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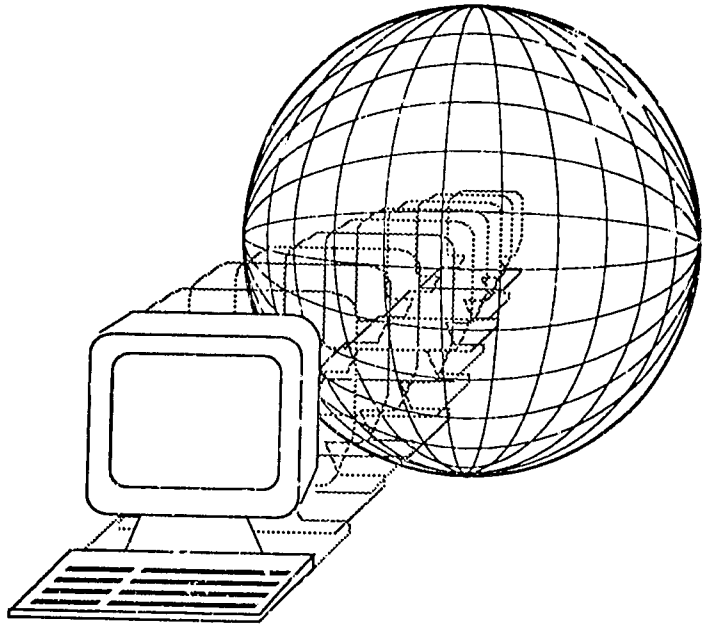
GUIDELINES FOR MANAGING AUTOMATION ASSISTANCE IN A.I.D. DEVELOPMENT PROJECTS

VERSION TWO

JANUARY 1988



AGENCY FOR INTERNATIONAL DEVELOPMENT
INFORMATION RESOURCES MANAGEMENT

Guidelines for Managing Automation Assistance in AID Development Projects

Version Two

EXECUTIVE SUMMARY

This manual has been prepared for USAID officers who design, manage, or evaluate host country projects with an automated data processing (ADP) component. Automation raises a set of planning, administrative, and procedural requirements that may be unfamiliar to many project officers. The manual builds on basic project management knowledge while highlighting particular issues that project officers should consider as they work with automation projects. In addition, the manual points to sources of additional information on key procedural points, especially in ADP acquisition. The structure of the manual is keyed to the normal AID project cycle.

Section One, **Automation Strategy and Planning**, is designed to provide a strategic framework for automation planning. Emphasis is placed on a systems perspective that encompasses the major tasks of automation planning, implementation, and evaluation. A checklist of issues to consider in the first step in the project cycle, the social and organizational analysis, is provided.

Section Two, **Applications Analysis**, discusses the first task in actual project design. Key issues include matching information flow to the needs of users, budgeting for material and human resource needs, and addressing potential automation constraints identified in the organizational analysis.

Section Three, **Technical Analysis**, covers the issues involved in ADP system configuration. Factors in system choice are reviewed as well as key hardware and software performance options. The section ends with a summary checklist that may be used as the basis for a feasibility study.

Section Four, **Acquisition**, reviews procedures and guidelines for acquisition of ADP commodities and services. The major concerns are applicable acquisition laws and regulations, the presolicitation phase, solicitation, evaluation, selection, and award, and contract administration. The section concludes with a summary of AID/Washington resources for assistance with project-related automation.

Section Five, **Institutionalization**, addresses tasks to be performed during and after automated system delivery and installation. Implications for management are reviewed and recommendations provided for policies and procedures requiring attention from system managers.

Section Six, **Evaluation**, discusses the assessment of automation projects. Guidance is provided on planning and structuring an evaluation and a set of evaluation points, indicators, and sources of information is provided as a reference for preparing an evaluation scope of work.

Annexes to the manual provide more detailed explanatory or illustrative material on key points.

Guidelines for Managing Automation Assistance
in AID Development Projects

Version Two

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INTRODUCTION

PURPOSE AND ORGANIZATION OF THE MANUAL

AID project officers increasingly deal with automation in three areas: internal mission applications (word processing, accounting, etc..), general project management (for monitoring, budgeting, statistical analysis, etc..), and project assistance involving an information management component.

This manual summarizes procedures and guidelines for the third area, project-funded development assistance, and covers the planning, acquisition, management, and use of automated data processing (ADP) equipment. The manual is written for project officers who may have little experience with automation but who understand the AID project cycle and know the basics of project management. The manual deliberately steers a middle course between discussion of key automation issues on the one hand and the suggestion of "blueprint" solutions on the other. Certain "tools" are provided, but with the assumption that they will be used by creative and thoughtful USAID project officers who can apply them selectively to a wide and complex range of potential automation initiatives.

The use of the terms "automation" or "automated data processing (ADP)" in this manual encompasses the entire range of computer-related applications that may be part of an AID project. This includes mainframe, mini, and micro computers, networks and other multi-user systems, customized software applications such as an accounting system, automated management information systems (MIS), and other database management systems (DBMS).

Often the automation of a particular host-country agency, office, or set of functions will be part of a project with broader objectives that require effective information management for their achievement. In other instances, information system development will itself be the primary focus of a project. In either case, automation brings with it a unique set of planning, administrative, and procedural requirements. This manual summarizes those requirements and identifies sources of more detailed information.

In handling projects that include an automation component, project officers address several familiar concerns such as project strategy and design, feasibility studies, budgeting, acquisition, implementation planning, and training. Automation in projects, however, raises several special issues for USAID staff and their host-country counterparts:

- Unlike many items of equipment purchased for AID projects, ADP equipment likely will have applications and implications beyond the project's immediate objectives.

- Because ADP is relatively new and ADP technology is evolving rapidly, the interactions of ADP equipment and the management structure of a host organization can be complex. Thus special attention to these issues is needed for automation-related assistance.

- Although project officers are concerned generally with ensuring that commodities and manuals purchased for AID projects are legitimate, special problems and complications arise with the proliferation of hardware "clones" and illegally reproduced software.

- ADP products can be used by high-level managers and officials to make far-reaching decisions within their agencies. Because the technology may be new and unfamiliar, decisions that are supported by the use of ADP equipment can seem mysterious or threatening.

- Acquisition of ADP equipment differs from that of other commodities in several respects. In particular, AID/Washington approval is required when the value of the life-of-project U.S.-financed procurement is $100,000 or more.

In October 1985, the AID Office of Information Resources Management (M/SER/IRM) issued the System Manager's Guide, which outlines policies pertaining to automated information systems for internal USAID mission use (operations expense funded). By contrast, this manual is limited to project-funded automation.

The manual is organized into six sections that follow the usual AID project cycle. The first section addresses strategy and planning issues. Sections Two and Three focus on project design, specifically the applications and technical analyses that underlie an automation feasibility study. Section Four summarizes issues in the acquisition of automated data processing equipment. Section Five reviews the institutionalization of automation in a host organization. Finally, Section Six explores evaluation of automation initiatives. Supplementary material is contained in annexes to the Manual.

These Guidelines, the initial version of which was distributed by M/SER/IRM in October, 1986, reflect AID regulations and procedures as of the end of FY 1987. The Guidelines will be updated as necessary to reflect changes in these regulations.

Please send comments and suggestions to Joseph Gueron, AID/M/SER/IRM/MPS, in Washington.

AUTOMATION AND DEVELOPMENT

By most social and economic indices, the gap between the richest and poorest segments of the world's population has widened over the last 20 years. This disadvantage of developing countries is at risk of being further extended by forces associated with advances in information technology. At the same time, these forces hold great promise for those countries able and willing to commit human and capital resources to the development of automated systems for managing critical information resources. Improved information management can address two commonly cited development problems: weaknesses in policy analysis and lack of effective planning.

New information technologies will change every country's development opportunities. How nations manage this technology and adapt to the process of change will profoundly affect whether their development goals will be achieved.

The transfer of technology is one foundation of AID development policy. But it will take a high degree of cooperation between the countries that control the new information technologies and the developing world if developing countries are to avoid a new generation of comparative disadvantage and, instead, take advantage of the new opportunities that the information revolution can make available to them. These opportunities include better access to relevant information for decision makers, enhanced analytical capacity, support for decentralized management, and improved information coordination. In short, the underlying assumption of automation assistance is that access to automated tools can improve the management performance of developing country institutions.

A primary demand is to ensure that developing countries have full access to knowledge of the rapid changes taking place in information technologies and their applications so that these countries may develop the capacities to evaluate the implications of these changes, both positive and negative. In addition, developing societies will need the best possible support for their own efforts to develop the policies, programs, and measures that will enable them to realize the benefits and minimize the risks of the information revolution. This is the developmental context for AID projects supporting the automation of developing country institutions (see Annex 1 for an elaboration of the policy implications of this context).

What emerges is a significant opportunity to harness computer technology in the service of the institutional development objectives shared by AID with host-country agencies.

AUTOMATION BENEFITS AND RISKS

While automation may promise significant development benefits, there are also risks that should be considered throughout the automation process. These potential benefits and risks include the following:

Benefits

1. Better Information Storage, Processing, and Analysis

The greatest advantage of automated information processing systems over non-automated ones is that data are stored on magnetic disk rather than on paper. Once magnetically stored, data exist as structured electronic elements that are easily and immediately manipulatable. In contrast, written records are fixed in time and format. This fundamental change is facilitated by software that combines ease of use with powerful processing capacities. Well-designed software creates an environment that closely mimics the natural working habits of the user and employs menus to facilitate proper use.

Information is stored mainly for retrieval. With automated systems, not only is the sheer volume of paper reduced (40,000 pages of text can be stored in a 40-megabyte hard disk and a half-million pages on an optical disk), but the speed at which files can be retrieved is reduced to a matter of seconds. An effectively organized data-base does the job even better. Chunks of related data having specified attributes can be cross-referenced and called almost instantaneously to the screen. Moreover, once data have been retrieved, processing time is cut down dramatically.

2. Improved Efficiency in Information Flow and Access

Automation puts information directly into the hands of the user. In many developing countries, a major problem is not so much the lack of information, but the lack of information in a readily usable form and within the time period when the information is relevant for planning and decision making. The flow of information from data collectors to decision makers is often discontinuous since the data are delayed in the field or stored in hard-to-find files. If captured electronically, information can be moved from the field to a central office through disk exchange, telecommunications, or other electronic transfer. Data revision, either for economic analyses or activity monitoring, can be done more efficiently, providing users with access to the most recent and accurate information available.

Cost-efficiency is part of the benefit of a well-designed and appropriate automated system. Although automation may not always produce cost savings, the quality of information flow and availability for a given investment in information management should rise considerably.

3. Improved Resources for Policy and Management Decision Making

The ultimate benefit of automation is providing a highly valuable resource for policy and management decision making. Many elements go into the decision-making process such as attitudes of the participants, stakeholder interests, and power relationships among those involved. Underlying, and perhaps even nurturing the entire process, however, is accurate, timely, and relevant information. This can never be overemphasized. Automation allows decision making to be an interactive process as participants develop their ideas from a solid information base, and even test the implications of their decisions.

Risks and Problems

Any computer intervention involves risk of failure. The degree of risk depends on the size of the project, the familiarity of the organizational personnel with the technology, the clarity of the objectives, leadership commitment, and the speed with which it must be implemented. Key risks include:

1. Premature Automation

Although the advantages of automation are powerful, acquiring the new technology before the organization is prepared can lead to undesirable results. Several preconditions should exist before an organization shifts to automation. These are discussed in the following subsection, "Social and Organizational Analysis."

2. Excessive Expectations

In marketing the benefits of automation to reluctant users, there is the risk of overselling. Computers function only as well as their system managers and programmers make them operate. Once computers are installed, much work remains to assure the integrity of the system. Expectations should be set realistically and take into consideration the capabilities of the available mix of hardware, software, and human resources.

3. Redistribution of Authority and Influence

The control of and access to information represent an important source of power in any organization. The organizational dynamics that automation brings must be taken seriously. Those who learn to use new technologies the quickest may become an information elite. Dispersed or decentralized data processing systems tend to redistribute authority since users now have direct access to information. Furthermore, more opportunity is available at the lower staff level to edit and process data. This opportunity presents both advantages and risks.

4. Organizational Vulnerability to System Malfunction

A programming error in the software, the breakdown of a machine part, or a glitch in the power supply may severely disrupt tasks performed by the computer. Depending on how important the task is, the costs may have a serious impact on the organization. These risks should be anticipated. Creating redundant systems, frequently updating copies of vital files, and keeping the most essential data on paper are some measures to minimize potential disruption.

5. Recurrent Cost Demands

Sometimes the death knell of a system is budgetary rather than technical. Automated systems need a constant source of spare parts, supplies, personnel, and maintenance services to keep them running. In making an ADP budget, the recurrent costs have to be planned carefully. This is especially important when the automated processes have already been integrated into regular organizational activity.

SECTION ONE

AUTOMATION STRATEGY AND PLANNING

How to use this Section

This section is designed to provide a strategic framework for automation planning. Emphasis is placed on a systems perspective that places the major tasks of automation planning, implementation, and evaluation into the usual AID project life cycle. This material will help the USAID project officer plan the sequence of actions necessary for an effective automation initiative.

The first step in the project cycle is the Social and Organizational Analysis. The Manual provides a number of questions that can serve as a checklist for analyzing both information and automation needs in an organization. Discussion of various preconditions to automation, common constraints to effective information management, and developing country variables leads to a recommended decision tree for organizational analysis.

Finally, the components of a needs assessment are summarized. This assessment bridges the organizational issues covered in this section and the system design issues of Section Two.

The section is organized as follows:

A SYSTEMS PERSPECTIVE

SOCIAL AND ORGANIZATIONAL ANALYSIS

- Planning Overview
- Preconditions to Automation
- Constraints to Automation
- Host Country Variables
- Components of a Needs Assessment

SECTION ONE

AUTOMATION STRATEGY AND PLANNING

A SYSTEMS PERSPECTIVE

Because of the potentially dramatic changes that automation can bring to an organization and because automation involves not simply the purchase of a machine but the purchase of a machine (hardware) programmed in such a way (software) to perform a particular task (application), it is necessary to keep a wide spectrum of factors in mind when designing an automation project. It also is important to consider future procurement, institutionalization and evaluation agendas during early strategy and design phases of an automation project.

This broad systems perspective is reflected in Figure 1-1 which illustrates the project cycle for an automated system and serves as the organizing framework for this Manual. The four major sections of the Manual address the sequential tasks of automation strategy and planning, project design, acquisition of automated equipment and services, institutionalization of automation, and evaluation of automation projects. For the AID project officer, major tasks fit into the automation project life cycle as follows:

Strategy and Planning

- **System overview:** determining appropriate automation criteria such as information requirements, system configuration options, technical sophistication requirements, support and training needs, budget limitations, compatibility concerns and potential system growth needs.

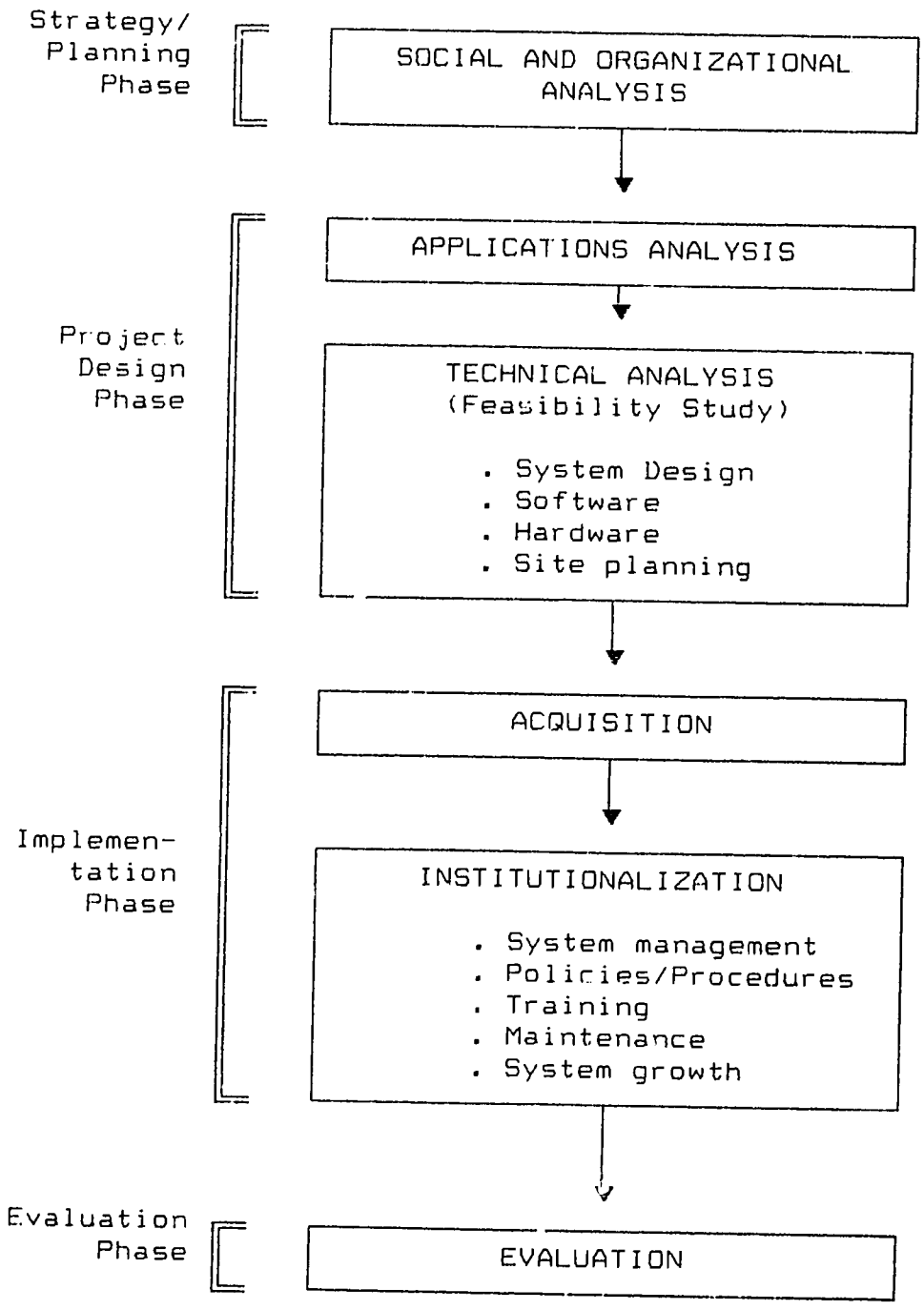
- **Social and organizational analysis:** broadly defining the information strategy of the organization, the objectives of the system, and the scope of the applications to be automated.

Project Design

- **Applications analysis:** assessing specific information needs and flows to recommend specific automation strategies, including system design, implementation strategy, budgets, and system outputs.

Figure 1-1

Project Cycle for Automated Management Information Systems



- **Technical Analysis:** detailing the system architecture, physical location, communications needs, output devices, storage options, peripherals, and networking strategies. Specific aspects of the technical analysis include:

- Software specifications: identifying whether packaged applications or custom-developed software will be required for the system and listing the specifications essential to the software.

- Hardware specifications: based on the software specifications, selecting compatible hardware. Selection issues include data storage, work-station memory, operating systems used, input-output capabilities, data back-up provisions, and vendor support.

- Telecommunications requirements: specifying protocols, transmission modes, and other issues that will affect remote data processing and data transfer between sites.

- **IRM approval:** sending the proposed system configuration, software, and other system requirements to the Office of Information Resources Management (IRM) for technical review and analysis. (Review is suggested for all computer-related acquisition but IRM approval is required only for purchases in excess of $100,000. IRM consultation is available at any point in the process).

Acquisition

- **Initial contract process:** identifying key acquisition regulations, reviewing the acquisition options, preparing the Invitation for Bids (IFB) or Request for Quotations (RFQ), and soliciting bids for services.

- **Vendor selection:** evaluating vendor bids according to appropriate and fair criteria and contracting for the required commodities and services.

Institutionalization

- **System delivery and installation:** developing the system in place and installing and testing all hardware and software. Programming and software development are completed during this period to accommodate planned applications.

- **System management:** developing organizational arrangements, management approaches, policies and procedures, security precautions, and system monitoring procedures within the organization.

- **User training:** instructing users on management and use of the hardware and software contained in the system configuration. This may require specialized courses from the equipment vendor or the use of third-party sources.

- **Maintenance/support:** establishing system maintenance and support guidelines to cover down-time, spare parts, upgrading, and technical assistance over the life of the system, including procurement of a vendor contract for these services.

Evaluation

- **System evaluation:** Assessing, in the context of the goals and objectives of the project to which the automation assistance is related, the performance of the system and its outputs over time. This assessment has technical, operational, and organizational dimensions.

The timing of these events will be dictated by the particular project life cycle. It is the project officer's responsibility (with responsible authorities from the host country) to develop an appropriate time line for these sequential tasks in each situation. Normally, a **minimum** time for the design through installation steps will be nine months.

SOCIAL AND ORGANIZATIONAL ANALYSIS

The aim of the analysis phase of the automation project cycle is to determine if the host organization is ready to introduce automation and, if so, to identify information needs, potential applications for automation, and the appropriate system design to perform those applications. The result of these sequential analyses (organizational, applications, and technical) will be a feasibility study to guide implementation (both acquisition and institutionalization). The first analysis is organizational.

