plans. The collection of data about actual completions should be performed during the normal operating procedures within the organization such as time recording for payroll reporting. The determination of status is normally obtained by subjective analysis of the current position in relation to the balance of work remaining on the task. To minimize the amount of subjective analysis required, it is desirable to structure work task assignments in such a way as to minimize the number of points in one standard work task where subjectivity is allowed. Only the individual reporting status subjectively and his Project Manager understand the subjective intermediate status.

Resource consumption data should be collected and summarized on a regular basis. Note that recording, collecting, and summarizing are separate activities. Resource consumption data should be collected for manpower, equipment usage, materials, support services, travel, supplies, purchased services, and any other direct expenses. The collection technique must have the capability of segregating the data into the following types of categories: (1) for a project, the stage, phase, and standard work task in which the charge occurred; (2) the type of charge, debit or credit; (3) the type of resource performing the work, including all resources listed above; (4) the point in time at which the charge occurred; and (5) the number of chargeable units and the unit of measure. Unit rates are typically matched to the charges later.

The collection of consumption and task start and completion data is easily accomplished in an organization. The collection of performance evaluation and status data is much more difficult. The value of the work performed to-date must be determined in relation to the total effort required to achieve the next

physically-identifiable work task or phase. To overcome the subjectivity of this determination, the Project Manager must structure the work task assignments in such a way as to give an individual a logical piece of the project, but at the same time provide convenient interim measuring points. For example, a task of forms design which might allow four weeks for twelve forms might better be broken down into four subtasks of designing three forms each. Similarly, a program which consists of fifteen modules to be completed in three weeks might better be assigned three subtasks, each consisting of five modules. This approach has a two-fold advantage in that the Project Manager will feel more comfortable in the intermediate checkpoints and the person performing the subtasks can see some intermediate accomplishments.

The qualitative reporting process is supported by status data collection on a regular basis in narrative style. A narrative report should cover specific accomplishments, specific problems, and specific future plans. This type of reporting requires an individual's introspection to answer the following questions:

(1) What was accomplished this period? How did these accomplishments relate to the goals set in the last planning period? (Note the use of the word "accomplishment" rather than asking what was worked on.)

(2) What problems were encountered? Were they solved? Is assistance in solving them required? What impact did the problems have?

(3) What problems can be anticipated in future periods?

(4) What plan(s) has been developed to solve the problem(s)?

(5) How do the accomplishments relate to the total effort to complete the task?

(6) Should changes be proposed in the plan, objective, and/or scope of the activity?

(7) What will be accomplished in the next period?

(8) What can be done to improve long-range performance?

The format of this type of analysis should have a strong correlation to the performance reporting and evaluation system used in the organization. This will strengthen the importance of reporting. Enforcing completion of the evaluation should assist in making individuals aware of the results of their work and cause them to replan future efforts. When replanning is done honestly, a valid basis for evaluating work performance and for establishing management control over future work requirements should result. It is important that the individual's self analysis be reviewed by his superiors and that it becomes a part of his record of performance.

The regular collection of resource consumption and task status data must be enforced. Accurate and timely data is required to compose useful reports and to stimulate management reponse and control.

Simplification

The fact has been established that one of the major problems of controlling EDP projects is the regular collection and reporting of project status information. The problem is compounded by organizational inertia and resistance, and as a result, many organizations have expended a large quantity of resources on efforts which they have abandoned. It is logical, therefore, that management might be wise to install a comparatively-simple system prior to committing significant resources to an extensive and automated system. This system should acquaint the organization with control problems and help identify the real information required for an effective total system.

The first step in the development of any project control system is the same as for any other project: the definition of the problem and the determination of objectives are spelled out in a project plan. The process involves dividing the total project into major segments which are subdivided into small segments until individual task assignments can be identified. A project schedule should be prepared using one of the techniques described previously in this chapter. Proper planning at this stage is extremely important as it is the primary base for all future reporting. Minimum information required at this stage would consist of the following parts:

(1) Project objectives
(2) Individual tasks or events including:
    (a) Identification
    (b) Man-hours (days, weeks, etc.) to accomplish
    (c) Responsible individual
    (d) Scheduled start date
    (e) Scheduled completion date.