Ultimately the success or failure of an automation project will be measured by change in the effectiveness of the organization. Even with a great deal of planning, sensible applications, and appropriate hardware and software, there is no guarantee of success unless the organizational environment is ready for automation. With developing country organizations this is particularly true. Due to lack of experience with automation, expectations (both positive and negative) may be exaggerated. Because of allure of computers to the host country and the enthusiasm of expatriate donors, premature automation may result.

Certain minimum conditions should be in place if automation is to have any chance of success, therefore organizational assessment must be the first step. This front-end planning reduces risks later on.

Planning Overview

Automated data processing (ADP) offers significant promise to an organization. Automation can provide cost-effective solutions to information management problems and expand capacities to use information for effective planning, control, operations, and management. Computers can be valuable tools in the recording, storage, retrieval, processing, and reporting of the management-related information needed for making timely and informed decisions.

It is risky to assume, however, that computers will solve data processing problems automatically. Often the first task of AID project officers is not to convince managers of the value of computerization but to help them conform their expectations to what is feasible and appropriate in a particular situation. Sometimes this may mean deferring automation while working on information management procedures that will accommodate computerization in the future. AID's role should be to help users develop systems that work, regardless of the degree of automation that has already been implemented or appears to be immediately desirable.

Any automation initiative involves risk, depending on complexity of the data and analysis, familiarity with the technology involved, clarity of the objectives of automation, commitment of leadership within the organization to ADP, and time available for implementation. Experience shows that a key to successful introduction of automation is a demand for better information and a general perception that technology will make a difference. In some cases this means finding critical points in the organization to introduce ADP where there is a relatively high level of confidence that this technology will address a recognized need. In time, the merits of automation may sell themselves more widely in the organization.

Properly designed and implemented, an automation strategy addresses the organization, aggregation, and analysis of relevant data and the local information management requirements of programs designed to decentralize responsibility and build capacity at sub-national levels of government -- major problems in most development programs and projects.

A strategy for automating information management must differentiate between information management objectives (who will use the information and for what decisions), information products (what form of information is most useful or necessary), and information technology (what systems and equipment are most appropriate).

Underlying strategy development is the fundamental task of determining what information resources are required and are available; how these resources are to be assembled, manipulated, and exploited; what the needs of different user groups are and will be over time; how information and data of different kinds may need to be integrated; and how all these processes will be managed. In short, what is required is a thorough understanding of the information problems to be solved and how elements of an automated system relate to the proposed solution. The scope of the application is a key issue. Is the system intended to address a specific, definable problem, or is the intent to put in place a general computing capability to meet future needs? If the latter is the case, flexibility and expandability are major issues.

Several basic questions should be raised in considering the information management scope of an automation plan:

1. Will current information systems effectively support the organization's strategies and operations? If so, will a computerization effort genuinely improve existing information management? The answers help define the conceptual, as distinct from the technical, dimensions of the information management task. In general, new automated systems should be designed to make maximum use of existing information flows to minimize disruption of established procedures.

2. Is there an office, department, or person charged with overall responsibility for coordinating computer introduction? If so, will this centralization of responsibility be helpful or be a bottleneck? What has been the experience with computers to date? Who currently drives the effort? Is this person more technically competent or functionally oriented?

3. What trained resources are available within the organization? Are these skill levels appropriate for the level of sophistication of the proposed system?

In practice, one or more joint teams or task groups should be formed to carry out early definitional work for any information automation process. The membership of these groups should be selected in ways that begin the necessary redefinition of organizational responsibilities that can be expected with any new or modified information system. The time and effort spent at this early step to help staff look anew at the current information system and take joint responsibility for designing and introducing automation will have significant benefit later.

The optimum sequence of analysis is to define the problem, select the software strategy, and determine hardware needs. The usual pattern of hardware first (by choice or because it is already there) tempts users to redefine their problems to fit the solutions they have acquired. In such cases, particular attention must be paid to maintaining the integrity of the information system.

Major system questions to be addressed at the beginning are:

- Is automation an appropriate solution to the problem?
- What are system objectives?
- What is the scope of the application?
- What kind of detail is necessary?
- How much flexibility, interlinkage, and expandability are needed?
- What are the costs of the current system?
- What are the anticipated costs of converting to and operating an automated system and developing the internal technical resources to make it work?

In general, identified applications should be computerized incrementally to allow implementation experience to influence design and help enhance organizational fit and commitment over time. Any system designed completely in advance will be less well suited to user needs and less accurately understood by others.

Preconditions to Automation

As a general rule, prospects for successful automation will be much better if the following five conditions exist before an automation project commences. Specification of these points is based on experience both in the US and overseas.

1. **The organization has manual information systems in place.** Effective information systems are, first, a management and organization challenge and, only second, a technical concern. Automating a poorly conceived manual system will not of itself produce an effective information system and may aggravate problems. The lack of manual information systems indicates information is not valued or that insufficient incentives exist to collect or make use of information.

2. Organizational decision making is based on information. The value of computers is that they increase individual productivity, in part by permitting rapid analysis as the basis for, or in support of, decision making. However, decisions are often made for reasons other than analysis such as politics, nepotism, tribalism, or expediency. In environments where non-analytical decision making predominates, analytic data may appear as a threat, or at minimum, be ignored.

3. Senior level management support for automation is present. This support not only means a willingness to introduce automation and to use the products of the automated system, but a willingness to devote the time and an ability to manage the organizational changes that are inherent in automation.

4. Staff are receptive to change and innovation. Introduction of automation necessarily involves change within the organization, affecting staff roles, relationships to supervisors, and power. Moreover, if staff perceive computers as threats to their jobs or as an unnecessary disruption to the current order, ADP introduction may aggravate their concern. Strong high-level management support is a key to overcoming these anxieties.

5. The technical environment is adequate. Computers of any size or sophistication have minimum technical requirements if they are to operate. These include consistent sources of electricity, a physical environment within tolerances for heat, humidity, and dust, and a reasonably stable supply of all the necessary supporting inputs (paper, ribbons, disks). Also, adequate support facilities may not exist. Particular vendors may not be represented locally with the result that information about current systems and guarantees may both be inadequate.

When one or more of these preconditions are missing, consideration should be given to alternative courses of action such as:

- Working on establishing or improving manual information systems.
- Conducting training on basic computer literacy so that organization personnel better understand the potential and limits of computers;
- And renting or otherwise introducing a "pilot" computer that has no assigned application to allow staff to dabble and become more comfortable with the presence of automated equipment.

Constraints to Effective Information Management

Even in cases where the preconditions are satisfied, at least for the most part, there are many information-related factors that may constrain the success of automation and which represent risks that should be addressed carefully in system planning. These include the following:

- Decision makers are not sure what information they need;
- Appropriate information is not accessible to those needing it or tends to be misinterpreted;
- Too much information masks the perceived value of pertinent information;
- The time and cost of implementing an ADP strategy are underestimated;
- Information control is associated with power, and critical information is thus held closely by some members of the organization;
- Information has value that is intangible and therefore often underappreciated; and
- Information users have differing cognitive styles so that formats useful to some may be less valued by others.

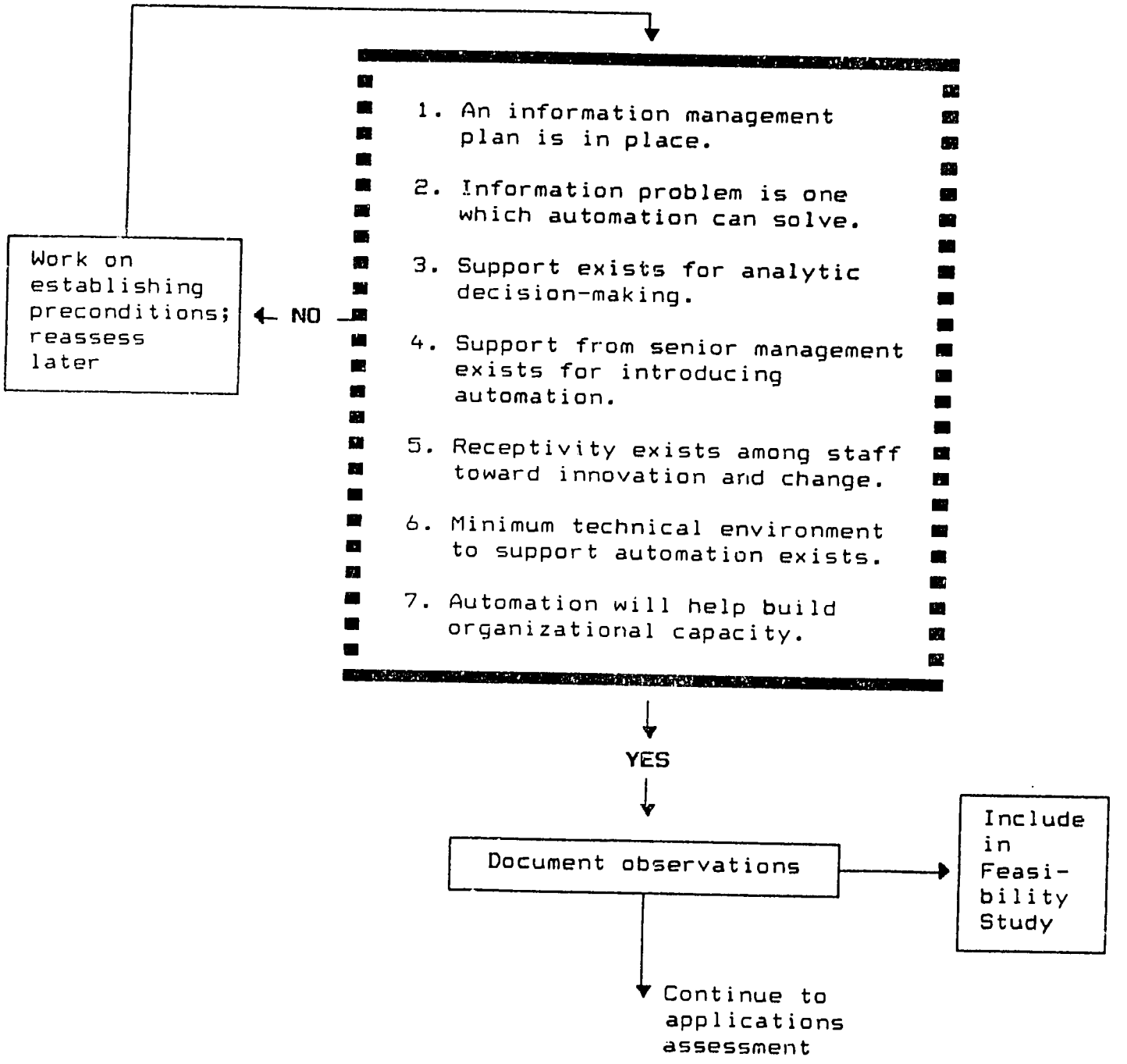
A decision tree for a decision to automate based on the preconditions and constraints discussed above is contained in Figure 1-2.

Host Country Variables

If a system is designed in the suggested sequence in which use dictates software and software dictates hardware, the status of local computer technology and use is a factor that needs to be given early consideration. In the absence of local technological constraints, it would be possible to design a system to accomplish almost any ADP task. In fact, local constraints often impose severe limits on what may be done and how it may be done. These should be reviewed for possible impact in each situation. Areas of concern are discussed below.

Figure 1-2

Decision Tree for Organizational Analysis



Local Computer-related Support Capacity

The lack of a critical mass of installed computer equipment in a particular area often means a shortage of readily available facilities to support needed installation, repair, and software services. If ADP seems desirable in a project area that does not yet support enough ancillary services, several projects sometimes can band together formally or informally to contract with vendors or service companies to visit the area on a weekly or semimonthly basis. If there are still not enough computers in the area to warrant on-site service, a less desirable but workable alternative is to contract for the supply of loaner equipment by air freight with repairs done on the defective equipment at the supplier's premises. In some of these situations, it may be necessary to procure a spare computer from which parts may be scavenged.

The quality of service available is crucial. A walk-through of a supplier's facilities should indicate how many technicians are in place, what the level of sophistication of diagnostic equipment is, and above all, how extensive the stock of board-level spare parts is. At a minimum, the service agency must have component-level ability -- that is, it must have equipment and skilled human resources to diagnose the source of malfunctions, and be able to pull that component and replace it with another of equal quality.

Even if repairs are possible, commercial channels for access to spare parts and foreign expertise remain important. In some countries (especially in Southeast Asia) provision is made for offshore warehousing of most merchandise and virtually all spare parts. In others, computer service agencies have arrangements for 48-hour air delivery from sources in the United States or Europe. These supply factors should be made clear during the negotiation of service contracts.

User Training and Programming Support

An area in which many developing countries lack resources is the availability of end-user training, whether in the use of standard software packages or of specially developed programs. Unless there is strong pressure to the contrary, minimal user training may consist of using photocopies of legally obtained instruction manuals in English with a classroom commentary on each paragraph in the local language. Apart from trainer-originated examples and software-linked tutorials, few local teaching aids normally will be available. Expectations regarding training approach and results should be clearly stated in training contracts with outside vendors, and the means by which progress will be monitored should be understood.

Obtaining programming support is also a difficult issue. Development of complex software from scratch is often relatively easy to procure because, in many countries, local universities turn out more technically oriented graduates than the economy can absorb. The ability to adapt off-the-shelf packages, especially spreadsheets and data-base managers, is much less common. This can result in a bias against the kinds of computers that run the off-the-shelf software. The project manager for an ADP effort should have a clear idea of agency needs and how various computer systems can satisfy them well before talking to the first dealer. Otherwise, what is most easily available is what may be recommended and supplied.

Political and Cultural Factors

Other, more subtle constraints to automation of information systems may well exist. In some situations a tendency toward centralized control of information may inhibit wider access to automated information management. Crucial actors in the process of automation may have a vested interest in not having more exact, more up-to-date information about their programs or activities made available. Cultural attitudes toward mechanical devices in general also may influence project design. In any event, cultural sensitivity is an important factor in the effective introduction of automated systems and adds to the importance of incorporating user insights into system planning. Talking to persons at both managerial and staff levels in organizations that have been automated can help provide insights in this area.

Communications

Most serious applications of ADP technology evolve to a stage at which exchange of data among work stations is desirable. Exchanges may involve transfer of data on floppy disks, use of network technology, hard wiring of two computers together, or full-blown communications setups using modems to transmit data over the telephone system or through emerging public networks (using packet-switching technology). Some assessment of a local telephone system's suitability for data transmission should be made early in a project that involves the introduction of computers. Alternatives to the telephone range from mailing floppy disks to the use of modems with direct cable connections.

Power

Electric power supply is the factor that most often derails an ADP project in the early implementation stage. Experience shows that, in general, an expenditure of one-half to two-thirds of the cost of the data processing hardware will be necessary to ensure electric power of a quality sufficient for a computer system to function satisfactorily. Power outages themselves do little or no damage to most equipment but create intense frustration in users when data are lost and must be re-entered. More serious, however, are surges and spikes, especially those that occur before micro power-outages -- losses of power so brief that they are unnoticeable. Inexpensive surge protectors widely used in the United States are inadequate for such a situation. Generally an uninterruptable power supply (UPS) will be required

Local Acquisition

An important planning factor in the local ADP environment is the option of buying equipment locally. Frequently a strategy of off-shore acquisition is followed on grounds of cost and in line with AID "buy American" statutes. This approach, however, may not be in the project's or host country's best long-term interests. An opportunity to help build the local infrastructure for ADP sales and support is lost when off-shore acquisition is used. Another more immediate impact is loss of any practical warranty. Even outside the warranty, local dealers may be reluctant to service equipment bought elsewhere. Thus where available service and maintenance capacity are adequate, local acquisition may be preferable even if the initial cost is higher. Furthermore, limited local purchase of microcomputers and peripherals as shelf items may be possible with considerable procedural and cost efficiencies.

Components of a Needs Assessment

This section has raised a variety of issues to be considered in the organizational analysis stage of automation planning. Finding answers may be accomplished in various ways, depending on the nature of the project, the capabilities of the host organization, and the resources available to the USAID mission to accomplish the task. If contractors are used, members of the host agency should be closely involved in the work so that they may benefit from the experience and build "ownership" of the findings. A needs assessment may bridge organizational issues and more specific project design issues covered in Section Two of this manual.

A summary of the major components of a needs assessment is contained in Figure 1-3.

Figure 1-3

Components of a Needs Assessment *

I. Interviews

A. Senior Management: Determine purpose of proposed system, current information management arrangements, the level of management support, and the resources available

B. Staff: Review existing data sources, data quantity, and the technical environment for automation

C. Middle Management: Review system management, operations, the scope of the proposed applications, and key organizational issues (see preconditions to automation above)

II. Benefit/Cost Analysis

A. Costs: Personnel, hardware, software, installation, operations, technical support

B. Cash benefits: Time saved, reduction in expenses, value of public gain

C. Qualitative: Improvements in quality of organizational performance

III. Report

A. Purpose of proposed system

B. Existing system review

C. Functional Specifications

D. Software/hardware/programming requirements

E. Organizational issues and potential constraints

F. Benefit/Cost Analysis

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* Adapted from Implementing Automated Information Systems in Developing Countries, Washington, DC, Economic and Management Consultants International 1987, p. 13.

SECTION TWO

PROJECT DESIGN I: APPLICATIONS ANALYSIS

How to use this Section

This section reviews the first task in actual project design, the Applications Analysis. A review of key issues to be considered in applications planning is provided as a checklist against which to fit the requirements of a particular project. These include matching information flow to the needs of users, budgeting for material and human resource needs, and addressing the risks and constraints identified in the organizational analysis stage of project planning. A major topic of this section is the issue of centralization versus decentralization. Characteristics and implications of the choice are detailed to help the project officer move from applications analysis to appropriate systems design. For situations where a relatively formal approach to applications analysis is called for, a tool called information mapping is presented. Emphasis is placed on using this technique to address system design issues identified elsewhere in the Section.

The section is organized as follows:

SYSTEMS DESIGN

- Applications Planning
- Addressing Risks and Constraints

CENTRALIZATION VERSUS DECENTRALIZATION

- System Characteristics
- Issues in System Choice

INFORMATION MAPPING

SECTION TWO

PROJECT DESIGN I: APPLICATIONS ANALYSIS

SYSTEMS DESIGN

As emphasized in the previous section, The primary question to ask when considering automation is "What role can effective information management play in the organization?" rather than "What functions in the organization can be automated?" It is important that information management, including its automation, be seen as part of an entire strategy serving particular applications such as personnel management, statistical analysis, or financial record keeping.

It therefore is essential to define early in the design stage what the system applications should be. Consider, for example, a high-level economic policy analysis unit that reports directly to the cabinet and is considering automating some of its functions. Is there a need for on-line and more up-to-date information for tracking the progress of foreign-funded projects in the field? Or is the need to prepare textual briefing materials for the cabinet? Perhaps economic analyses can be improved if more macroeconomic variables can be incorporated into a model. All these are possible system objectives. Their relative priority will have a major impact on system design. Prioritization of systems application is necessary in view of limited resources available and constraints on the readiness of the organization to accept automation.

Applications Planning

After system objectives have been defined, the scope of the application needs to be addressed. Will the size of the data base be 100 or 10,000 records? Will the information be collected from one or 10 geographic regions? Will the data to be entered cover only one year or up to five years? Are the operations simply numerical, or will they involve statistical manipulation? A sense of the physical size, period covered, functional complexity, and staff involvement has to be formed to reaffirm the feasibility of automation and define its scope. As noted in the previous section, the scope of the application will affect the extent of the organizational change to be anticipated and the management preparations needed as part of the automation strategy.

Finally, as part of mapping out an information strategy, it is necessary to project how automated applications will grow with the organization. How much flexibility has to be built into the system with regard to the kinds of software it can run, how many terminals can it support, and how distant can they be from the main processor or file server?

Can the system's memory be expanded? If the hardware configuration started out as independent processors, will they need to be linked at some future time? What would trigger this networking? The key factor is that automation is not a static process but one that should be responsive to the changing applications of the user.

Some specific issues to be considered in applications planning include the following:

The Applications Pyramid

As one ascends through a management hierarchy in an organization, the nature of management tasks and related information needs changes. Specifically, as one climbs the hierarchy, management tasks become less structured and repetitious. Lower management is more operations oriented, concerned with controlling day-to-day activities. Middle management levels are more involved in tactical decision making, concerned with near to intermediate term organizational activities. Senior managers are more strategically oriented, concerned with plans and programs that have a longer-term time horizon.

The significance for ADP applications planning is that the type of information needed by managers at each tier of the pyramid is different. Thus the most appropriate computer applications will differ also according to the tier involved. Crop data from an agricultural field station that are important to a researcher will have little direct importance to a deputy minister. Similarly, a sophisticated decision-support system used by a program manager is of little relevance to junior staff in his or her department.

The applications pyramid concept is a reminder that even the same generic application, a database for example, may have different performance requirements and system outputs depending on the management tier involved.

Analysis of Work Flow to be Converted

Although the automation of manual functions represents a major transition, planning should not be limited to this change alone. Designing an automated process presents an opportunity to gain fresh insights about how information functions can be made more effective at each level of the organization involved. Certain intermediate steps can be consolidated, fewer copies of documents can be produced, or spreadsheets can be linked to data bases for more rapid calculations. Consideration of the

applications pyramid may permit varied aggregations of data to be made available to personnel at different levels of the decision hierarchy. Automation planning should be used to streamline information flow as well as its processing.

Identification of Key Personnel

The choice of who will be responsible for setting up a new automated system as well as the set of initial trainees is crucial. The kind of people chosen sends a message throughout the organization as to how serious top management is about the mission of automation. On the shoulders of this initial batch of computer vanguards also lies the burden of demonstrating to the rest of the organization that automation can succeed. In most cases, therefore, a planning group should include representation from senior management and from different categories of potential system users. Obviously, whatever resources of persons skilled in automation use that exist in the organization should also be tapped.

Requirements for a Transition Work Plan

The most tedious aspect of automating a specific process is usually the conversion of historical paper files to electronic files. This conversion includes choosing which paper files to convert, coding them, inputting the data, validating the data, and testing the system for programming errors. This stage can take weeks to an entire year, disrupting normal work habits in the organization. Provisions should be made to develop a work plan to minimize these disruptions, as well as inform the staff of inconveniences that lie ahead as the organization automates. Usually manual and automated information processes will need to be maintained in parallel until there is full confidence in the computerized procedures. This is particularly true for such functions as accounting, where the integrity of data is especially critical. The maintenance of dual processes represents a major burden for any organization and adds to the difficulty of the transition period. Pilot testing using a small unit within an organization, before any major scale implementation is launched, usually prepares the organization well for automation. The host agency also needs to be prepared for extensive overtime work during this so-called beta-testing period. The old system should never be abandoned before a formal review is held to determine the suitability of the new report formats to the related needs of the agencies, whose reports are often mandated by law.

External Assistance

Local or expatriate resources may be used at any stage in the automation process. Many host country and U.S. consulting firms have developed the capability to assist in virtually all phases of office automation. Contracting their services is an option for planning and implementing automation assistance, especially where capabilities or staff availability in the host agency and the AID mission are limited. If a local procurement strategy is followed, vendors are often a valuable resource for installation, training, and maintenance support. Vendor responsibilities in this regard should be written into procurement contracts.

The Information Resources Management Office (M/SER/IRM) is an in-house AID resource available if short-term professional technical analysis and review are required or requested during the acquisition process. AID also manages a variety of Indefinite Quantity Contracts (IQC), which can be a source of technical and managerial assistance for automation. More details regarding AID resources are provided at the end of Section Three of this Manual.

Budgeting

A major problem of automation is the lack of financial resources to support the system after installation. In estimating the cost of an information system, the budget should look beyond the costs of hardware and software, which in the final outcome may amount to only 50-60 percent of total system cost over its useful life. The most important components of these other recurrent costs include:

- Material costs:

  Computer supplies and spare parts.
  Environmental costs such as electrical wiring, air conditioning, furniture, and special partitions, and Hardware/software upgrades and additions; and

- Human resource costs:

  Staff and programming resources,
  Maintenance and support services, and
  Training.

Investment in human resources should not be underestimated for, in the long run, they make up the most critical part of the entire system.

An important budgeting issue is the length of time an automated system will remain effective. Although the market has seen some stabilization in recent years, establishing certain hardware and software standards, many products have a useful life span of only two to three years before becoming obsolete. The question always arises, therefore, about whether it would be wise to wait for some new technology that is always around the corner. Two points to bear in mind when considering this decision are :

- The cost of the delay in automating may be higher than buying the current technology and upgrading or replacing it later; and

- Most new generation machines can absorb the functions of those they replace.

Addressing Risks and Constraints

Section One emphasized the potential pitfalls to any automation initiative. In the system design stage, observation of these guidelines will help reduce the impact of known constraints:

- Be aware of and work to reduce threats that key actors and stakeholders may perceive from the introduction of computers and potential impacts on their roles and power.

- Obtain support from top leadership and assure that this is communicated throughout the organization. One way is to select an initial application that will generate useful information for the interested senior manager.

- Limit initial risks of ADP introduction by limiting the size of the initial automation project, its technical complexity, range of applications, and human resource requirements.

- Be prepared to demonstrate the accomplishments of the system to all key actors after each step during introduction to build increased commitment and support.

CENTRALIZATION VERSUS DECENTRALIZATION

To a greater or lesser extent, computers affect an organization's power relations, both internally and externally. One key dimension of this change is whether automation promotes the centralization or the decentralization of power and control. It is not the computers themselves that centralize or decentralize, but rather the combination of the technology and the social and organizational environment. Simplistic statements like mainframes centralize and micros decentralize obscure the real issues.

In automated systems, centralization usually refers to the degree of direct access employees have to the agency's computing capability. The issue includes technical questions, such as the choice of computer equipment and standardization of application software and data structures, as well as management issues, such as access to computer equipment and files. The degree of computer centralization appropriate for a given agency depends on a number of factors, including the size and nature of the proposed computing activities, the training and computer literacy of the agency's employees, and the availability of both hardware and software support and maintenance personnel. Recent hardware and software advances, combined with the declining cost of processing power, gives organizations a wide range of options for tailoring automation to their particular automation needs.

System Characteristics

In highly centralized systems, there is usually a data processing center that houses all computing equipment and is staffed by professionally trained systems analysts, computer programmers, data base managers, machine operators, and maintenance personnel. Typically, the central piece of equipment is a large mainframe computer or a minicomputer with an array of peripheral devices. All of the computing requirements of the agency or project are handled by the center and processed by its specialized staff. Much of the center's effort is devoted to routine activities such as accounting, maintenance of an agency data base, and the production of periodic reports. Computing is usually managed as a specialized activity requiring a high level of expertise. Other agency personnel needing computing typically submit job orders to the center and receive output, usually in the form of printed reports. In some developing countries, a single computer agency provides computer services for the entire government or for a single ministry. In the past, AID has established highly centralized computer operations for projects involving agricultural census and statistical reporting services.

In highly decentralized systems, operations are characterized by a dispersion of computer equipment throughout the agency or project, and the general use of the equipment by non-professionals for a wide range of applications. Often there is little coordination of computing activities and a lack of standardization of either hardware or software. Agency or project personnel are free to use the equipment for a wide range of activities; there may be no attempt to impose common software or to maintain a common data archive. Each user is responsible for his or her own computing. The major disadvantage of the decentralized approach is that computing becomes an individual activity, no agency-wide files are maintained, and sharing organizational information may be difficult.

Between these extremes is a wide range of computer operations with varying degrees of centralization. In most situations, there is, in fact, need for some form of centralization. The question is one of degree and involves consideration of both technical and management issues.

Issues in System Choice

Technical issues include the choice of hardware and applications software, maintenance and repair, computer and data security, and level of training and expertise necessary for the management and operation of a given system. The nature of the data to be processed and country-specific factors, such as level of computer training and support, will determine how these issues are resolved.

From a management and organization perspective, the fundamental question is what types of applications are required by the organization. (The answer to this question will also have implications for choice of software and hardware, a technical issue.) Some primary management and organizational considerations are:

Type of applications. Do data bases and applications vary widely by user, or is there a large body of data to which many users need access simultaneously using a relatively few programs? If the former is the case, a more decentralized system such as a minicomputer or multi-user system should be chosen; if it is the latter, a linked or centralized system such as a minicomputer or local area network (LAN) will be more satisfactory. A mainframe may be required if common access to a very large body of data is required.

System vulnerability. With highly centralized systems such as mainframes or multi-users systems, when the system fails, no user will be able to work. However, in a decentralized system such as a LAN, another microcomputer can be made into the file server and the network can continue to operate short one microcomputer. This feature is particularly important i remote areas where maintenance is difficult. LANs, however, are a relatively new technology and are therefore more prone to technical bugs than established centralized systems. The tradeoff depends, in part, on what local support capacity may be available.

Expansion. Since systems tend to grow, consideration should be given to future expansion in the original plans. Minicomputers can be upgraded by the addition of peripherals and the appropriate processor. A multi-user system can be upgraded by replacing its processor with one of higher

speed. Several upgrades are possible, as processors are available in several speeds. Terminals also may be added. Since these are only display units, they are cheaper than fully functioning microcomputers. A LAN may start as a single-user microcomputer with new microcomputers added as needs increase. For this reason, it is important that new equipment is technically compatible with the old, even if immediate plans do not call for it to be used in the system. By the same token, if some equipment is currently in use, it may be incorporated into a system if the newly purchased equipment is compatible with it. Equipment should be compatible to the extent that all units have the ability to use the same operating system and run the software required for the organization's applications. At a minimum, files should be movable from one part of a system to the other by floppy disk exchange or direct cable transfer.

INFORMATION MAPPING

Information mapping is a formal technique of input-output analysis that illustrates the kind of planning that may be helpful during the applications analysis stage of an automation initiative. The benefits of going through the exercise can be summarized as follows:

1. It serves as a basis for streamlining existing manual procedures by pinpointing areas where there is 1) duplication of effort in data gathering and dissemination, 2) there are inconsistencies and inaccuracies in data gathered, 3) there is inadequate information for decision-making, or 4) unnecessary information is generated and received.

2. It serves as an important input in building a framework for the organization's primary database by helping to define the systems objective and scope, helping to identify key personnel for setting up a new automated system, and pinpointing priority areas where automation can make the most impact (especially when automation resources are limited and the implementation plan calls for a phased-in approach).

3. It serves as input to future expansion and system upgrading and in determining the type of configuration most suitable to the organization.

Following is an outline summarizing the key in preparing an input/output analysis and organizational information map.

Step 1: For each office or functional unit, gather sample copies of all reports received or generated by that unit. For each of the incoming and outgoing reports or documents note the following information:

a) Office/unit
b) Title of report/report form number;
c) Number of copies received/transmitted and their distribution;
d) Frequency of the report (daily, weekly, monthly, etc.);
e) Source of the report/information (office and if possible the person who actually prepares it);
f) Processor/user (office or person who receives and uses the report);
g) Action/process conducted on the report (tabulation, summary, decision making, etc.);
h) Storage/filing mode (organizational keys, how long the files are kept, who has access); and
i) Storage medium (paper, diskettes, microfilm, tapes, etc.)

Step 2: Draw up a matrix (one each for incoming and outgoing reports) covering all of the above information and all data elements in each report. A simplified example is contained in Figure 2-1.

Step 3: Draw an informacion map for each office /unit using the Input/Output matrix as a guide. Represent each office or functional unit as a box and use lines and arrows to represent information coming in or going out. Putting together each office or unit in one map illustrates the information flow among them. An example of an information flow map is in Figure 2-2.

The input/output matrix and information map can help the applications planner to

- **define systems applications and priorities:** Looking at the Input/output chart one can see the office/unit that will stand to benefit the most through automation. The I/O matrix and the information map shows which office/unit handles and processes the biggest chunk of information received and processed. This and other factors such as impact on decision making, volume of information, frequency and accuracy of reporting, and minimizing of repetitious processing of data should be taken into consideration in setting the systems objective and priorities.

- **define the scope of automation:** By referring to the I/O matrix, tabulating the data element columns, considering the frequency, filing method, and sources of information, the planner can have a realistic answer to questions like the size of database, source of information, how far back the data collection and conversion ought to cover, physical size and complexity of the database, and the staff requirements needed for implementation.

Figure 2-1

Information Matrix

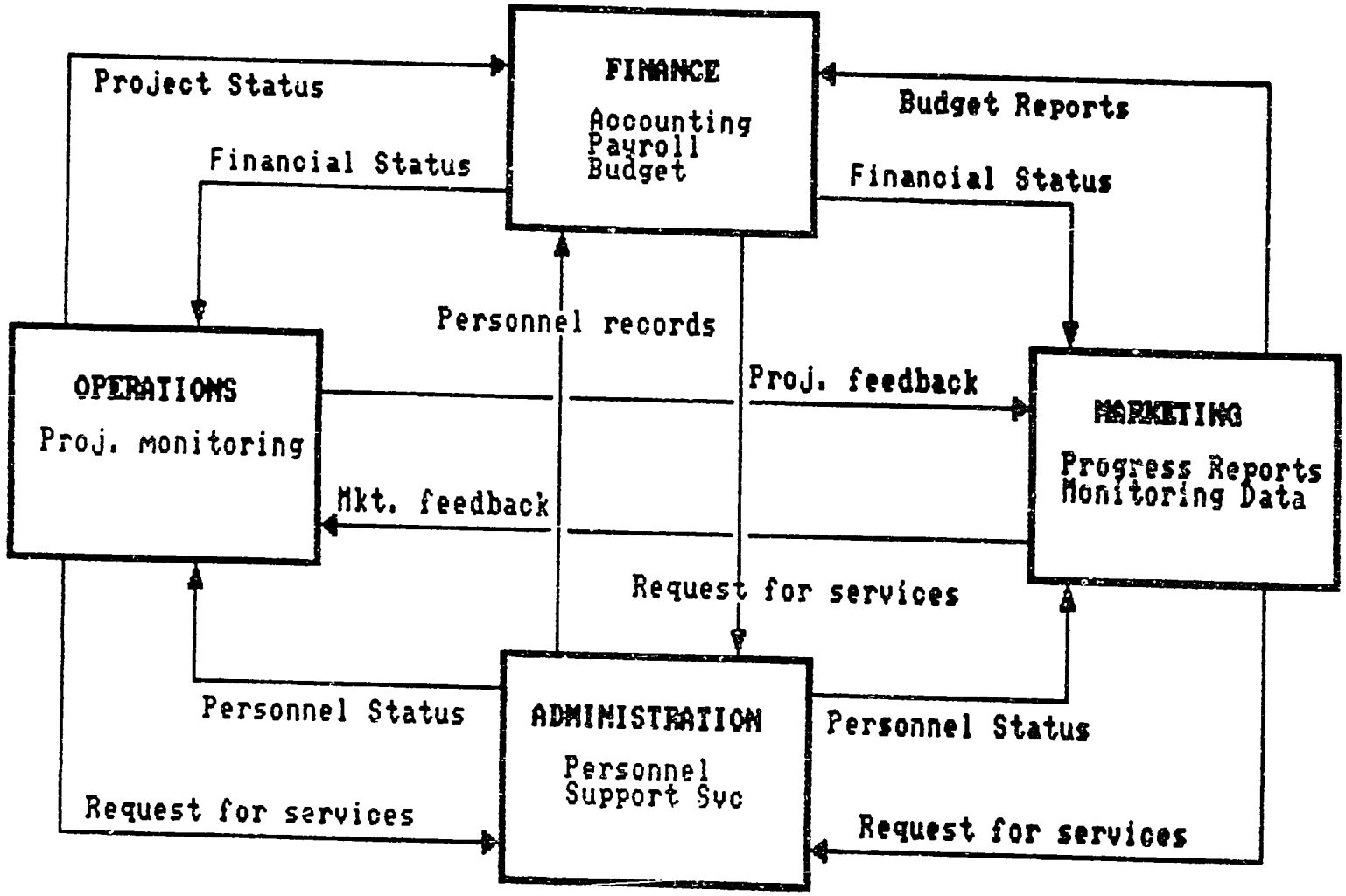
Unit / office _____

Incoming/outgoing report matrix

REPORT TITLE/	DATA ITEM 1	DATA ITEM 2	... DATA ITEM n	SOURCE	DISTRIBUTION	PROCESSOR/S	ACTION	FILING SYSTEM	FORM NO.
Report no.1	x		x	Fin	Ops, Prog	Ops	Tabulate/ compute	filed by proj.	
Report no.2		x	x	Prog	Ops, Admin	Ops	Consolidate	by date	
Report no.3	x	x	x	Prog	Ops, Fin	shipping clerk	prepare invoice	by date	
Report no.n									

Figure 2-2

Information Flow Map



- **Planning for future expansion and upgrade:** On the assumption that resources are limited and that conversion will have to be done on a phased basis, consideration for future upgrades and expansion have to be based on the priorities set earlier. Again the I/O matrix gives the designer an idea of what applications should be projected for future implementation.

- **Improving the manual procedures and reporting system:** The I/O matrix is not only helpful in determining areas for automation but also is a useful tool for improving a manual reporting system. By looking at the data element and user columns the designer can see what information is contained and repeated in several reports submitted to the same office or unit. Improvement may come in the form of deleting unnecessary data elements or, in some cases, consolidating several reports into one that contains only the necessary data elements. This minimizes duplication of effort, reduces paperwork, and assures quality information. In many instances a report may not be needed at all as evidenced by the fact that nobody uses it and it makes no contribution to the effective performance of the office.

- **Identification of key personnel:** In the preparation of the I/O matrix and the information map, the designer will have an idea who are the personnel currently involved in the system and their particular roles. It may be worthwhile to consider these people for training for the new system since they are familiar with the operation of their office and understand existing system.

- **Resolving questions of centralization versus decentralization:** In the process of deciding the issue of centralization vs. decentralization, the I/O matrix and information map can be useful. Those applications that have many users will probably be better off residing in a central computer where updating and reporting are done by one group. This prevents duplication of effort and safeguards data integrity. On the other hand, applications that are unique to a particular office or functional unit usually best operate on a distributed system.

SECTION THREE

PROJECT DESIGN II: TECHNICAL ANALYSIS

How to use this Section

This section moves from the applications analysis of the previous section to the technical issues involved in the choice of an actual system configuration. First, a review of major factors in the choice of a mainframe, mini-, or micro-computer system is provided. This broad decision is likely to be made first, based on the scope of the application, the level of technical support available, and cost factors. Within any of the system configuration options, a range of choices must be made regarding specific technical specifications. These specs provide the basis for actual system acquisition. A review of important factors to consider is provided. The section ends with a summary checklist that may be used as the basis for a feasibility study.

The section is organized as follows:

SYSTEM ARCHITECTURE

- Mainframe Computers
- Minicomputer Systems
- Microcomputer Systems

TECHNICAL FACTORS

- Software
- Hardware
- Telecommunications
- Site Planning

THE FEASIBILITY STUDY

SECTION THREE

PROJECT DESIGN II: TECHNICAL ANALYSIS

SYSTEM ARCHITECTURE

Major options for system design include mainframe computers, minicomputers, and microcomputers. The choice depends on the task to be done and on local conditions. Factors in selection of the system architecture are discussed below.

Mainframe Computers

Mainframes are large, relatively expensive systems with high speed processors, large memories, and large storage devices. They usually require a high level of technical expertise to operate. Being a single computer, a mainframe exemplifies centralization of hardware and software. With timesharing, a mainframe can support a large number of remote users via terminals or work stations. Thus, although a mainframe system is inherently centralized with regard to hardware and software, the degree of user access is strictly a policy question. The following factors should be considered when evaluating a mainframe computer system for a project in a developing country:

- Centralized mainframe computers are well suited for operations requiring the maintenance of large data bases, routine production jobs, and large-scale computing activities. For example, a mainframe may be appropriate for census, crop reporting, and similar projects.

- There is typically a need for a large support staff of trained programmers, analysts, operators, and maintenance personnel. The necessary cadre of trained personnel is often missing in developing countries. Should you choose a mainframe, however, the professional staff should be in place prior to the installation of the equipment.

- Preventive maintenance and repair service for mainframes are often unsatisfactory in developing countries. Both are necessary. When problems arise, the entire operation can come to a halt waiting for parts and service.

- Not only is the initial cost of a mainframe system high, but there also can be substantial recurrent costs for personnel and maintenance. Before the purchase of a mainframe system, consideration should be given to whether the host country will support it after installation.

Minicomputer Systems

Minicomputers occupy the intermediate position between mainframes and microcomputers. They can support as many as several hundred users simultaneously. Usually they are much cheaper, process data much slower, have less memory, and can store smaller amounts of memory than mainframes. Their performance, however, usually exceeds that of microcomputers. Although minicomputers typically require a lower level of expertise for operation, they still require the same sort of centralization of hardware as a mainframe. However, minicomputer systems are typically time shared and easier to use, and are more accessible to personnel working outside the computer center. The following points are worth considering when evaluating a minicomputer for a development project:

- Minicomputers are well-suited for situations where there is a need to have 10 or more users accessing the same programs or data files. A minicomputer system can serve, for example, as the basis for automating an office, with terminals distributed around the office serving as work stations for word-processing, accounting, and other routine office activities.

- Although the level of support staff needed for a minicomputer operation is considerably smaller than for mainframe operations, there is still a need for professionally trained operations and service personnel. These personnel should be in place before the installation of the system.

- As with mainframes, minicomputers are often difficult to maintain and repair in developing countries. Without good maintenance and repair service, one can expect periods when the system is not functioning. A plan for providing adequate service should be in place prior to the purchase of the system.

- Although the recurrent costs are less for minicomputers than for mainframes, they are still substantial.

Microcomputers

Microcomputers represent the small-scale end of the continuum. Since the entire central processing unit (CPU) is on a single microprocessor chip, it is possible to house the entire microcomputer system in a desktop or even a portable unit. Compared with mainframes and minicomputers, microcomputers usually process data at a slower rate, and have less memory and smaller storage capacity. They also are much cheaper. While it is possible to configure microcomputers as multi-user machines, the majority still are used as stand-alone, single-user machines.

Microcomputers lend themselves to decentralization; it is not unusual for microcomputers to be physically dispersed throughout the work area and even assigned to individual workers. Some microcomputer operations are centralized, however, with all machines housed in a computer center with controlled access. Being relatively simple to operate, they require a much smaller support staff. Users typically work independently of one another. The following factors should be considered when evaluating microcomputer systems:

- Microcomputers are ideal in situations where there is only a limited need for computing. Although the computer may be used for a variety of work activities, they are typically small discrete jobs.

- Microcomputers do not require a large support staff. Although it would be useful to have persons knowledgeable in microcomputer hardware and software working with the project, it is not necessary to have a staff devoted to supporting the operation. Microcomputers are simple to install. Typically, the operating system is on a floppy disk or a hard disk, and turning on the machine boots up the system. Applications software is user-friendly and requires less specialized user training than most custom software.