The planning portion of the report will never be changed unless there is a major change in objectives and a replanning of the total effort. The events listed are the control points of the project; therefore, data must be collected and reported against the events. The report is prepared by the Project Manager and is one of his primary control reports.

A weekly time expenditure record should be prepared by each individual. Completion of the record requires that each individual report and account for a minimum number of hours per week, by event as listed on the project task schedule and progress report. To ensure accuracy, each individual should record his time every day when he can easily remember his day's work.

A weekly project progress report should also be prepare by each individual who has a responsibility assignment listed on the project task schedule and progress report. The weekly project progress report is a narrative-style report which is divided into four sections: the basic project report information, the progress section, the problem section, and the plans section. The weekly project progress report should be utilized to relate progress in detail against the events listed on the project task schedule and progress report. Anticipated as well as actual problems should be identified.

A weekly computer usage report should be utilized to record data regarding resource consumption and status against specific project tasks. The required information is:

(1) Actual time consumed by project task;

(2) Encountered problems which relate to physical set-up;

(3) Observed problems to be corrected;

(4) Analysis of testing, especially system or parallel testing.

APPENDIX A

Interview Action List

INTERVIEW ACTION LIST

Analyst:

Business Process:

Name and Organization of User	Interview Scheduled Date	Date Sent	Interview Conducted Date	Interview Record Submitted	Record Returned	Record Amended	References & Comments

APPENDIX B

Interview Checklist

INTERVIEW CHECKLIST

GENERAL

General description of responsibilities and objectives:

. current and planned.

Identify how responsibilities are accomplished:

. current and planned;
. any special programs being developed?
. obtain organization chart and staff names;
. continue development of organization's function chart.

What information is needed to plan, to solve problems and to make decisions?

. how does information relate to objectives?
. identify performance indicators;
. what is relative priority and importance of information needs?
. avoid information needs not within scope of study.

What information is actually received?

. current and planned.

What systems are being utilized?

. current and planned;
. obtain sufficient information to sketch out a data flow diagram.

What level of performance and availability would be expected from a computerized facility?

Identify other general problems and their impact.

Identify opportunities for improvement.

SPECIFIC

Determine characteristics of information needs:

- when is it needed?
- what is the required frequency?
- where does it originate?
- what are the volumes?
- when and where do the peaks and valleys of volumes occur?

Obtain information on data groups and, ultimately, data elements and their definitions.

Obtain information on detailed processes (if examining operational processes).

Obtain specific turnaround times, data security requirements, information archiving needs, and names of approval authorities.

Request samples of the following:

- forms
- documents
- reports
- user manuals
- procedure manuals.

APPENDIX C

Walkthrough

WALKTHROUGH

The walkthrough/inspection concept came from IBM's programming teams. It uses the theory that the Programmer is a part of the complete team and that the team (not just the Programmer) is responsible for each program. This is commonly known as egoless programming.

The walkthrough concept is basically an extension of the desk check process. During desk checking, the programmer examines his code to discover errors. During a walkthrough members of the team inspect the code in a systematic manner to find any errors.

Although the walkthrough concept was developed for inspecting programming output, and this description is in that context, it is equally applicable to the products of analysis, design and testing.

The objective of this process is to find errors in logic, in specifications etc. An inspection also looks for errors in style such as readability, efficiency, unreasonable specifications, etc. The purpose of the inspection is not to find fault with the originator of the product being inspected but to improve upon that product.

Also Refer to Datamation Oct. 1977
Inspecting Software Design Code
By M.E. Fagan.

Below is an outline of an inspection technique used on one project.

Inspection team consists of:

- Chairman, who coordinates and schedules the meetings, chairs the inspection, notes all errors, circulates the inspection report and follows up on the rework.
- Document creator, the person who has created the document, whether it be the program specification, design or code. It is his responsibility to have all documents circulated to the other members at least 24 hours before the inspection.
- Implementors, those who will be taking over responsibility for the documents (e.g. designers who will receive the specifications, programmers who will receive the program design, etc.). There will normally be one or two people in this category.

Inspection process consists of:

- Preparation and distribution of the document to all members of the inspection team prior to the meeting by the document creator.

- Preparation by all of the inspection team members which involves going over the document in some depth before the meeting.