- A system composed of a number of compatible microcomputers is less vulnerable to maintenance and repair problems than one utilizing a mainframe or minicomputer. Since each microcomputer operates independently of the other, if a given microcomputer malfunctions, its files and application programs can be quickly shifted to another machine. The need for maintenance or repair service does not cause a halt in the overall operation -- an important advantage in developing countries.

- Microcomputer-based systems make computer experimentation more financially feasible, not only because of relatively low cost but also because implementation can proceed in gradual stages.

- Since microcomputers require less support personnel than either mainframes or minicomputers, recurrent costs are substantially lower.

Although most microcomputers are used as stand-alone machines, communications hardware and software have been developed that allow the use of microcomputers in concert with mainframes, minicomputers, or other microcomputers. With this technology, systems can be closely tailored to an agency's needs. Some common options include:

Micro-to-mainframe/mini systems. Two types of technology exist that allow communication between microcomputers and mainframes. The first involves the use of a modem connected to a serial port of the microcomputer and appropriate software to communicate with the mainframe or minicomputer. The second involves the use of an expansion board that emulates a mainframe or mini terminal. In either case, the microcomputer serves as an intelligent terminal when connected to the larger computer. Programs can be run and data and program files uploaded and downloaded. When not serving as a terminal in a larger system, the machine can be used as an independent microcomputer.

Options now exist for interconnecting highly dissimilar computers. For example, a multi-user minicomputer can serve as the central coordinator and main data cache for one or more networks of microcomputers. When systems are planned with eventual integration in mind, it is possible for users at work stations to access data on large mainframes as though the databases were local resources and then continue processing as though the work station were only a stand-alone microcomputer. It is rare that a new system will be seen as needing seamless interconnections between micros, minis, and mainframes, but any system design that ignores the possibility of such interconnections risks early obsolescence. These technologies for "mix and match" connectivity are developing so rapidly that, with proper foresight, provision can be made for any data anywhere on the mainframes, minicomputers, or microcomputers of a given system to be immediately accessible to users on any other part of the system.

Multi-user microcomputer (distributed) systems. Another way to use microcomputers to share data and programs among users is the multi-user system. Using the appropriate software, several work stations are connected to a single computer that functions as the host. Users share software and peripherals, through the processing power of the host. This system allows a large number of users to access a common pool of data simultaneously. Moreover, since the work stations are display terminals rather than full-function computers, the cost is less than a local area network (LAN) of microcomputers.

Microcomputer networks. A LAN is a system in which an assortment of microcomputers and peripherals such as printers and mass storage devices are linked by cables within an office or across many offices within a building. One microcomputer, usually with a large volume of disk storage and faster processing speed, functions as the file server for the other microcomputers in the network. As the system grows, the number of file servers increases to maintain the system's quick response time.

The three major configurations to have emerged in the market are: (1) star-based LANs, which radiate from a hub; (2) bus LANs, which tap into a single cable; and (3) ring LANs, which connect the work stations in a physical ring. Each configuration has its own special features, but all allow the sharing of programs, data, and peripheral devices, and permit integration of all aspects of data processing (including data base management, word processing, and electronic mail). Each microcomputer performs its own processing and can run its own software as well as that of the network.

Attractive features of this arrangement are that initial investment can be small, growth of the system can be incremental, failure of one unit does not compromise the entire system, and the need for ongoing software support is relatively small.

The tradeoffs are the relatively high cost per work station (especially the hidden costs of installing cables in the office), the longer shake-down time required to get a new system to function as planned, the lack of LAN standards, and the limited experience with networking technology even in more developed parts of the world.

In summary,

- If intensive common access to a vast body of data is essential, if parts of the collection of data will be subjected to the same series of procedures repeatedly (batch processing), and if adequate professional back-up support is available, a mainframe computer may be indicated.

- If the body of data is not so extensive, if the number of users who will need common access is more limited, and if "generic" software packages are acceptable, a minicomputer system installed, programmed, and maintained by a local distributorship may be the best answer.

- If regular attention from data processing professionals is not easily available, if specific microcomputer software packages are preferred, if limited interaction on common sets of data is foreseen, and if no body of non-computerized data exists on which to base the design of a full-scale automated system, microcomputers, possibly networked, may represent the best choice.

TECHNICAL FACTORS

Software

The selection or production of software is the most critical factor in the choice of an automated system. An increasing array of off-the-shelf applications software is available, supplemented by specialized products developed by associations of users who see a marketing or service opportunity. Much software, however, is difficult to use or is poorly documented. Also, some local vendors do not include manuals and other installation documentation as part of the original cost of a package. Without support from some source, most users will experience serious frustrations and difficulties when employing new programs, whether packaged or custom written.

Cost and other considerations dictate that packaged software be given preference over the writing of new programs unless there is compelling reason to believe that no package exists that will do the required task. If customization is needed, consideration should be given to the possibility of assistance from vendors and other users of the same hardware as an alternative, or at least supplement, to the expense of technical assistance in modifying and debugging new programs over an extended period of time. In general, custom software will have greater maintenance demands than a well-tested off-the-shelf applications package. An incremental approach to software development in which a separate software system is designed for each task can reduce the risk that the failure of one system will stall the entire system.

In many countries, language will influence software choice. Two questions should be asked: first, do screen prompts appear in the local language? second, does the software support special character sets for proper screen and print display of the local language? The latter factor is especially important for word processing where normal written output is required.

Whether software is custom designed or only to be maintained after purchase off the shelf, programming assistance will be required. Thus a decision is needed on whether in-house programming skills will be hired or developed or, alternatively, whether this technical support will be obtained by contract with outside expertise. In any case, this essential input will be an important factor in the overall cost of software to an organization.

Key software selection criteria include:

- Functional/user requirements. How do the basic functions of the package meet the requirements of the organization, and is the performance of the package adequate for the organization's needs?

- **ADP configuration.** Will the program run properly on an existing system as configured or on a planned system whose configuration fits budget and other organizational boundaries? Will it run on a LAN?

- **Technical factors.** In what language is the program written, and is source code provided so that the program can be customized? If so, are there programmers in the organization or with supporting vendors who can implement modifications?

- **Support.** How much support (installation, maintenance, and training) will the supplier furnish, and what are the qualifications of its personnel to service the particular package? Is adequate and understandable documentation provided? What arrangements exist for software upgrades?

- **Cost.** What are the acquisition alternatives (purchase, lease, etc..)? What is the total cost of the package, including vendor support? What are the training implications of the package, and how will this be funded?

- **Miscellaneous.** What is the experience of other users with the program and its support? Is it possible to test-drive the program before making a commitment to it?

Some central control should be exercised over the purchase and use of software. Limiting the number of software packages used makes training investments more efficient. Furthermore, choosing common word processing, spreadsheet, and data base management programs for an entire agency or project facilitates the sharing of data.

Software packages should also be selected that support a common data interchange format. It often is desirable to move information from one application to another, such as from a spreadsheet program to a word processing program or data base management program. Increasingly, major software packages incorporate this capacity.

Hardware

Reliability is more important than state of the art in hardware selection. Technical problems of all kinds are likely to be multiplied in the hostile setting of many developing countries. Easy-to-maintain system components are generally to be preferred over more complex options, even if some ease of use is sacrificed. Also, systems with modular, decentralized component parts are more likely to survive than highly integrated (and interdependent) systems. Systems always fail; in a modular system, the failure of one component will not cripple the whole.

Component choices fall mainly in the categories discussed below:

Work Station Memory

The question of work station memory is normally significant only for stand-alone or networked microcomputers. The MS-DOS (PC-DOS) operating system can make direct use of up to 640 kilobytes (Kb) of internal memory (usually called random access memory (RAM). Memory beyond 640 Kb can be accessed by various means, the Lotus-Intel-Microsoft Extended Memory Standard (EMS) currently being the most used. IBM's recently announced OS/2 operating system abolishes the 640 Kb limit for directly addressable RAM. Until software is available that actually exploits the larger addressable memory, however, computers with 640 Kb to 1 megabyte (Mb) of memory will generally suffice in non-specialized work stations.

There are several means of attaining desired memory configurations in microcomputers. The IBM PC and those compatible with it come with space for up to 1000 Kb (1 megabyte) on their "mother boards." Adding and subtracting memory in increments of 128 Kb involves simply plugging or unplugging chips. Add-in boards are required for RAM above the motherboard capacity. These boards usually come with added features such as a clock and calendar and added input/output ports.

Microprocessor and Operating Systems

The world of microcomputers has from the beginning been divided into two basically incompatible camps. The Apple family of computers was built on the Motorola 6500 series of chips, now advanced to the 68000 series. A number of other computers, including the CP/M computers, were built on Intel's 8080 series, which over time developed into the 8088 (used in the IBM PC and PC-XT and clones), the 80286 (heart of the IBM PC-AT and clones), and the 80386 (used in the recently announced IBM PS/2 line of machines, the Compaq 386, and various clones). Programs that run on one family of microchips will not run on the other unless they are rewritten from scratch. Data transfer difficulties and networking problems can be overcome when a mismatch of computers already exists, but for simplicity it is better to plan a new system to be in one camp or the other.

Compatibility problems are even more prevalent among minicomputers. Xenix, generally a subset of the Unix operating system first developed by Bell Laboratories, is one of the more common multi-user operating systems for minicomputers.

Unfortunately, software that will run on one brand of minicomputer often will not run on another minicomputer, even though the microchip on which the computers are based is the same and both operating systems are nominally Xenix. Two other operating systems often seen in developing countries are Oasys and Pick. In choosing among these systems, the most practical technique is to return to the task to be automated and the software required to implement the automation. The task dictates the software, and the software dictates the hardware.

Input/Output, Interface Capabilities

Any means by which a computer acquires information is a means of input. Any means by which a computer dispenses information is a means of output. The most familiar means of input is the keyboard. The monitor, which contains the cathode ray tube (CRT), is the most obvious form of output. The parallel printer ports, of which there are usually one or two, are another form of data output. Serial ports, of which there also are usually one or two, can carry communications in either direction. Attached to a printer, the serial port is primarily a means of output. Attached to a modem or directly to another computer by means of a null modem adaptor cable, the serial port passes data in both directions.

Keyboards. Some stand-alone microcomputers or terminals for larger systems have only a typewriter-like keyboard, but most include a number keypad like that of an adding machine that also serves as a cursor keypad. This arrangement can be inconvenient for activities that involve intensive use of both numbers and cursor keys, such as financial spreadsheets. For a computer to be used primarily for financial calculations, keyboards with separate cursor and number keypads can be acquired.

Mice. In the past, use of a "mouse" to point to menu selections on the screen was a luxury. Increasingly, however, complex software with really large numbers of choices requires a mouse to operate at all. Desktop publishing applications usually require a mouse. There are several options for mouse installation primarily distinguished by whether they have a circuit board that mounts inside the computer or whether they plug into a vacant serial port. All mice work in a similar fashion. Choice should be dictated by price and by potential for conflict with other installed boards or serial devices.

Ports. The use to which a computer is to be put determines the appropriate port configuration. In general, all modems (for sending data over a telephone wire), some laser printers, and most of the better quality plotters require their data in serial form.

Printers, unless stated otherwise, usually require data from a parallel port. The usual minimum port configuration is one parallel port, to which a standard printer can be attached. Beyond that, any combination of parallel and serial ports can be added to accommodate equipment that is to be attached.

Video. Color video is rarely needed to display output. Generally, monochrome monitors are preferable on grounds of higher resolution and lower cost. If color is required, it is necessary to procure as high a resolution as possible to approach the steadiness and smoothness of monochrome monitors. The monitor chosen will dictate the choice of the adaptor card that translates the computer's signals to a form the monitor can display. Some specialized software (desktop publishing systems in particular) require the added resolution of a monitor and graphics board that meet the IBM Enhanced Graphics Adaptor (EGA) standard. Since this technology is volatile, purchase of monitors that sense the type of signal they are receiving and then synchronize their processing of the signals automatically is advised. EGA monitors should be capable of at least a resolution of 640 x 400 dots in their highest resolution mode. Higher resolutions are available.

Printers. The printed output of the newer 24-pin dot matrix printers is near enough in quality to the struck letters of daisy wheel (letter-quality) printers for most purposes, and dot matrix printers can also produce several sizes and styles of type and graphic output (including international character sets). If a higher quality of printed output is required, a daisy wheel printer will be necessary, but these are slow and relatively inflexible. The most powerful option is a laser printer, which can provide fast, print-quality output. Supplies and facilities for servicing laser printers exist in many developing countries, but the technology is new enough that local resources should be checked first. If the laser printer is to be used in desktop publishing applications, memory of at least 2 Mb is essential; 4 Mb or more would add convenience in publication of larger documents. Other desirable features in a laser printer are the ability to emulate other laser printers and the ability to accept print fonts sent to it by the computer.

Plotters. Plotters offer the capability to produce multicolor graphics for presentation quality output. The ability to drive a graphics plotter is usually a function of the software employed. Configuring software to drive any printing device is greatly facilitated if the printer and plotter adhere to a major standard of software control such as Epson or IBM.

Modems. The modem (modulator-demodulator) is the device that, with communications programs to drive it, allows data from one computer to be sent through its serial port over the telephone wires to another computer also equipped with a modem. The most common modems communicate at speeds ranging from 300 bits-per-second (baud) to 2,400 baud. More expensive modems that handle transmission speeds up to 19,200 baud and do extensive checking of errors before passing data on to the computer are now available. They are worth considering when large volumes of data will be transmitted or transmissions will be automated -- processed by the computer alone late at night, for example. Some attempt to determine the data transmission capacity and quality of the local telephone system should be made before ordering modems and programs for serial communications.

Data storage. In many cases the choice of the basic system architecture will dictate the medium for data storage. Microcomputers leave the user with the most options. Among smaller machines, especially stand-alone microcomputers, the floppy disk remains the workhorse of data storage. Floppy disks are cheap and portable, and can be used confidentially. Current sophisticated software applications, however, generally call for hard disk storage since floppy disks are much slower in access time and have limited storage capacity. Current hard disk technology provides the capacity for storage of 10-80 megabytes (Mb). For most stand-alone applications, 30 Mb provides the best balance of cost, reliability, and capacity. In most small systems some provision should be made for the use of 3 1/2 inch diskettes, which are becoming more popular on portable computers and may eventually become the standard for desktop computers as well.

Compact Disk Read Only Memory (CD-ROM). Compact disk read only memory (CD-ROM) is a promising technology not yet ready for widespread use. A small library of information can be scanned and accessed rapidly from CD-ROM. Some initial uses include digitized law libraries and encyclopedias. Hardware is also being released that includes the same CD-ROM technology, but in a write-once form. This technology has future potential as a means of archiving historical data, a promising alternative to the bulky and perishable files maintained by most public sector institutions. The benefits derive best from applications involving the adding of new data or maintenance of a constant body of information rather than on information that must be revised or erased, which is beyond the ability of CD-ROM devices now commonly available. In situations where long-term storage of facsimiles of documents (including signatures and handwritten addenda) is needed, several write-once CD-ROM systems are available.

Data back-up and archiving. The most effective method of data back-up is a tape streamer unit installed on each computer that has a hard disk (even if the computer just serves as a work station in a network). Small configurations can use floppy disks for back-up, but this requires organized and consistent procedures to be effective. Another option is the Bernoulli Box, in which replaceable hard disk-type cartridges can be used for storage of archival data.

Telecommunications

Telecommunications is appropriate as an element of the automation process for routine text and data exchange where computer-to-computer communication can provide rapid and efficient information handling. Examples of appropriate applications include:

- On-line data-base searches;
- Mainframe uploading and downloading (for example, for statistical manipulations that require mainframe processing speed and power);
- Format conversions;
- Telex/cable/electronic mail transmission; and
- Correspondence and file transfer.

These transactions require specific technical capacity (typically a CPU, storage devices, monitoring equipment, and network interface) in addition to adherence to requisite standards. In the determination of the most suitable hardware and software configurations for a particular application, the following steps should be taken:

- Determine network characteristics (such as types of switching);
- Learn local equipment specifications (packet sizes, modems, and character sets);
- Ensure compatibility through interconnection standards: a variety of transmission media (cable, satellite, and microwave) make up existing national and international networks. Interconnection requires compatibility between terminal equipment and the channel as well as between sending and receiving devices;
- Consider individual needs in light of location parameters:

Number of locations and how they are geographically related,

Traffic volume to determine necessary transmission speeds and facilities requirements,

Delay inherent in satellite transmissions that may cause loss of data calling for error checking protection and forcing lower transmission rates, and

Security (line of sight and relay transmissions are more susceptible to interference and interception); and

o Investigate host country technical, political, and commercial boundaries:

Service options and availability,

Tariffs,

What is allowed to be attached to the network (to preserve network integrity), and

Political constraints and procurement implications:

* Privacy and access limitations,

* Transborder data flow policies,

* Data protection laws, and

* Trade restrictions (limited marketing agreements, controls on service provision).

Since all of these applications can produce output available through other means (libraries can send a paper copy of a bibliographic search, telexes can be sent from a hotel, etc..), a decision to exploit telecommunications efficiencies depends on budgetary and legal constraints. Telecommunications activities for any given location are likely to be both domestic and foreign, making planning requirements diverse and complex since regulatory considerations vary by country and are constantly changing. Close management is needed to keep abreast of a country's current telecommunications environment, including the status of its networks and services, equipment interconnections, regulatory structure, and policy. This information can be obtained from a local post, telephone, and telegraph authority.

Site Planning

Planning and preparing the physical location of a computer system is an important step. Factors to consider include:

Work Station Location

If a machine is to be shared, it should have its own location in a low-noise, low-traffic area with adequate space for system components. A typical microcomputer work station will require space for the CPU, the disk drives, printer(s), software, and floppy disks. Adequate table area is needed to work efficiently and comfortably. In addition, ample out-of-the-way storage space for extra paper, ribbons, elements, and extra floppy disks must be provided.

Three other considerations in setting up a work station are glare, noise, and wiring. Glare from overhead lighting and sunlight causes eyestrain and stress. Indirect lighting or a glare filter for the screen will help alleviate this problem. Noise from fans, disk drives, and printers is another source of irritation. Measures to combat this problem include acoustic covers for noisy components and noise-absorbing partitions around the computer area. If neither of these is feasible, surrounding the noisy component with acoustic ceiling tile is a low-cost alternative. Components should be placed so that cables and electric cords do not pose a hazard.

Physical Factors

Smaller systems, particularly microcomputers, do not call for the strict control of factors such as temperature, humidity, and air quality that is usually required for larger systems. Microcomputers will operate well in the office environments normally found in the United States. Since conditions in developing countries are often extreme, however, it may be necessary to take special precautions to protect equipment and supplies.

High temperatures can cause system malfunctions in disk drives; adversely affect the operation of power-supply systems; and seriously damage floppy disks, memory, and logic circuits. Many manufacturers recommend that their equipment not be operated above 80 degrees Fahrenheit (27 degrees centigrade). In some countries, this means that the computer room must be air-conditioned. Opening windows or using fans are not satisfactory ways to regulate temperature because they introduce dust and dirt, which also can cause malfunctions.

Extremes of humidity can be a problem. High humidity can result over time in moisture damage to equipment, especially metallic parts. Low humidity is of concern because of static electricity that can cause a program to fail or entire files to be lost. To reduce static electricity, humidity is best maintained between 40 and 60 percent. Most larger systems should be installed on an anti-static mat.

Air quality is of importance because dust and dirt particles can stick to the read/write heads on disk drives causing them to wear heavily or stick to disks, producing distorted or misread data. Particles in cigarette smoke can cause serious damage. To protect against air pollution, make sure heating and cooling systems do not blow toward the computers, use covers for all components when not in use, prohibit smoking and eating in the area, and in very dusty environments, install an air purifier. For severe conditions, seal off the computer area entirely.

Magnetic fields can alter, scramble, or replace data. Therefore, magnetic data storage media (especially floppy disks) should be kept away from hi-fidelity speakers, power transformers, electric motors, telephones, and all magnetic devices.

Similarly, fire, smoke, and heat generated by a fire and water used to extinguish a fire can all cause damage to equipment and data files. All building materials and furnishings used in the computer area should be fireproof or flame resistant if possible. To protect against water damage, only carbon dioxide or Halon fire extinguishers should be used. Important software and back-up data files should be stored in a vault or fireproof box.

Power Supply

It is essential that any system have a clean and constant power supply; otherwise, there is serious risk of loss of programs or data, logic errors, misread input data, faulty data transfer, and even system damage or failure. When computer systems share a power supply with devices such as heaters or copiers that use a lot of power and turn on and off frequently, voltage fluctuations (drops or surges), brown-outs (reduced voltage), and black-outs (no power) can result, producing serious malfunctions. A reliable and constant power supply is a serious problem in many developing countries.

The best way to guard against voltage and line interference problems is to install a dedicated electric line, solely for use by the computer system. All units of the system should be plugged into this line. In addition, this dedicated line should have a separate ground to protect the system against lightning and high power surges. Line filters, voltage-surge regulators, or surge suppressors should be installed in the line.

Much computer equipment, especially if acquired in the United States, is designed to operate at 110 volts and 60 hertz. Use of transformers for such equipment in countries where power is 220 volts and 50 hertz will usually work for peripheral equipment but is more problematic for the computers themselves. Equipment rated for the local power configuration is preferable. If transformers must be used, the ability of the chosen equipment to operate with them should be thoroughly tested before procurement.

To guard against the lost of data during power failures, a battery-based back-up power system may be necessary. Two distinct types of back-up systems are in use: the standby power system (SPS) and the uninterruptable power supply (UPS). Often both kinds of system are called "UPS" by vendors, but the differences are important, especially in developing country settings. A SPS switches to its battery supply when line power fails. The UPS continuously operates from battery power, using line voltage only to keep its batteries charged. Thus a properly working UPS will protect all computers during a power outage; an SPS may fail to protect some. An UPS is also better at protecting against spikes and surges on the power line. Most SPSs pass along power line overvoltages.

When choosing a back-up system, the following guidelines should be followed:

- The system should have enough capacity, measured in watts or volt-amperes (VA), to power both the computer and its monitor. Back-up time is less important. Note that the power ratings of computer power supplies are output ratings. All power supplies require more input power than they produce. The exact power demands of a computer depend on the number and kind of expansion boards and disk drives.

- Another consideration with both kinds of back-up power system is the wave form of the output: sine wave or square wave. Sine wave current matches normal line voltage; square wave inverters for battery systems are cheaper and easier to make but can cause problems such as overheating.

- Because a power loss need not be complete for data loss to occur, a back-up device should protect against temporary undervoltages. If line voltage gets too low, the computer's voltage regulator cannot make up for the lack of voltage and its protection circuitry may shut it down.

Compared with the computers themselves, back-up power systems are technologically primitive -- bulky, inefficient, noisy, and expensive. Nonetheless, they are a necessity in many developing country environments. More extensive information on UPS options is contained in the IRM <u>System Manager's Guide</u>.

Security of Equipment and Files

For reasons of confidentiality and to ensure data security, measures to protect equipment and files are necessary. In planning a computer system of any size, one should institute measures that will ensure uninterrupted computer support and control of the data being processed. These measures may vary by situation, but some of the most common measures are listed below. The most obvious problem is theft. Means of protecting against it include labeling, locks, lock-down devices, and alarms.

Several measures can be taken to secure files. First, if the system contains confidential information, legitimate users should be identified and the system restricted to only these users. One way to do this is lock the computer room or, if there is a detachable keyboard, lock it up instead when the system is not in use. Second, if the information on the system warrants, users may be isolated from one another so the one user cannot gain use of another user's program or data. This can be done through a system of passwords. Each user has a password that must be entered before a program can be run or that will restrict certain functions of a program.

To protect the integrity of data and program files, the system should be routinely backed up. To prevent unauthorized alteration of data bases and other files, they can be designated as read-only files. Sensitive information can be protected against unauthorized access by encryption.

THE FEASIBILITY STUDY

The feasibility study is the culmination of the technical analysis and has two basic functions: to help AID decide whether and in what manner to assist a project's information management needs and to be the first stage of a host country agency's disciplined examination of its own capacities and automation needs. A sensitively done feasibility study can greatly strengthen the host agency's "ownership" of the project, which is very important in later stages.

Various techniques are available for dissection of the information flow-pattern from source to final report. What must emerge at some point is an understanding of which parts of the flow should be automated and which should remain manual. The capacity of the host organization to absorb rapid change is also a major factor. If a large part of the work load is seen as amenable to automation, a staged approach is indicated.

A clear plan, with milestones, is needed at this point so that earlier components of the information system can be designed to be compatible with elements that are to be added later. No staged approach to automation of the information system will foresee every problem in linkage that will arise, but the more careful the plan is, the more time will be saved in reprogramming during later stages.

If an expatriate consultant is used for the feasibility study, it is often convenient to break this work into several relatively short visits. The initial visit usually is the longest because the most intensive interaction with the host agency occurs at this stage. A second visit can then deal primarily with selection of potential suppliers of services. Other visits can be related to identifiable milestones in acquisition, installation, and initial programming of whatever system results.

Figure 3-1 contains a summary checklist to be used as a guide to the scope of work for a feasibility study as well as a basis for IRM technical review. Information for the feasibility study may be drawn from the Needs Assessment (Section One) supplemented by further technical analysis.

Figure 3-1

Feasibility Study Checklist

Social and organization analysis
- information requirements and system objectives
- capabilities of implementing organization to manage automation resources

Description of the planned automation applications
- system design
- system outputs

Technical analysis
- Software description
  * Operating system
  * Number of users (for multi-user system)
  * Volume of use (number of transactions per day, size of database, etc.)
  * Data access/security requirements
  * Use of customized versus off-the-shelf software

- Hardware description
  * Main memory required
  * Amount of data storage space needed
  * Number of terminals and other devices to be attached
  * Communications and networking requirements
  * Printers (type and speed)

- Site planning
  * Equipment location
  * Physical environment
  * Power requirements and protection
  * Security of equipment and data

Acquisition Strategy
- Contracting plan
- Vendor selection criteria

Institutionalization
- System management
- Policies and procedures
- Maintenance
- Training
- Estimated cost
  * Initial costs: equipment, facilities preparation, installation
  * Recurrent costs: maintenance, software maintenance, supplies, staff

Evaluation Plan
- Timing
- Information needs
- Use of findings

SECTION FOUR

ACQUISITION

How to use this Section

This section reviews applicable acquisition statutes and regulations with particular reference to ADP resources acquisition. It covers the acquisition cycle from needs identification through contract administration, addressing the requirements of both AID direct and host country contracting. Since ADP acquisition does not preclude application of the more general regulations applicable to all commodity procurement, this section should be read in the context of broader Federal Acquisition Regulations (FAR) for AID direct contracting and AID Handbook 11 for host country contracting. The Section concludes with a list of resources available from AID/M/SER/IRM and from other AID Washington offices to assist with the project automation process.

This section is organized as follows:

ADP PROCUREMENT LAWS AND REGULATIONS

PRESOLICITATION

- Needs Identification and Analysis
- Specifications and Statements of Work
- Contract Planning
- Preparation for Vendor Selection and Award
- Requisition (The PIO/T or PIO/C)

SOLICITATION

- Sources
- Solicitation Preparation

EVALUATION, SELECTION, AND AWARD

CONTRACT ADMINISTRATION

- Inspection and Acceptance
- Damages for Failure to Perform
- Warranties
- Exercise of Fixed Price Options

AID RESOURCES FOR ACQUISITION ASSISTANCE

SECTION FOUR

ACQUISITION

INTRODUCTION

The purpose of this section is to give project officers a basic understanding of the automated data processing (ADP) acquisition cycle. The focus is on process, providing a summary of the steps necessary to execute an ADP acquisition request. The section makes reference to several AID handbooks and to various acquisition regulations. Specific regulations are not repeated in detail since they may be changed or updated to reflect Agency policy. To keep abreast of these changes, project officers are advised to refer to the cited documents and their updates.

Acquisition activities fall into a predictable order that repeats itself for each acquisition. This ordering represents the acquisition cycle. This cycle holds broadly constant for all commodities, including ADP resources. The principal phases in the acquisition process are presolicitation, solicitation, evaluation and award, and contract administration. Contracting involves events and activities occurring in the acquisition cycle from receipt of the requisition documents (PIO/C or PIO/T) by the contracting officer to contract close out. The sequence of these activities is depicted in Figure 4-1.

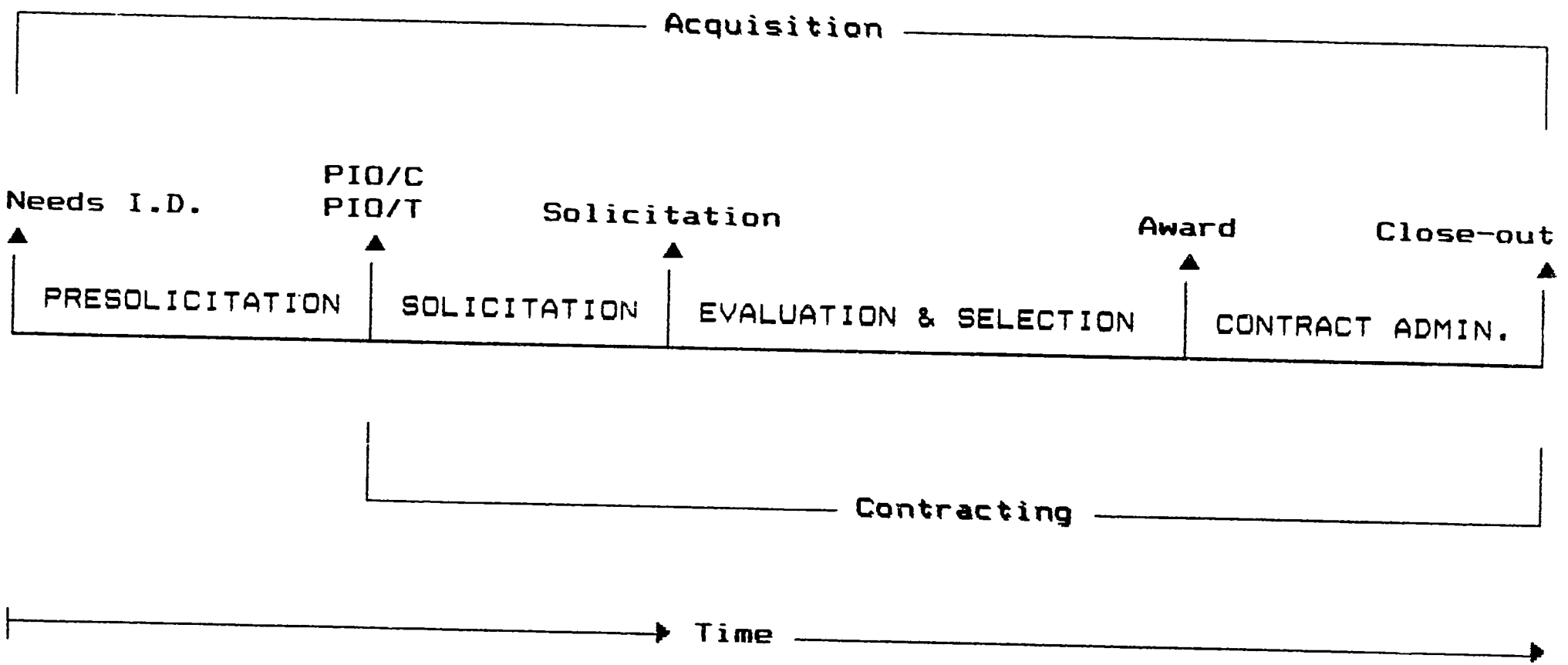
ADP ACQUISITION LAWS AND REGULATIONS

This section provides project officers summary information about the acquisition by direct contract of ADP resources in accordance with applicable statutes and regulations. It also provides information concerning the conduct and guidance of host country ADP resources acquisition. It is not intended to be definitive. Users will find it desirable and necessary to refer directly to various primary sources as noted below.

Federal statute (the Brooks Act Amendment of 1986 (PL 99-500) defines ADP as "any equipment or interconnected system or subsystems of equipment that is used in automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information." This includes all telecommunications equipment. The Brooks Amendment, supplemented by the Paperwork Reduction Act (PL 96-511) gives the General Services Administration (GSA)

Figure 4-1

The Acquisition Cycle



authority to acquire or to manage acquisition of general purpose ADP by other agencies. The GSA has issued comprehensive guidelines, the **Federal Information Resources Management Regulations (FIRMR)** to this end. All AID direct acquisition of general purpose ADP must be in compliance with the FIRMR.

General purpose ADP (as distinct from special purpose) is defined as commercially available, mass produced automatic data processing devices that are designed to be applied to the solution or processing of a variety of problems or applications rather than being specially designed (as distinct from configured) for any specific application. This includes components, equipment systems configured from these components, commercially available software packages that are provided with the system and not priced separately, and related manuals and documentation.

To carry out its mandate, GSA in the FIRMR asserts control over acquisition, management, and use of all general purpose ADP resources including equipment, proprietary software, maintenance and other services, and ADP supplies.

Other important sources of acquisition guidelines include:

- **Federal Register (FR).** When a federal agency issues a new regulation or amends its existing regulations on a given topic (for example, government acquisition), the regulatory text first appears in the daily FR.

- **Code of Federal Regulations (CFR).** Later, the regulation in the FR will be codified and permanently published in the CFR. The CFR is revised annually to reflect all FR publications appearing during the past year.

- **Federal Acquisition Regulations (FAR).** The FAR is a volume in the CFR that contains the government-wide federal acquisition regulations that govern all military and civilian contract solicitations issued on or after April 1, 1984. This extensive volume covers all AID ADP resources and other acquisition. It is supplemented by the AID Acquisition Regulations (AIDAR) and a series of Contract Information Bulletins (CIBs).

- **AID Handbook 11** for host country contracting. The previously cited statutes and regulations are of mandatory application to AID direct ADP resources acquisition. They do not have legal application to host country acquisitions. There are, however, certain statutes and AID policies that are applicable to host country contracting for all commodities, including ADP. These are set forth in AID Handbook 11. Broadly stated, these policies seek to ensure that host countries follow good business and administrative policies and practices in their acquisition efforts. Since

the FIRMR, FAR, AIDAR, and all AID CIBs reflect substantial acquisition experience, their content provides much that should be useful to host countries in their acquisition process and to Missions guiding and assisting that process. Further references to host country ADP acquisition can be found in AID Handbook 3, Supplement B (Host Country Contract Project Manager's Manual and Project Officer's Handbook under AID Direct Contracts), Handbook 15 (AID-Financed Commodities), and Handbook 18 (Information Resources Management).

- **The Competition in Contracting Act [CICA] (PL-98-369 of 1984).** CICA reduces the previous statutory preference for formal advertising and requires, almost exclusively, competitive acquisition. CICA requires an increase in publicity for Government solicitation, attempts to equalize contractor access to technical specifications, and promotes competitive procedures in all areas of contracting.

There are many OMB circulars that complement the above laws and regulations. Two of the most relevant ones are:

- **Circular No. A-109 of 1976:** Major System Acquisition. This circular enumerates the policies and procedures for the acquisition of major systems.

- **Circular No. A-130 of 1985:** Management of Federal Information Resources. This circular provides general guidelines for managing federal information resources. It also implements provisions of the Paperwork Reduction Act.

In addition, two important guidelines address the role of IRM in approving of the use of mission project funds and operational expense (OE) funds for ADP acquisition:

- **State Cable 159195 dated May 1985:** All ADP purchases from OE funds require formal review and approval from M/SER/IRM.

- **AID Handbook 18, Part V, Section 1G5:** Program-funded acquisition for ADP equipment, software, and services must be reviewed and approved by M/SER/IRM only if the life cycle costs exceeds $100,000.00. Life-cycle costs include all estimated project costs associated with the acquisition (hardware including peripherals, spares, and uninterruptable power supply [UPS]), site preparation, installation, operations, software development, equipment maintenance, and training projected over system or item life.

All of the these laws, regulations and circulars are available from the Government Printing Office (GPO).

In addition, a good source for assistance in Federal ADP Contracting is the GSA Office of Information Resources Management Services (GSA/IRMS). One function of this office is to support federal managers in the use of ADP technology and to provide information on current records and information management practices.

PRESOLICITATION

Presolicitation activities begin with needs identification and end with the signing of the requisition. This phase is led by the technical office involved. However, cost-effective acquisition requires in depth participation by the contracting office since many of the acquisition issues to be faced demand a melding of technical, business, and administrative expertise.

Needs Identification and Analysis

The initial activity in this phase is the development of a needs statement. This statement should express needs in the form of:

1. deficiencies in existing capabilities in the host organization;

2. new or changed program requirements; or

3. opportunities for increased economy or efficiency.

Ordinarily, this statement can be quite succinct. Its purpose is to provide a statement of the operational conditions that need to be established or improved. This statement is the base point for a detailed analytical process that is designed to define ADP needs by means of careful analysis and evaluation of alternative means of responding to the identified need.

The next step in the presolicitation phase is the conduct of a requirements analysis commensurate with the size and complexity of the need. FIRMR 30.007 sets forth a list of factors to be considered in this analysis.

Upon completion of the requirements analysis, an evaluation of alternative solutions should be conducted to determine the most cost-effective means of addressing the need. Considered alternatives should include non-automated solutions (see FIRMR 30.009). If the needs involve conversion of existing automation, a software conversion analysis must be performed. Its purpose is to assure that all the "hidden" costs of conversion are considered in the analysis of alternatives (see FIRMR 30.012).

The requirements analysis, evaluation of alternatives, and software conversion analysis provide the data and background information needed to prepare the technical specifications that will serve as the basis of the solicitation.

Specifications and Statements of Work

Types of Specifications

Specifications are a critical component in the acquisition process in that they turn ideas into concrete definitions that are suitable for acquisition. The specifications will influence the number of respondents to a particular acquisition. If too vague or too restrictive, contractors may decline to respond. The quality of the proposals that are received also will be influenced by the clarity of the specifications. Later in the acquisition process, the specifications are important for evaluating proposals and still later as a standard for measuring the performance of the selected vendor.

There are several basic types of ADP system and/or equipment specifications. They are described below in descending order of preference.

Functional Specifications

The preferred method for describing requirements is by means of a functional specification (FIRMR 201-30.013-1). This method includes 1) the description of the objective which the system is intended to accomplish and 2) the data processing requirements underlying that accomplishment. The latter includes:

- response time and throughput goals;
- data description, flows, size, and characteristics;
- mix of applications and transaction processing;
- hard copy volume and characteristics;
- workstation input and output volume and usage;
- human interface objectives;
- timing or turnaround restrictions;
- backup and recovery constraints;
- security and privacy requirements; and
- compatibility with existing equipment, software, and procedures.

The advantage of such a goal-oriented description is that is allows each vendor to design its system to best meet the buying agency's requirements. But from the technical and programmatic view, functional requirements present significant challenges.

Agreeing on a functional specification can be quite difficult. A primary purpose of the preceding statement of needs, requirements analysis, and evaluation of alternatives is to provide the distilled knowledge necessary to establish and state these functions accurately and completely.

A functional specification describes the need in generic terms, application by application, function by function; it leaves the specific configuration largely up to vendors. However, it obliges the vendors to learn the buyer's line of work and its lexicon. Care must be taken to ensure adequate communication and competent solutions before the contract is awarded. Finally, a functional specification usually requires validation.

Performance Specifications

This type of specification prescribes how big, how much, or how fast the system is to be. These specifications measure the buyer's estimate of the quantitative capability of the system necessary to support the agency's applications. This can be stated in terms of data storage, processor speed, cycle time, expandability, modularity, input/output speeds, and accompanying software capabilities.

The equipment performance requirements approach, while less desirable than the functional description, can be used with fairness if done carefully. However, such a method may not take into account the fact that a particular vendor may offer a configuration that can perform the same workload with an alternative mix of outputs. Nevertheless, a fair and equitable acquisition should result if 1) the solicitation requires performance rates not arbitrarily outside the range of most vendors, and 2) an appropriate performance and capability validation technique is used.

Combined Functional and Performance Specifications

A common method of presenting requirements is to combine the functions performed with required performance capabilities for the equipment offered. Care should be taken to avoid conflicting requirements. Moreover, functional specifications should be employed unless there is a definite need to specify equipment performance requirements.

Plug Compatible

This specification references one or more specific commercial products by brand name, make and model, or other similar definition. It then calls for the delivery of an item or items that, when plugged into the referenced product, will operate all relevant features of the item(s) without modification of either the referenced product or the item. Plug compatible specifications are restrictive and therefore require a special justification for use (see FIRMR 30.309-3).

Brand Name or Equal

This specification refers to one or more specific commercial products identified by brand name, make or model, or other restrictive nomenclature. The specification must include salient characteristics of the particular product which are documented as essential to buyer requirements. All responsible vendors may offer "equal" products, that is, products other than those specifically referenced. The buying organization must then evaluate all offers for compliance with the requirements as defined by the stated salient characteristics. Care must be taken to ensure that a make, model, or equivalent specification is not a pretext for avoiding full and open competition.

Specific Make and Model

As defined in the FIRMR, this specification means a description of an agency requirement that is expressed in a form so restrictive that only the specified make and model will meet the agency's needs, irrespective of the number of suppliers that may be able to furnish the specific item. This specification type uses a manufacturer's make and model or other similar nomenclature by which the product is cataloged or sold. Acquisition conducted using this type of specification are by law and regulation (FIRMR 201-11.002-1) "other than full and open competition" and must be certified, justified, and approved in accordance with FAR 6.303 and 6.304, notwithstanding the appearance of the existence of more than one responsible source" (for example, competing dealers).

Other Factors in Specifications

In addition to technical description, the specifications should address a variety of important additional factors. These include:

1. **Features:** Desired evaluated optional features should be identified and described in the specifications.

2. **Buyer furnished property:** Any such items should be identified and described.

3. **Manuals and Publications:** Provision should be made for the offeror to furnish all manuals and publications relevant to the software and equipment of the contract.

4. **Maintenance:** Clauses should be written to account for maintenance of the equipment. Options might include on-call maintenance, preventive maintenance, or several alternatives to be decided during negotiations. Items excluded from maintenance should also be detailed.

5. **Training:** Training courses should be outlined and the trainees should be designated. Both user training and technical training should be addressed and a time schedule should be established.

6. **Software support:** The specification should provide for software maintenance and support during system/item life if this service is desired.

7. **Quality control:** Applicable requirements should be specified for all technical performance items.

When Federal Information Processing Standards (FIPS) and/or Federal Telecommunications Standards (FED STDS) are available and applicable, they must be used in the acquisition specifications for AID direct contracts unless waived (see FIRMR, Part 8). AID standards must also be used. While standard specifications are not required for host country contracting, they should be considered for use.

The GSA publishes "Guidelines to Federal Agencies on the Preparation of Specifications, Selection, and Acquisition of Automatic Data Processing Equipment Systems." This is a useful document for anyone responsible for drafting ADP acquisition specifications.