- Inspection of the document by the whole team in the meeting. As the objective is to find errors, discussion continues only until the point where an error is recognized. The aim of the inspection is only to find errors, so often the chairman must be firm in limiting discussion. The error is then noted by the chairman. At the end, the team decides if the document passes the inspection and if not, a date is set for further inspection.

- Circulation of the inspection report by the chairman within 24 hours of the conclusion of the inspection meeting.

- Rework by the document creator to correct the errors.

- Follow-up. If the number of errors is small, then the Chairman is responsible for verifying that all errors are redressed. If there are a large number of error, the inspection cycle is repeated.

During a walkthrough of actual code, there are major areas where problems occur. These are:

DATA REFERENCE
DATA DECLARATION
COMPUTATION
COMPARISON
CONTROL FLOW
INTERFACES
INPUT/OUTPUT

WALKTHROUGH REPORT

Project:

Date:

Participants

Chairman :

Author :

Others :

Record of Walkthough and Planned Action

APPENDIX D

Program Estimating

WEIGHTING GUIDE

Programmer Know How

Programmer Job Knowledge

Input Characteristics

Output Characteristics

Major Processing Functions

WEIGHTING GUIDE

Programming Know-How

Overall Programming Experience	Man-Days Per Program Weighting Point
Senior Programmer	0.50 to 0.75
Programmer	1.00 to 1.50
Apprentice	2.00 to 3.00
Trainee	3.50 to 4.00

Overall Programming Experience is defined in the following list:

Senior Programmer - Written and implemented many programs on different types of equipment. Very experienced with particular configuration and operating system.

Programmer - Written and implemented programs of various complexities. Experience with particular configuration and operating system.

Trainee - Completed programming school. Written training programs. Very limited experience on operating system.

Programmer Job Knowledge

Job Knowledge Available	---Weighting Factors--- Job Knowledge Required* Much	Some	None
Detailed knowledge of this job	0.75	0.25	0.00
Good general knowledge of this job with fragmentary detailed knowledge	1.25	0.50	0.00
Fair general knowledge of this job but little or no detailed knowledge	1.50	0.75	0.00
No job knowledge, no general knowledge of related subjects	2.00	1.25	0.25

* Job knowledge required is defined as follows:

Much: Detailed knowledge is required and subject is complex and difficult to understand;

and/or

Job requires knowledge of complex mathematical or statistical formulas;

and/or

Job requires application of special program concepts not in common use (such as linear programming).

Some: Detailed job knowledge is required but subject either is not complex, or is complex but can be easily explained;

and/or

Job requires knowledge of standard mathematical or statistical formulas.

None: Job can be understood with little or no background on the part of the Programmer (similar to a classroom problem).

INPUT CHARACTERISTICS

Input	Weighting Points
Card - Single Format	1
- Multiple Format	2
Each tape per file - One Type Record	1
- Multiple Types of Records	2
- Variable Length Records	3
Each sequential disk per file - One Type Record	1
- Multiple Types of Records	2
- Variable Length Records	3
Each Indexed Sequential Disk Per File - One Type Record	2
- Multiple Types of Records	3

OUTPUT CHARACTERISTICS

Output	Weighted Points
Print-Per record format	1
Each Tape per File - One Type Record	1
- Multiple Types of Records	2
- Variable Length Records	3
Card - Single Format	1
- Multiple Format	2
Each Sequential Disk per File - One Type Record	2
- Multiple Types of Records	2
Each Direct Disk per File - One Type Record	2
- Multiple Types of Records	3

MAJOR PROCESSING FUNCTIONS

PROGRAMMING SYSTEM	FUNCTION	WEIGHTING POINTS Simple	Complex	Very Complex
IBM/370 with PL/1 or COBOL	Restructure Data	1	3	4
	Condition Checking	1	4	7
	Data Retrieval & Presentation	1	4	7
	Calculation	1	3	5
	Linkage	1	4	6
IBM Utility Programs (sort, file-to-file, copy-restore, etc.)	Control Card Changes Only	1	-	-
	Own Coding Required	2	3	4
Package Programs	Control Card Changes Only	1	-	-
	Own Coding Required: Restructure Data, Condition Checking, Data Retrieval & Presentation, Calculation, Linkage	apply factors as above for programming system involved		