Developing a Statement of Work for Services (SOW)

The specification for ADP services acquisition, for example, third party maintenance, software development, or support services, usually is called a purchase description or statement of work (SOW). As a form of specification, a SOW may be, in effect, a functional specification, a performance specification, a design specification, or a combination.

Many work statements are functional: they tell the contractor what needs to be done, the goals and achievements. It will be the job of the contractor to tell in the proposal how these objectives will be accomplished. As such, the contractor becomes responsible for the results. If the work statement is a design specification, the buyer outlines the performance steps that are to be taken and the buyer also is responsible for ensuring that these steps will produce the desired end results. In general, most design responsibility should be placed on the contractor since the contractor is being used for its expertise. The acquisition cost may increase, however, if the contractor is required to do its own design.

Certain general principles should guide the writing of the SOW, whether is it simple or complex:

- The statement should be neither so narrow as to restrict the contractor's efforts nor so broad as to permit the contractor to explore or undertake work in areas having little relationship to the particular contract tasks.

- The work statement must define the contractor's obligations and be definitive enough to protect the buyer's interests.

- A contractor taking direction from the work statement alone should be able to perform the required work; that is, the work statement should provide a clear, unambiguous, and complete basis for effective and efficient performance.

Additionally, the work statement should be clear in stating whether it seeks a completion type of requirement (the need for an end item), or a term type of effort (a requirement that a certain level of labor-hours be applied to a certain function.) Completion type requirements might be used for: delivery of a final study report, the submission of test results, or the development and delivery of documentation on a computer program. A term type of requirement might entail, for example, provision of a certain level of maintenance, or provision of technical support in the development and implementation of an ADP system.

A careful distinction needs to be made between the two. A level-of-effort type of work statement is appropriate for certain studies and early development work. The contractor is required to furnish a stipulated level of technical or professional effort over a stipulated time period and to furnish a report of the results (whatever data have been accumulated over the time specified.) A job completion type of work statement, on the other hand, is appropriate when the contractor is to develop and deliver end items, new methods, demonstrations, or other tangible results without specification of the level of effort.

Since, in many development or study requirements neither the end result nor the experimental approach can be specified adequately, a good approach is to write a work statement that specifies the work be done in phases. This can give the buyer the option of cancellation at the end of each phase. When one phase is complete, the contractor can submit a report that provides the basis for deciding whether or not to go on to the next phase.

The particular issues to be addressed in a work statement will vary with the nature, purpose, size, and complexity of the requirements. However, every work statement should:

- Give a precise statement of objectives;
- identify the work to be performed;
- set parameters by which the desired scope of work can be defined and by which progress and results can be measured; and
- require some defined "end product" and some tangible form of progress/compliance reporting.

If a SOW is for a level-of-effort type of requirement, it should specify:

- kind of personnel (labor categories) required to perform the work and any qualification requirements, for example: education, experience, certification;
- Nature of work; and
- required level of effort.

Every SOW should be tailored to the particular requirements and circumstances for a given acquisition. The following points are illustrative, not definitive.

Background

This discussion should provide the prospective contractor with an idea of how the requirement arose and where it fits in the broader picture. The statement should be brief.

The background or introduction section should include:

- A general description of the requirement.
- A brief discussion of why the particular project is being pursued, and how the project will relate to previous, ongoing, and future projects.
- If applicable, discuss any known difficulties or constraints, and any techniques or methodologies that have been tried and found ineffective.

If it is necessary to make the prospective contractors aware of detailed background materials or to make such information available to them, then either:

- List the materials and state where they can be obtained or reviewed, in a separate "References" section of the work statement; or

- Provide for the inclusion of the materials in the RFP as an attachment.

Objective (Purpose)

Provide a succinct statement of the purpose of the work or the desired end product. Express how the results are to be used, explain the benefits of this project for future agency missions, include the level of funding available, and state the overall goal and the smaller objectives under that goal.

Scope

Provide a nontechnical sketch of the nature of the work required. Summarize the actions to be performed by the contractor. Delineate the overall boundaries of the effort: time frames, special areas of interest. If the work is to be done in phases, delineate each phase and draw a clear relationship of the work done in each phase to the specific project objectives. Include functional or performance requirements, if applicable.

Task Requirements for Detail SOWs

- Clearly define and explain the main steps and types of actions that the contractor will need to perform. Communicate the requirements completely, not assuming that the contractor already understands or can be told more following contract award.

- Indicate the <u>sequence</u> in which the work is to be performed. Provide a sufficient level of detail to enable the prospective contractor to plan its personnel and other requirements.

- For most requirements, concentrate on stating the <u>results</u> or end products required, allowing contractors to devise and propose various approaches to satisfying the requirements. If, however, the state of the art or the status of an effort is such that s specific <u>methodology</u> or approach is warranted, indicate the desired methodology or approach.

- Provide all available <u>information</u> that would help to assure that a contractor conducts an effective project: known specific phenomena, constraints, operational issues, etc..

- If the contractor is to use any Government furnished <u>data, property, or facilities</u> in performing specific tasks, state what will be furnished and at what stage.

- If the contractor is to provide a level of effort, define that nature of the work and estimated types and numbers of personnel required.

- State, when applicable, the place or places where the work is to be performed and regions within which travel may be necessary.

End Results (Deliverables)

Specify some product or end result that is expected from each task, stage, or area of work, and at contract completion. The result may be something tangible, like software or a report. The result may also be something intangible, like an analysis or an evaluation. Also specify, when applicable, the use to be made of the deliverable. Finally, specify the criteria that a deliverable must meet in order to be considered acceptable.

Schedules

Include a delivery date (or an estimated period of performance) for every key result or task that has been established. Stipulate either a calendar date or the number of work days that have elapsed since the date of contract award to be used as measure.

Reporting or other Progress/Compliance Requirements

- State how the contractor must demonstrate, prove, or substantiate fulfillment of its obligations as provided for in the work statement. These might be the submission of progress reports, attendance at periodic conferences, or oral briefings.

- Limit the number of reports required to the minimum necessary.

- State the specific types of information on progress that the contractor will be required to furnish, usually administration or financial information.

- State the date a report is due, when a consultation will take place, and the period of time or work segment to be reported on.

- State any requirements/options for report format, the number of copies to be furnished, and the person and address to which the report must be sent, or the person to whom the briefing should be provided.

Special Considerations

Use this section to provide further clarification or amplification if it is needed. This section can also be used to define any special requirements and to provide information that does not fit neatly and logically into other elements of the work statement.

Attachments

Attachments are sometimes necessary so that the prospective contractors will have sufficient information to prepare good proposals. If attachments are to be made:

- Include only those materials that are necessary to the prospective contractor's understanding of the requirement.
- State in the body of the work statement (in the background element or the detailed work requirements element, for example) that such attachments are provided.
- Indicate, as a preface to the attachments, whether the material is provided merely as background information or whether portions of the material set forth contractual obligations.

If a sole source procurement is contemplated, or if the acquisition request is based on an unsolicited proposal, the SOW should contain <u>no indication</u> of this circumstance. It should stand as a definitive, clear, and objective statement of work to be done. Any provisions dealing with legal, financial, or contract administration related issues, should NOT be included in the SOW. These matters should be discussed, if necessary, in a separate part of the requisition. The SOW should address only the work and the end items required after the contract is awarded. The presentation of requirements should not be obscured by combining proposal requirements and contractual requirements. Instructions for preparation of offers should be presented separately.

<u>Sources of Assistance</u>

The buyer may wish to supplement its available technical staff by engaging consultants to assist in analysis, specification drafting, and the follow-on acquisition activities. This can be done under separate contract or via existing AID support services contracts. Also, GSA/IRMS has arrangements with established commercial resources. Sometimes these resources can be brought to bear more rapidly than can independent contractors or consultants not currently under contract (see FIRMR 20.011 - 20.014).

Contract Planning

Major presolicitation tasks in preparation for contracting include estimating costs, developing the acquisition strategy, and determining the contracting method to be used.

Estimating Costs

An integral part of the presolicitation process is the development of an independent acquisition cost estimate. For ADP systems or items, this may be based on the best alternatives as revealed by the prior analysis. For services contracts, it usually will be developed from analysis of the SOW. To do this, the buyer's personnel put themselves in the place of a typical contractor and develop that "contractor's" price offer. Note that in either situation, the independent cost estimate should have a much higher probability of reasonable accuracy than earlier developed budget estimates because of the intervening accumulation of knowledge and need refinements caused by analysis and specifications or SOW drafting.

Developing the Acquisition Strategy

As the specification or SOW develops, it becomes necessary to make an acquisition plan and schedule. This cannot be accomplished until the specification/SOW is reasonably well developed since many of the issues in developing the acquisition plan are dependent on the specification/SOW content. Thus a key early milestone for the acquisition plan schedule is the expected completion date for the specification/SOW. The acquisition plan and schedule should cover all activities and events from the time of the planning effort through the completion of the acquisition, i.e. contract close out.

The planning effort should be a joint venture between technical and contracting personnel since many of the subjects to be addressed have business, administrative and technical ramifications. FAR, Part 7 sets forth a list of subjects that can be used as a starting point for the planning effort. The degree of planning detail (and the concomitant administrative effort) should be guided by the size, complexity, and criticality of the need. A major objective of the planning effort is the development of a PIO/C or PIO/T that can serve as the basis for expeditious solicitation action.

As part of the acquisition planning process, a decision should be made regarding the packaging of acquisitions. How many contracts will be used and how will the need be subdivided for contracting purposes, if at all? For many small requirements, the obvious answer will be a unitary approach. For larger needs, it may still be considered most desirable to proceed via a single contract. However, the relative advantages of multiple contracts should be considered and the acquisition plan shaped accordingly. This is particularly true for systems where acquisition can be broken down into logical phases or option packages.

Factors to consider include optimization of technical strengths, the organization and allocation of the likely market, relative acquisition costs, administrative costs, in-house technical and administrative capacities, likely funding sources and availability over system or item life, system expandability potential, and delivery times.

Method of Contracting

At least a preliminary determination of the method of contracting to be used must be made as part of the acquisition plan. Different methods require different acquisition strategies and schedules. Initially, it must be determined whether the acquisition will be from established sources (orders against existing indefinite delivery contracts such as the GSA "schedule" or by independent contracts via open market procedures. If it is to be the latter, there are several possibilities:

AID Direct	Host Country
Sealed Bids	Formal
Negotiation	Informal
Small Purchases (< $25,000)	Small Value (< $100,000)

The Sealed Bids/Formal method requires the use of price and price-related factors only as the contractor selection factor. Usually in ADP acquisition, the buyer benefits from basing the selection on other than price and price-related factors, that is, technical and management considerations. Therefore, Negotiation/Informal is the normal choice or, if under the threshold dollar amount, the Small Purchase/Small Value method is best. The contracting officer will select the appropriate method based on the developing specifications/SOW and other factors.

Competition

If the open market procedure is to be followed, it will be necessary to make at least a preliminary decision as to whether or not the acquisition will be fully competitive. The great majority of ADP resources acquisitions should be competitive. For AID direct negotiated contracts, this means that all responsible sources will be allowed to compete. For AID direct small purchases, at least three solicitations should be issued. For host country small value acquisitions, offers should be solicited from a reasonable number of sources.

With regard to AID direct negotiated contracts, any planned departure from full and open competition, including solicitation of a single responsible source, requires detailed justification involving inputs from both the technical and contracting officers (see FAR, Part 6). Approval must be secured from a level above the contracting officer. How high depends on the dollar amount. The determination to limit competition should be made early in the presolicitation phase in order to allow for drafting, forwarding, and approval of the justification at the earliest possible time. As a practical matter, securing approval of less that full and open competition (particularly for contracts over $100,000) is an administratively burdensome, lengthy, and doubtful proposition. A decision to allow full and open competition usually is best.

Compatibility requirements in a specification do not in themselves result in a less than full and open competition and thus they do not require a FAR, Part 6 justification. Such requirements are, however, restrictive and FIRMR 30.009-3 requires a special justification for their use.

With regard to AID direct small purchases, the solicitation of any less than three sources also requires justification. This justification is much less burdensome and time consuming to obtain than one for less than full and open competition.

AID Handbook 11, 2.2 provides that Mission Directors may approve host country informal acquisitions. Normally these acquisitions as well as small value acquisitions will be competitive. Single source acquisition must be approved by the USAID mission, the level of approval dependent on the dollar value. In certain limited cases, the USAID may waive the requirement for competition and approve negotiations with a single source (see Handbook 11, 2.2.6).

Contract Type

The term contract type refers to the compensation arrangement for ADP resources acquisition. There are two basic contract types, **fixed price** and **cost**. The contracting officer will select the proper contract type based on various criteria. An important one of these is cost risk. A fixed price contract assigns cost risk to the contractor while a cost type contract places cost risk on the buyer. The general theory of allocation is to place ordinary business risk on the contractor while extraordinary risks are assigned to the buyer.

In acquisition of ADP resources, there normally are no more than ordinary risks present. Typically, therefore, the contracting officer will negotiate a fixed price (lump sum) contract. This contract type legally binds the contractor to deliver to specification requirements without regard to performance costs. An exception occurs, of course, if the specification is modified during performance.

Occasionally, particularly in contracts for ADP support services, there will be substantial doubts about the quantity of effort that will be required in performance. This means substantial cost risk is present. In such cases, the contracting officer may choose to negotiate a cost type contract. In this case, the contractor will be paid all reasonable allowable and allocable costs (plus a fee) incurred in performance. Thus the buyer has accepted the cost risk of performance. If the contractor fails to complete performance within the initial cost limit negotiated, the buyer may choose to accept incomplete performance or to increase the estimated cost.

Fixed price and cost type approaches can be combined in one contract if appropriate. For example, if labor and materials are reasonably well known but travel is problematical, the former could be a fixed price and the latter a cost type arrangement.

Since the contract type interacts with acquisition specification writing, packaging, scoping, estimating, evaluation criteria, and the method of contracting, it should be addressed in developing the acquisition plan. Since it also affects financial management of the acquisition, contract type will be of concern to the program managers as well as contracting personnel.

Other Planning Issues

Publication: With one exception, the requirements for publication of a pending AID direct procurement for ADP resources are the same as for acquisition of other commodities and services (see FAR, Part 5; AIDAR, Part 5 and CIBs for AID Direct; and Handbook 11, 2.3 for host country regulations).

The exception pertains to AID direct acquisition over $50,000 to be placed under GSA "Schedule" contracts. In this case, before placing the order, notice of the pending acquisition must be placed in the Commerce Business Daily. Thirty calendar days after publication must be allowed for eligible contractors who wish to supply the item(s) to respond to the contracting officer. If, upon review of responses, the contracting officer determines that it is desirable to continue with the Schedule order, this can be done. On the other hand, if the contracting officer believes that an open market acquisition is desirable, a competitive solicitation can then be prepared. Details of this publication process appear in FIRMR 32.206.

For all acquisitions, the requirements for publication should be identified and included in the acquisition planning. Often the publication requirement can be fulfilled to some extent concurrently with other acquisition activities.

Small Business and Gray Amendment Requirements: These requirements apply to AID direct contracts for ADP resources as they do to other commodity procurements (see FAR, Part 19, AIDAR, Part 19 and the CIBs). The potential of small businesses or Gray Amendment organizations as contractors should be considered early in the acquisition planning process.

U.S. ADP Equipment Export Regulations: ADP equipment is one commodity on the Department of Commerce Commodity Control List (CCL). This CCL is supplement No.1 to Section 399.1 of the Export Administration Regulations. To export an ADP commodity to a cooperating country, one must obtain a validated export license issued by the Office of Export Administration (OEA), Department of Commerce. However, for transactions between government agencies, or those involving exported commodities that are to be used in U.S.-financed projects (if the purpose is not commercial, no middleman is involved), supporting documents required in the export license application are waived (see Annex 4 for a sample export license application). However, detailed information about specifications of ADP equipment to be exported should be included in the export application so the OEA can process the license quickly. In most cases, the export control commodity number for ADP equipment (computers, display peripherals, etc..) is 1565A. OEA usually takes four to six week to issue an export license so the export application should be sent in immediately after the completion of the technical specifications. In case of a rush order, a project officer can ask the procurement agent to submit a request that the export license be processed on an emergency status, which usually takes two to three weeks. For more information on U.S. export regulations, refer to Section 375 of the Export Administration Regulations. For re-export of AID-financed commodities, unless specially authorized by AID, commodities imported into a cooperating country under AID financing may not be exported in the same or substantially the same form from the cooperating country (Handbook 1, Supplement B, Chapter 24).

Preparing for Vendor Selection and Award

Criteria

Proposals or quotations must be evaluated and potential contractors selected in accordance with evaluation criteria and weights contained in the solicitation. To do otherwise invites bid protests that can result in all offers being rejected. The inclusion in the solicitation of well thought out evaluation criteria and weights is crucial. Development of appropriate criteria and weights is the first step in securing the optimum contractor to address the automation requirement. The recommended criteria and weights must also accompany the PIO/C/PIO/T.

Since price as well as non-price (mainly technical) factors are normally considered in ADP resources selection, an initial weighting between the two is critical. The relative weights to be assigned to each are largely within the discretion of the contracting officer. There is one regulatory qualification for AID direct procurements. FAR requires that some weight be put on price and some on technical qualifications in every acquisition. Management, technical, and business personnel frequently tend to have different orientations toward proper weighting. This issue should be considered and a decision made in the acquisition planning phase so that disagreements do not cause later delays.

Once the relative weights of price and other factors have been determined, the planning effort should focus on the technical criteria and the evaluation process itself. For large system or equipment acquisitions, it is frequently prudent to establish a two-tiered evaluation process. The first tier is evaluation of written proposals. This evaluation requires specific detailed evaluation criteria and weights. Table 4-2 provides an example of such a listing/weighting. This table is intended to be broadly illustrative. Criteria, sub-criteria, and weights need to be tailored to the particular circumstance. While Table 4-2 assigns numerical weights to all criteria and sub-criteria, this level of detailed scoring is not necessary.

The second tier is evaluation of a live demonstration of system operation on sample functions. This frequently is called a "benchmark" or live test demonstration (LTD). While benchmarks can offer a higher degree of confidence in the contractor.

Table 4-2

Vendor Evaluation Criteria
for Hardware Procurements

FEATURE	POINTS
1.0 SYSTEM SOFTWARE	
1.1 Compatibility with standards	50
1.2 Flexibility/expandability	20
1.3 Special features and capabilities	10
1.4 Documentation	10
	10
2.0 UTILITIES SOFTWARE	
2.1 Ease of use/documentation	50
2.2 Integration with total system	10
2.3 Languages available	10
2.4 Diagnostics	10
2.5 Peripheral control	10
	10
3.0 APPLICATIONS SOFTWARE (per package)	
3.1 Appropriateness to needs	100
3.2 Performance	20
- speed	
- capacity	10
- flexibility	10
3.3 Other user-experience with package	10
3.4 Support and upgrade potential	10
3.5 Documentation	10
3.6 Training and other user services	10
	20
SOFTWARE SUBTOTAL (assumes 4 rated applications)	500
4.0 HARDWARE (CPU/SYSTEM UNIT)	
4.1 Microprocessor	200
4.2 Compatibility with standards	30
4.3 Memory capacity (RAM)	20
4.4 Disk drives	20
4.5 Backup system	30
4.6 Expansion capacity	20
4.7 I/O channels/ports	30
4.8 Warrantee terms	30
	20
5.0 FEATURES AND PERIPHERALS	
5.1 Keyboards	100
5.2 Monitors (Terminals)	20
5.3 Printers	20
5.4 Power Supply	20
5.5 Multi-user/networking capacity	20
	20
HARDWARE SUBTOTAL	300

6.0 MAINTENANCE	100
6.1 Maintenance staff (size, experience)	20
6.2 Existing customer base	10
6.3 Service facilities	
- capacity of facility	10
- proximity to installation site	10
6.4 Inventory of components	20
6.5 Guaranteed response time	20
6.6 Capacity to deal with entire system	10
7.0 TRAINING	50
7.1 Range of courses offered	20
7.2 Staff (training/experience)	10
7.3 Training facilities available	10
7.4 Training documentation/aids	10
8.0 INSTALLATION	50
8.1 Customer reputation	30
8.2 Number of previous sites	10
8.3 Personnel available	10
VENDOR SUPPORT SUBTOTAL	200
TOTAL	1000

selection process, they are often costly in terms of elapsed time and administrative effort for both the buyer and competing contractors. If this method is to be used, it must be announced and described in the solicitation.

The Evaluation Plan

A plan for evaluating the offers received should accompany the PIO/C or PIO/T when it is forwarded to the contracting officer. This plan should include:

- the general mechanism for evaluating proposals;
- how technical and cost proposals will be separately evaluated and reconciled;
- the mechanisms for technical evaluation (including benchmarking if included in the solicitation);
- technical evaluation and benchmark chairperson(s) and committee members; and
- exact schedule of technical evaluation or benchmark evaluation and following contract award.

The development of this plan will require the close cooperation of business, technical, and administrative personnel.

Requisition (The PIO/T and PIO/C)

The event ending the presolicitation phase is the signing of the requisition (PIO/T or PIO/C) and its forwarding for contracting action to the contracting officer. Officially the PIO/T or PIO/C certifies the need and authorizes the contracting officer to take action to fulfill it.

The PIO/C or PIO/T contains a detailed description of what is to be acquired and thus serves as a purchase request. When the this document is countersigned by the cooperating country, it constitutes an agreement between the two countries on the specific commodities and services AID undertakes to procure (an important factor in ADP acquisition as a result of its complexity and environmental impact on some host countries). In addition, the PIO/C or PIO/T administratively earmarks funds obligated by a project agreement.

SOLICITATION

Upon receipt of the requisition, the contracting officer begins action to fulfill the requirement. His or her actions in this regard will be highly dependent on the contents of the requisition and the acquisition planning completed in the presolicitation period.

Sources

There are three basic ways by which the ADP resources requirements can be fulfilled (in descending order of preference): from buyer stocks, established commercial sources, or the open market.

Buyer Stocks

The first preference is for reassignment of excess resources within the buyer organization. If this is possible, there is no need for preparation of a formal requisition. Beyond reassignment, GSA manages an active inter agency program of excess ADP resources. An AID mission may be able to use this resource to fulfill its own operating needs or for program purposes in delivery of foreign assistance.

Established Commercial Sources (GSA Schedule)

It has been noted that AID and host countries may fulfill requirements for ADP equipment and services from established commercial sources, principally from GSA "Schedule" contracts and requirements contracts. ADP support services also can be obtained on interagency order from various GSA ADP management program operators (see FIRMR, Part 20). If in the acquisition planning process any of these sources have been identified to fulfill a particular requirement, the contracting officer will draft, sign, and place the necessary orders to enable needs fulfillment.

The main advantage of purchasing from the GSA Schedule is the elimination of several steps in the acquisition process. The FIRMR as amended on June 6, 1985, supersedes FAR regulations when dealing with ADP acquisition from the GSA Schedule. The requirement for special publication in the Commerce Business Daily has been noted previously. For Schedule acquisition of ADP resources over $300,000, a case by case delegation of authority must be obtained from GSA/IRMS before ordering.

The use of the GSA Schedule is considered a competitive procedure (if all applicable FAR and FIRMR procedures are followed), since the GSA has previously conducted full and open competition in placing the Schedule contracts. In using the GSA, however, there are certain possible disadvantages:

2 o Equipment warranties are voided when GSA Schedule purchases are shipped out of the United States. Thus it is necessary to make arrangements for local service and maintenance support, especially for mini-computers, once the equipment arrives in a host country;

o Schedule contractors may supply equal items based on the Schedule specification; therefore, in case of sole-source acquisition, it is usually wiser to buy from the open market;

o Purchasing from the GSA Schedule may take more than three or four months for an item not stocked;

o Local voltage equipment may not be available from the GSA schedule;

o Acquisition prices may be higher than in the open market; and

o Schedule contracts contain maximum order limitations (MOLs). Contractors do not have to accept orders over the MOLs.

Open Market

Only the GSA has statutory authority to contract for AID ADP resources requirements. However, GSA has delegated blanket authority to AID to contract directly for ADP resources for small and medium size acquisitions. The limits of this blanket delegation are set forth in the FIRMR, Part 23. If the particular acquisition is beyond the limits of the blanket authority, AID must prepare an Agency Procurement Request (APR), forward the request to GSA/IRMS, and receive a specific delegation of procurement authority (DPA) before the solicitation may be released. This process ordinarily requires several months.

The requirements for contracting authority do not apply to host country contracting. Host countries are not permitted to acquire ADP resources for AID use.

Solicitation Preparation

The contracting officer prepares the solicitation. For AID direct negotiated contracts it is called a Request for Proposal (RFP). For host country informal contracts it is called a Request for Quotations (RFQ). For small purchases/small value contracts it is called a Request for Quotation (RFQ). For system or major equipment buys, either AID direct or host country, the solicitation should be patterned on the GSA/IRMS publication, "Solicitation Document for ADP Equipment Systems." This sample solicitation is widely used as a guide. Its contents must be tailored to the particular circumstances of each acquisition. Failure to do so can cause later delays in the acquisition process.

In a search for the "least-cost" manner to fulfill the need, FIRMR 32.102 requires that every AID solicitation for equipment or a system estimated at over $25,000 invite offers on a lease, lease purchase, or purchase basis. Whether this is a desirable policy for application to host country contracting depends on all the circumstances surrounding each acquisition. This should be determined and a decision made whether the least cost or a purchase only method will be used.

If the least cost method is selected, the schedule of the solicitation must be designed to gather all the information necessary to conduct a net value analysis (NVA) during evaluation. The GSA sample solicitation provides a useful format for this information. Further, the solicitation must provide the discount rate that will be used in making the NVA. For domestic procurement, the current usual rate is 10 percent. The contracting officer may use some other rate if it would be more representative of the opportunity cost of the money to be used in the acquisition.

If evaluated optional features are to be included in the solicitation, a value for each such feature must be included with the evaluation information. Values may be stated in technical terms, for example, the increased technical value of a color monitor to a buyer. Alternatively, value may be stated as a dollar amount that will be assessed in price evaluation if the contractor opts not to offer on the evaluated optional feature(s).

The standard AID foreign assistance solicitation provisions for commodities, i.e. source, origin, componentry, etc.., must be included in ADP solicitations. All of these need to be incorporated with the provisions drawn from the GSA/IRMS sample solicitation.

Sometimes for acquisitions that are primarily for program services, offerers will include in their proposals substantial amounts for ADP resources. In this case, FIRMR 24.202 requires the contracting officer to include a separate line item in the solicitation for contractors to use in proposing their ADP costs.

EVALUATION, SELECTION, AND AWARD

Evaluation of proposals or quotations should be conducted in accordance with the evaluation plan developed in the presolicitation process. A cardinal rule is that the evaluation must be made based on the criteria and weights announced in the solicitation. The introduction of other criteria or sub-criteria or revision of stated weights is a violation of FAR. It may provide the basis for a successful bid protest that will seriously disrupt the acquisition process. Additionally, it is unfair to the competitors.

The contracting officer is responsible for supervising the evaluation of proposals. Technical and cost proposals are submitted separately. The technical proposals are reviewed and evaluated by a technical evaluation panel, and the contracting officer with help from other contracting personnel assesses the price proposals.

If the solicitation calls for a benchmark evaluation, the technical evaluation will be a two tier event. Initially written proposals should be evaluated. Offerors that submit acceptable proposals are then invited to give their benchmark demonstrations.

For ADP systems and equipment acquisitions, the contracting officer frequently has a much more than routine job in evaluating price proposals. In essence, the contracting officer must usually

1. make the evaluation adjustments required as the result of offers on any fixed price options or evaluated optional features;

2. determine and apply, with the assistance of technical personnel, any life cycle cost adjustments for each offer; and

3. make a net value analysis (various computer programs are available to assist in the effort).

In AID direct acquisition for ADP or otherwise, FAR procedures give the contracting officer discretion to select a contractor based upon the results of the initial technical and price evaluations if there is a clear winner. Often, however, the contracting officer determines that discussions are necessary before an award can be made. In this case, he or she establishes a "short list" of all those who have submitted acceptable proposals or proposals capable of being upgraded to be acceptable as a result of discussions. This is called establishing the "competitive range." Discussions are conducted with each contractor in the competitive range covering whatever subjects the contracting officer thinks necessary. At the conclusion of the discussions, the contracting officer asks the short list competitors to submit best-and-final offers. When received, the technical and price proposals are again evaluated, usually leading to selection of a winner. Additional rounds of competitive range discussions and best-and-final offers may be conducted if deemed necessary by the contracting officer.

Unsuccessful offerors should be debriefed on request. Meanwhile, the contract is drafted, administrative approvals received, and the award is made.

There is no requirement that host country buyers follow this sequence. Nonetheless, it is a good and fair procedure and is recommended for host country procurements.

In AID direct procurement involving general purpose ADP resources, unsuccessful bidders are permitted to file bid protests with the General Services Board of Contract Appeals. The offeror filing such a protest must point out the alleged imperfections in the process and may request the Board to order AID to remedy the defect. Frequently the protestor will ask that all offers be rejected and the acquisition process begin anew. The Board's decision may be appealed by either party to the U.S. Circuit Court of Appeals for the Federal Circuit. Whatever the outcome, a bid protest usually will delay contract award or performance from two months to over a year.

At this time, it is unclear whether host country acquisition actions for ADP resources are subject to the same bid protest procedure. Host countries should take all possible actions to consider and settle bid protests amicably and fairly without reference to AID direct procedures.

CONTRACT ADMINISTRATION

Generally the purposes of contract administration by the buyer are to facilitate contractor performance and to assure timely delivery of items that fully meet the specification or SOW requirements. In this respect the contractor is entitled to buyer performance, for example, making the site available, furnishing buyer property as represented in the contract, and making payments. On the other hand, the buyer also is entitled to strict performance by the contractor.

It falls to the buyer's contracting officer and technical representative (usually the AID project officer) working as a team to carry out contract administration activities. To do this the necessary prerequisite is a thorough knowledge of contract terms.

For AID direct contracts, the contracting officer is fully responsible for contract administration just as he or she is for contract formation. Typically, however, the contracting officer will need substantial assistance in administering the contract, particularly with regard to its technical aspects. Accordingly, the contracting officer will appoint a project manager to assist in this effort. Usually the project officer will be authorized to inspect and accept or reject contract deliverables and to be the eyes and ears of the contracting officer with substantial recommendation authority. Occasionally, the project officer may be given additional action authority, for example, to modify the contract itself. Most of the time, however, any action that would change the contract price, time, or other conditions is reserved to the contracting officer.

While the organization for host country contracting does not have to shadow the AID arrangement, good business and administrative practice generally would follow this team approach. For ADP resources, as for other commodities, AID may have certain approval responsibilities for host country contract administration (see Handbook 11, paragraph 3.11).

Inspection and Acceptance

AID direct contracts contain a standard "Inspection" clause (see FAR 52.246-2) that requires the contractor to establish a quality control system acceptable to AID and to deliver to AID only items that fully meet the contract requirements. AID may make in-progress or final inspections to assure quality. This clause further provides that once AID has made acceptance, it will be final and conclusive unless there are either latent defects in the deliverable or there is fraud or gross negligence amounting to fraud on the part of the contractor. Host countries should be encouraged to include a parallel clause in their contracts.

In contracts for ADP systems and equipment, when functional or performance specifications are used, it is customary to include a clause complementary to the Inspection clause establishing a standard of performance and providing for acceptance testing. A sample of such a clause appears in the GSA/IRMS Solicitation Document for ADP Equipment Systems (Section E). This clause provides that the system or equipment as installed will operate successfully with agreed-on reliability over a period of calendar time, usually 30 days, and operational time, for example, 100 hours, prior to acceptance. Only after this test has been met will the items be accepted. If the system or equipment fails to pass this acceptance test within a stated time after operations begin, for example, 90 days, then this clause allows the buyer certain remedies, for example, to order the contractor to replace the system/equipment or otherwise to default the contract.

When such a standard of performance clause is included in the contract, the buyer's technical representative must see that the user maintains an operational log documenting system/equipment performance. The contents of this log will be determinative of the date of acceptance or will provide the necessary evidence to back up the buyer's right to remedial action. The log should include a daily or hourly record of all "up" and "down" time. It also should record the cause of any failures, if known.

Damages for Failure to Perform

A contractor who fails to deliver an acceptable product within the specified time causes legal injury to the buyer. The buyer is entitled to restitution for this injury through the payment of damages by the contractor. These damages may be measured by the actual loss sustained by the buyer as a result of the failure of performance. In some cases, however, the parties to a contract may anticipate that it will prove difficult to measure the actual damages suffered by the buyer as a result of the vendor's failure to perform. In this case, they may agree to include a "liquidated damages" clause in the contract. This type of clause contains a formula for determining the amount of damages to be paid by the vendor.

Liquidated damages clauses frequently are included in ADP systems and equipment contracts. The GSA/IRMS Solicitation Document for ADP Equipment Systems includes such a clause (see Section F.1). This clause establishes formulas for measurement of damages for late installation of

- the total system;
- additional machinery;
- partial systems;
- operating software; and
- other software.

The clause also permits the buyer to obtain replacement hardware or software under certain circumstances, charging the contractor for liquidated damages until the substitute equipment is installed or until an established damages cut-off day.

The liquidated damages clause provides that the contractor will not be assessed liquidated damages if the delay is beyond the control and without the fault or negligence of the contractor. This is called "excusable delay." Examples of excusable delay include acts of God, acts of the public enemy, fires, floods, and so forth.

When a liquidated damages clause is included in a contract, it is a substitute for measurement and assessment of actual damages. Therefore, it is the responsibility of the contracting officer and the buyer's technical representative to enforce the liquidated damages provisions in case of late installation. This frequently is done by offset of the calculated amount against payments due the contractor.

A special type of liquidated damages provision called "Maintenance Downtime Credits" often is included in contracts that include ADP equipment maintenance. An example of this type of clause also appears in the GSA/IRMS Solicitation Document for ADP Systems (Section F.9).

This type of clause assumes a cause and effect relationship between untimely and/or unskillful maintenance work and excessive system or machine downtime. Thus, it provides a formula for measuring damages for each hour of downtime in excess of normal amounts established in the clause. Abnormal downtime may be chargeable to system failure or individual machine failure. Also it may be due to operating or application software failure. The measurement of downtime for purposes of this clause begins on notice to the contractor of the down condition.

Experience has shown that buyer entitlement to maintenance downtime credits often is lost because the user has failed to notify the contracting officer of the excessive downtime or has failed to adequately document it. In this respect, contract administration of ADP maintenance activity should include the establishment and operation of a system that records all downtime, identifies its cause and extent, and documents the time and circumstances of notice to the contractor. Credits should be offset against payment to the contractor as appropriate.

Warranties

A warranty is a form of insurance. For a premium to cover the contingent risk (usually hidden in the lump sum price), the manufacturer or contractor agrees to guarantee the system/ equipment for a specified period of time. Unless otherwise stated, normal maintenance is excluded and the warranty period begins at the date of acceptance.

Most governments prefer to function as self-insurers. The theory is that insurance is essentially a device to spread risk and avoid catastrophic loss. Governments are sufficiently large so that catastrophic loss is not a consideration and, by definition, they spread risk over their entire constituency. Therefore, there is no need to pay a premium to cover overhead and profit for an insurer to carry the risk.

Government buyers of ADP systems and equipment, however, may opt to include warranty provisions in the contract. The GSA/IRMS Solicitation Document for ADP Systems includes warranty provisions (see Sections H.1, I.5, and I.12).

If such a clause is in the contract, its enforcement becomes an essential part of contract administration. It therefore is essential for the buyer's technical representative to become thoroughly familiar with the warranty provisions of the particular contract including coverages, exclusions, mechanisms, and other features.

Generally, warranty enforcement requires prompt notice to the contractor of the defective condition. In practice, this call usually must be made by the contracting officer. There also are special conditions that may have the legal effect of relieving the contractor of warranty liability, for example, improper use or maintenance, user repairs, or user modifications to the system or equipment. Sometimes, as a matter of seller policy rather than legal requirement, the warranty may be honored despite the existence of an excusing circumstance.

Exercise of Fixed Price Options

If the contract includes fixed price options for additional quantities of goods or additional time for service provision, their exercise by the buyer should not be automatic upon receipt of the proper requisition. Rather, the contracting officer must make a business analysis before exercising an option in order to determine whether or not exercise is the most advantageous method of fulfilling the need. This review must consider price and other factors such as calendar time and administrative cost in determining advantage. The result of this evaluation should be included in the buyer's contract file. An option is to be exercised only when the evaluation documentation shows that it is the most advantageous procedure.

AID/WASHINGTON RESOURCES FOR AUTOMATION ASSISTANCE

A variety of resources are available from AID/Washington to support project officers in planning and implementing automation assistance.

Several IQC contractors are managed by supporting offices in AID/Washington. Included are:

- Management consulting firms to assist in formulating strategic information system plans (managed by M/SER/IRM);
- ADP consulting firms to perform requirements analyses and implement application systems (managed by M/SER/IRM);

- Procurement agent service contracts to assist in all phases of procurement (managed by the Office of Procurement [M/SER/OP]);

- Specialized technical specification writing firms (managed by M/SER/OP); and

- Consulting firms specializing in automating sector information systems, such as health, population, finance, etc.. (managed by the Bureau for Science and Technology).

For set-aside activities, the Office of Small and Disadvantaged Business Utilization (OSDBU) maintains a directory of 8(a) consulting firms, many of which specialize in automation areas, including training and analysis.

For short-term assistance, Mission and Project Services (M/SER/IRM/MPS) has a pool of direct hire and contracted analysts to support project activity. Direct hire support requires operational expense (OE) funding; contract analyst support can be funded either by OE or project funds.

GSA contracts are in place with all major manufacturers and suppliers of ADP commodities.

Information services are available to provide information on commodities, U.S. manufacturers, and GSA schedules. IRM can provide details and assistance. Two particular services relevant to acquisition are:

- The GSA Multi-Use File for Inter-Agency News (MUFFIN) is a data bank containing information on 25,000 federal supply schedule items covered by 1,100 contracts plus 80,000 other national stock numbers. This data bank can be accessed with any terminal, IBM PC or compatible, or other computer capable of emulating ASCII/TTY protocols at 300 or 1,200 baud.

- Information Marketing International (IMI) offers two services: index and microfiche of all GSA schedule items and contractors and indexed microfiche of open market commodities.

IRM/MPS has the responsibility to review agency acquisition of ADP goods and services for mission and project use. Project officers should remember that this office approves all project ADP acquisitions that have total life-of-project value over $100,000.

In addition to reviewing large ADP acquisitions, IRM/MPS can assist project officers in ADP acquisition or projects of any size on request. IRM/MPS can direct project officers to a variety of IQC contractors that work with AID/Washington offices, 8(a) set-aside firms, and GSA contracts that supply particular goods and services.

IRM/MPS can also supply direct short-term technical assistance in planning, implementing, and evaluating automation components by drawing on its U.S. direct hire or contract staff. This assistance includes advice on selecting and using automation equipment, resolving contractual matters regarding the acquisition of automation equipment, and overseeing automation services provided by contract or other non-direct hire staff supporting AID field organizations (see Handbook 17, page 18J-4).

To help plan their automation acquisition and help IRM perform quick and thorough technical reviews, project officers are asked to assemble as much of the following information as possible:

- Project name, number, and overall purpose. It is also helpful if the name and number of the AID/Washington backstop is provided;
- Narrative of planned computer application. Include any requirements analysis and feasibility studies;
- Descriptions and estimated costs for all components of the information processing activity, including hardware, software, training, maintenance, and support; and
- Level of maintenance and training support available from local vendors. If none, explain how support will be provided.

See Annex 2 for an example of a mission request for IRM technical review.

SECTION FIVE

INSTITUTIONALIZATION

How to use this Section

This section addresses tasks to be performed during and after automated system delivery and installation. Successful institutionalization of automation is an issue requiring the continuing attention of both host agency managers and USAID. Implications for management are reviewed and recommendations provided for policies and procedures that require attention from system managers. Particular attention is paid to the kinds of training that are usually needed to assure effective system use. ther issues that require attention are system support and maintenance. Several options are provided along with factors underlying choices to be made. Because an automated system must change to fit any dynamic organization and because advances in technology constantly expand the available options, the section concludes with recommendations on planning for system growth.

The section is organized as follows:

SYSTEM MANAGEMENT AND PERSONNEL NEEDS
- Implementation Planning
- Management of the MIS Function
- Policies and Procedures

TRAINING

SYSTEM SUPPORT AND MAINTENANCE

SYSTEM GROWTH

SECTION FIVE

INSTITUTIONALIZATION

SYSTEM MANAGEMENT AND PERSONNEL NEEDS

Implementation Planning

Factors of importance in shaping a specific implementation strategy for an organization can be summarized as follows:

- **Organizational Structure:** As emphasized in Section One, a key condition for successful automation is the existence in the organization of an overall information systems policy and decision making structure.

- **Staffing and budgeting constraints:** Plans must fit the realities of resource constraints in the organization. Appropriate use of contracted services can help. Expected productivity gains from automation may make it possible to train and reassign staff to system-related tasks.

- **Current staff responsibilities:** Certain components of the system development plan may correspond closely with the job descriptions of current staff members. Where so, the implementation plan should take advantage of current assignments and skills.

- **Phasing:** A project to develop an automated system should be addressed in logical, controlled phases. The duration, activities, and management structure for each phase should be carefully determined.

Management of the Automated System

Organizations frequently are unfamiliar with the processes of planned organizational change that accompany any major revision of information management procedures. Computerization involves issues of people and management as well as hardware and software. Information is a resource requiring effective management as much or more than any other organizational resource. In most cases, it is best that someone be specifically charged with responsibility for the information management task. Clear leadership in support of disciplined data administration is critical to generating acceptance and effective use of computers among people in an organization.

If responsibilities and authority for decision making are clearly understood within an organization, there is seldom any reason not to share information more widely. Better information flow can reduce misunderstandings, provide a better planning environment, identify erroneous information earlier, and suggest new solutions to problems. One result of increased information, however, is that the way work in the organization is done will change. Not only will certain staff be performing new tasks but system use also will foster a more interactive environment as a result of the enhanced level of information sharing and analysis. Optimization of the value of greater information flow therefore requires attention to issues of the quality of communication.

A major characteristic of the information revolution is the devolution of power from information centers to individual users, specialized departments, and divisional groupings. Tasks, roles, and relationships are changing as technology works itself deeper into offices and bureaucracies. More individuals are directly engaged in the creation, manipulation, and dissemination of information. This situation has both positive and negative effects. Dispersal and decentralization can lead to loss of control, fragmentation, duplication of effort, waste of resources, or development of incompatible systems within the same organizational structure.

Thus, although automation may result in a decentralization of information access and use, the overall information management function should not be equally decentralized. A risk of the proliferation of microcomputers or even work stations of a larger system is the dispersal and atomization of information control to the point that no overall information management strategy drives the system. In this context the role of the information manager becomes especially critical. This role has these major elements:

- Understanding the new technology and the impact it will have on the roles of organization staff;
- Providing direction for the organization's overall information management strategy;
- Developing and implementing services and support that match end-user needs; and
- Managing the process of information sharing among decentralized points of data processing in the system.

Policies and Procedures

An appropriate environment needs to be created to optimize the benefits of automation. Discussed below are suggestions on the handling of crucial components of the system.

System management. The authority, role within the organization, and scope of responsibility of the system manager need to be defined and clarified for system users. Although the manager's role usually evolves with experience, at any given time it should be stated in unambiguous terms. This reduces the uncertainty that normally accompanies any organizational change.

Data administration. Throughout the entire data management process, close attention should be given to the integrity and usability of the data. In setting up a data-base management system, for example, the content of each field in the data base has to be clearly defined. Paper forms have to be designed to report information from the file accurately. The flow of data at each stage, from input to validation to processing to output, has to be checked regularly for possible corruption. A set of criteria for removing data from the system should be developed to purge the system of obsolete data. Feedback should be secured from users to assess the system's responsiveness to their needs. Data administration also includes the standardization of data formats and codes to facilitate communication among users.

Security. To reduce system vulnerability to disruptions, three levels of security measures can be set up to restrict access to the system and its contents: (1) programmable -- passwords and encryption of confidential files; (2) procedural -- procedures regulating the use of the machines or disks; and (3) physical -- barriers such as locks that protect the machines from unauthorized persons and environmental hazards.

Documentation. All hardware and software related to the information system should have clear documentation to explain its operations. This is most helpful for whoever will maintain the system, especially if a programming error has to be corrected or a customized program has to be modified to include new features. Administrative bulletins also may be useful in informing participants of the progress of conversion work as well as updates in policies, procedures, and available computer resources.

System support and maintenance. Mechanisms should be established to ensure that all equipment and software are in good operating conditions at all times with a minimum of down time. For large systems, managing the inventory of parts, computer supplies, and software is a necessary task. This includes making sure that recurrent costs are incorporated into budgets. The two most common methods of protecting a system are by signing a maintenance contract with a vendor or other source or by hiring an in-house technician/programmer.

Monitoring and evaluation. Procedures should be set to monitor the impact of automation on the quality of work output as well as on the overall performance of the organization.

Quantifiable targets may be defined to assess the degree to which planned system objectives have been achieved. This is a function of both system performance and its effective use. Collecting regular user feedback is helpful to fine tune the system. The formation of users' groups to enhance the learning process, increase the sharing of information, and serve as a forum for discussing the needs of users is helpful in larger organizations. Finally, documenting the content of monitoring and evaluation processes is valuable in decisions to install another system or expand the current one. Part of the process of monitoring involves developing backup procedures which insure that the work process itself is not so dependent on a mechanical device that work cannot be carried forward should something major occur.

TRAINING

The effect of any computer application will be determined, in part, by its effect on the place of individuals in the organization. A move toward automation may lead to fears on the part of some staff that their jobs may be lost or downgraded as functions are assumed by the computer. This fear may express itself in ways that are destructive to the organization and the process of automation. In most cases, it is more likely that job content will be changed than that positions will be eliminated. Often, in fact, new information-related jobs will be created. The need to re-channel human resources should be seized as an opportunity and interpreted as such by management to the organization's staff.

To be effective, computer training should be directly related to organizational needs and operator skills. Training many people at lower levels is more important than training a few people at high levels; it allows more staff to feel involved in the new systems and reduces risk that all the trained people will leave for higher paying private sector jobs.

Learning in the context of actual on-the-job applications is normally preferable to detached classroom training. Different kinds of applications require different kinds and levels of basic skills. Typically, for decentralized user-oriented systems, the major applications include 1) entering data into menu-driven systems, 2) word processing, 3) use of interactive programming packages, 4) use of statistical packages, and 5) programming in user-oriented languages such as dBASE III and BASIC. Software can be designed to compensate for the lack of technical skills by being more menu-driven, but such software may be less responsive to individual user needs.

Immediate training agendas should include information on the use of the operating system and related utility programs; intensive orientation to software packages; and preparation regarding requirements, responsibilities, and procedures for protection and maintenance of data and equipment. The amounts and kinds of training needed will be situation-specific, and appropriate analysis should be a part of the requirements analysis undertaken in the planning phase.

Major recipients and types of training should include:

- **Clerical.** Skills are needed to operate the equipment on a routine transaction basis, usually for such interactions as entering accounting data or doing word processing. Skills needed include an understanding of the hardware configuration, operating system requirements, and use and basic data input and output functions. These persons should be able to take responsibility for the entry of data and for routine reporting.

- **System management support staff.** The above skills are needed plus the ability to adapt and utilize applications programs to the needs of users. Also important is the ability to integrate functions among different applications programs, prepare documentation for specific applications, engage in routine system diagnosis and maintenance, and respond to requests for new data formats and analyses.

- **Professional users.** Skills are needed for use of computers for analytical and data management operations relevant to particular areas of expertise (including research design, statistics, financial record keeping, information management, and communications). Training in this category will normally focus on use of appropriate applications packages or custom software.

- **System managers.** The above skills are needed. Also required is the ability to develop larger and more customized applications, establish system standards, define network architectures, ensure component compatibility, establish procurement specifications, and establish necessary interfaces between technical and management applications and users.

- **Technicians.** In conjunction with an overall strategy for system support and maintenance (see below), selected in-house staff should be trained to provide routine maintenance services, including preventive care. Where staff size and capabilities permit, this training can be extended to include skills in replacing defective hardware components and maintaining and upgrading customized software.

- **Senior management.** Special kinds of training are needed for managers who need to understand but are not expected to use new automated systems. This understanding of new systems and how they change information management roles and procedures is necessary if these managers are to make appropriate policy judgments that affect computerization.

SYSTEM SUPPORT AND MAINTENANCE

A major concern with any automated system is the long-term maintenance and support of both hardware and software. There are various options for handling this requirement. These options should be considered in the systems planning stage and provision made for the management and budgetary requirements of the chosen strategy. The options include:

- **A maintenance contract with the system vendor.** Where a local procurement strategy has been followed, certain warranty-related maintenance and support services will usually be provided by the vendor or vendors as part of the purchase package. Generally, the period of vendor service can be extended by means of a maintenance contract covering parts and labor (including services related to software maintenance) for a cost of approximately 15-20 percent of the purchase price per year. Such costs are not unrealistic in view of decreases in hardware costs compared with the cost of skilled technical labor. Advantages of a maintenance contract are the predictability of these costs and the ability to plan for them in the budgeting process. Obviously, the merits of this option depend on the capabilities and proven responsiveness of the vendor. Responsiveness is usually best if there is a single system vendor with responsibility for the entire computer configuration rather than multiple vendors among whom responsibility for system failure may be ambiguous.

- **A maintenance contract with a computer service supplier.** When off-shore procurement renders vendor support impractical or in cases where specialized service firms offer superior services, a contract may be arranged with a local computer service firm with capacities appropriate to system needs. The advantage of this arrangement is that responsibility is placed in a single source. Familiarity with certain system aspects, however, may be less than for a vendor specializing in the particular components.

- **In-house maintenance and support.** Any system will benefit from the presence of in-house staff with the technical qualifications to deal with routine maintenance, especially preventative care. Larger organizations may chose to expand the degree of maintenance handled internally if sufficient technical skills are available in-house. A corollary requirement is the need to maintain an inventory of component system parts such as disk drives, printer heads, and other replaceable items to minimize down time.

SYSTEM GROWTH

The rate of change in computer technology is very rapid. At the same time, the use of automation gives people much greater flexibility in the design and use of information systems. Any new system will soon encounter changes such as:

- New hardware technology;
- Price adjustments that alter cost-effectiveness factors;
- Increasing skills and experience among users;
- Changing needs and demands in the user organization;
- Availability of more appropriate or powerful software; and
- New opportunities for exchanging information electronically.

This means that a growth path should be sketched out that goes well beyond current needs. To a new user organization, the initial steps will often seem complex enough, let alone planning for future change. Failure to consider the future when designing a new system, however, can prove costly in the long run.

There are several identifiable stages of growth in most automated systems, each with distinctive applications and potential managerial problems. These include:

- **Initiation (growth in applications):** The growth and mix of applications rarely will follow expectations. As a result, realities of equipment location, control, and use may vary from plan and result in some organizational disruption. Since controls are likely to be rather loose at this point, the need for effective management of change is crucial.

- **Expansion (growth in the specialization of system users):** This phase usually is characterized by increasing need for effective system management combined with loose (usually decentralized) organization of the ADP facilities and few explicit means of setting priorities or crystallizing plans. The system atmosphere, while stimulating, can easily get out of control at this stage.

- **Formalization (growth in formal management and organization of the automated functions):** Management's response to the perceived chaos of rapid expansion may be a sharp pendulum swing in the direction of centralized system control. While a sense of priorities and direction for use of the automation resources may well be needed, the result can be to deaden creativity and over formalize system management.

- **Maturity:** Management faces choices between maintaining stability (running the risk that the automated system will become outdated and inefficient) or keeping the system up-to-date (running the risk of losing the integrative fabric that makes the system effective and minimizes organizational disruption.

Sometimes planning for system growth will entail higher initial system costs than seem necessary. In other cases, a long-range view may point to adapting older technology within a well planned (and budgeted) program for upgrading when certain criteria are met (for example, price changes, availability of anticipated technical options, available support, system experience, or achievement of a pre-determined transaction volume).

In any case, anticipating future directions and needs contributes discipline to the initial planning process and reduces the risk of launching into a technological dead end with equipment that cannot be upgraded to meet growing or changing requirements. Issues to consider include:

- The ease with which the system can be modified or enlarged in accordance with prevailing standards for components appropriate to the initial system configuration;

- The potential costs of anticipated upgrades and modifications and the source of funding for them; and

- Additional personnel requirements (staff and training) when upgrades are implemented.

The most common technical growth options are additional memory capacity, additional work stations (and their networking to one another or to a central processor), new software applications, and peripherals for new capacities such as telecommunications or graphics. But these must be accompanied with growth in the organization's capacity to manage these resources. An evolutionary strategy in which users participate heavily in development and in decisions about organizational change is most effective.

SECTION SIX

EVALUATION

How to use this Section

This section is written for a USAID project, program or evaluation officer planning an evaluation of a project with an automated information system component. Distinction is drawn between projects in which the automated system is itself a major output and projects where automation is an input to serve achievement of broader information management outcomes which are the primary object of the evaluation. The focus of the section is on a set of guidelines for planning and conducting an automation evaluation. Each item in the prescribed AID evaluation scope of work is related to the particular requirements of an automation project evaluation. Emphasis is placed on evaluation points and sources of information that may serve as a resource to define evaluation questions and indicators. These indicators are placed in a matrix of input, output, and purpose indicators arrayed against phases of the automation project cycle. This assists their application both to standard input-output or output-purpose evaluation or to assessments of part or all of the process of information system development.

The section is organized as follows:

AN APPROACH TO THE EVALUATION OF AUTOMATION PROJECTS

STRUCTURING EVALUATIONS

- Types and Timing of Evaluations
- Planning for the Evaluation
- The Evaluation Scope of Work
- Information for Evaluation

USING EVALUATION INFORMATION

SECTION SIX

EVALUATION

INTRODUCTION

The Agency for International Development stresses evaluation of the projects and programs that it implements. Evaluation is seen as a way to help managers make more informed decisions by documenting the benefits and outcomes of specific development activities and by capturing the experience gained and the lessons learned during the course of a project's life. AID views evaluation as a cooperative activity that addresses the information requirements of the host country or recipient organization as well as AID. Hence evaluation is a joint responsibility of the Agency and its counterparts as usually defined in the operative loan or grant agreements.

At the project level, evaluation should provide information about the use of project resources and should track progress toward the development objectives of the project as defined in the Project Paper and Logical Framework. For a project providing automation assistance, it is important to distinguish whether an ADP system is a planned project **output** in itself (basically a resource transfer) or is an **input** contributing to some broader information system outcome. An example of the first case (output) is a project that provides automated equipment to a host country agency with the stated goal of improving that agency's general capacity to process information in the course of its normal activities. An example of the second case (input) is an agricultural research project whose goal is new or improved research capacity in a Department of Agriculture, using automation as one means to build information collection, management, and analysis capability. Such a project is likely to have other host-country and USAID inputs addressing complementary aspects of agricultural information management.

In terms of the AID project Logframe, evaluation of a **project** in which automation is a major output usually will focus on the **output-purpose** linkage, that is, how did the automation strategy contribute to improved information management in the host agency. Evaluation of a project in which automation is an input has two dimensions. Evaluation of the automation component itself will focus on the **input-output** linkage, that is, how did automation contribute to the particular function it was designed to serve (agricultural data analysis in the example above). Usually, however, assessment of the automation component will be part of a broader examination of project accomplishment and impact. In this case, output achievement must be interpreted by the evaluator in that broader context.

Reflecting the importance ascribed to evaluation by A.I.D., numerous guides and handbooks are available from the Bureau of Program and Policy Coordination and the Regional Bureaus. ***.

Two recent guides are: (1) A.I.D. Evaluation Handbook.

A.I.D. Program Design and Evaluation Methodology Report No. 7., April 1987. and (2) Guidelines for Data Collection, Monitoring, and Evaluation. A.I.D. Program Design and Evaluation Methodology Report No. 9., April 1987.** The aim of this section is to supplement what is documented elsewhere, by a focus on the specific issues that emerge when evaluating an automation project.

AN APPROACH TO THE EVALUATION OF AUTOMATION PROJECTS

Automation projects pose special challenges which complicate their evaluation. Automation usually is intended to build the capacity of an organization or a unit within an organization to manage information more efficiently and effectively. While it might seem that a focus on one organization or unit would narrow and simplify an evaluation, the nature of the forces that collide within the organizational setting make evaluation complex.

First there is the technology itself. Computers, even in the relatively benign form of a microcomputer, are a powerful force. Indeed, it is their recognized power to increase performance that drives the demand for automation around the world. At the same time, computer technology is fairly demanding. Certain basic environmental conditions have to be met if a computer is to function at all and certain technical functions have to be performed if the system is to function well (see Section One). Moreover, automated technology is likely to influence power relations and informal structure within the host organization. Thus the technology itself may stimulate or impose change, not all of which can be anticipated.

Next there is the organization. The importance and strength of internal procedures and norms in determining an organization's receptivity to automation has been discussed in Section One of this manual. Suffice it to say here that the centralized and rigid structure of many organizations in developing countries may not be particularly accommodating to the demands of automated systems.

When the demands of the technology collide with the orientation of the organization, it is often over something procedural or operational, like a budget, a timetable, or a planning report. For example, the lack of money in the budget for equipment repairs (a procedural or operational concern) may be the product of poor equipment choice or insufficient preventative maintenance (technical matters), an inability to forecast repair needs accurately or a lack of senior-level support for the automated system (organizational matters), or a combination of both.

As this example demonstrates, automation evaluations pose a challenge because the results -- good, bad, or indifferent -- are usually the result of a combination of technical factors, organizational factors, and the interplay between the two. To be useful, an evaluation must do more than document the end result of the collision of the factors (the inadequacy of the repair budget), but delve a bit deeper to sort out where it is that these problems and successes are derived.

Such an inquiry is consistent with the usual AID evaluation approach of examining the linkages between project inputs, outputs, and purpose. Figure 6-1 displays the application of these linkages to an automation project.

For projects in which automation assistance is intended to assist information management capacity in a host agency, the broader **purpose** is to help persons make effective decisions and take appropriate actions. As noted in the discussion of the "Applications Pyramid" in Section Two, this may take place at three levels:

- Operational level activities involve the day-to-day functions of the organization and related routine decisions. Most information systems begin with a focus at this level. For example, a payroll system designed to process checks is operational.

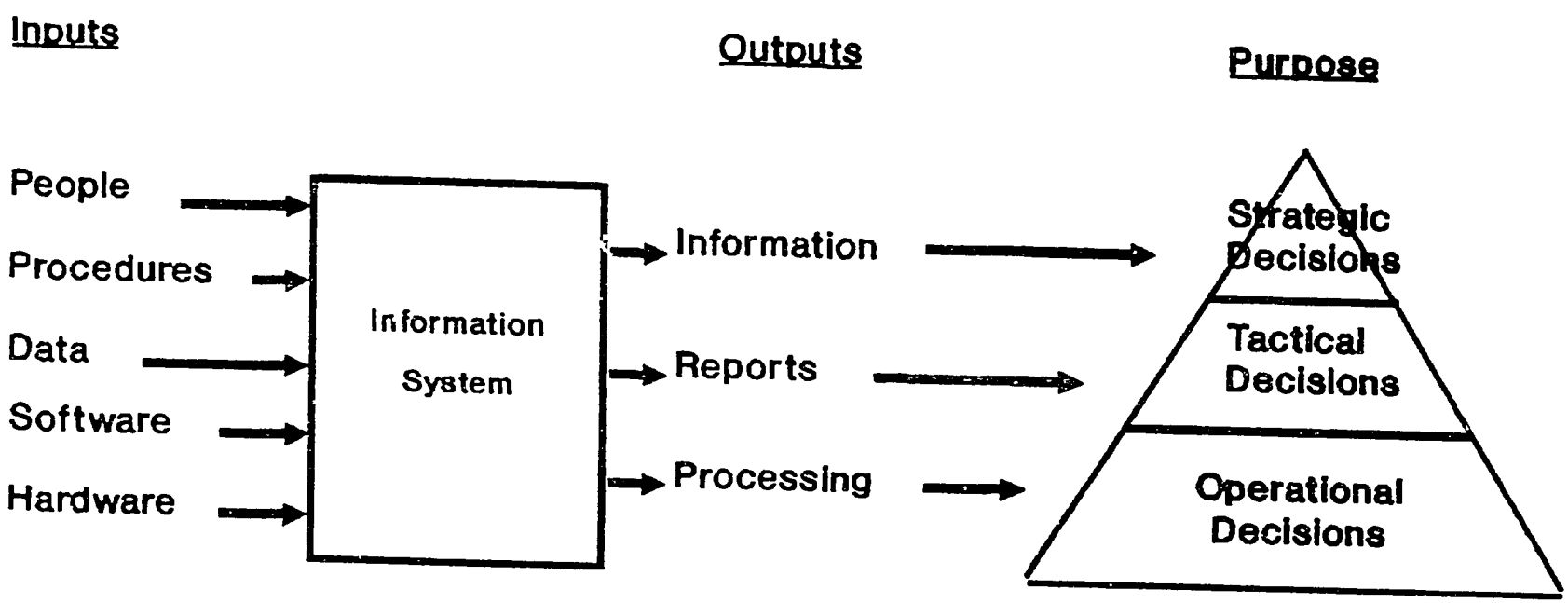
- Tactical level decisions focus on a some what longer time-frame and are less structured and repetitious than operational decisions. An example is the use of market data to make periodic changes in food distribution patterns.

- Strategic level decisions focus on long range-policies of the organization and are usually made at upper levels of the hierarchy. For example, a system providing analytical information to support allocation of resources to a national immunization program is strategic.

Different kinds of information are needed at each level of the pyramid. Strategic decisions require aggregated and analyzed information. Operational decisions require detailed, processed, short-run information.

Figure 6-1

Information System Model for Evaluation



Information system **outputs** consist mainly of data that is processed, aggregated, and/or analyzed into information products, usually in the form of reports. The transformation of data into information is the key task of any information system whether automated or not. Useful information outputs are **relevant** to the decisions to be made, **accurate** and **complete** enough to guide the user to the appropriate decision, sufficiently **timely** to allow the decision or action to be taken when needed, and **concise** enough to be efficiently used. As noted in previous Sections, these output criteria should guide the automation planning and implementation process. Specific objectives defined early in the project cycle then can be used as benchmarks that are tailored to the evaluation at hand.

Project **inputs** to most AID automation initiatives will consist substantially of commodities, technical assistance, and training. Another way of considering inputs as they apply to a functioning information system is to disaggregate them into **people, administrative procedures, data, software, and hardware.** This disaggregation has two benefits. First, in incorporates the usual host country inputs to the information system; second, it provides a useful basis for evaluation. Here again, specification of these inputs in project design will provide useful criteria for later evaluation.

Using this conceptual approach, the remainder of this Section addresses the specific requirements of planning and conducting an evaluation for an automation project and highlights suggested evaluation points and sources of information.

STRUCTURING EVALUATIONS

Types and Timing of Evaluations

A.I.D. distinguishes between two broad classes of evaluation, each with its own aim and use. **Interim** evaluations are conducted during the course of project implementation to determine if actual progress is matching expectations or to provide the basis for mid-course corrections in implementation strategy. **Final** or ex-post evaluations are conducted when implementation has been concluded are more concerned with documenting project impact or lessons learned. Each type of evaluation raises special issues as they relate to automation projects.

Interim evaluation: Although interim evaluations are not required as a matter of course under A.I.D. guidelines, they should be routinely scheduled when dealing with automation activities. Given the complexity of managing the introduction of an automated system, the strength of both the technical and organizational forces at play, and the uncertainty surrounding actual response to automated equipment, periodic examinations of the automation activities will be beneficial. These interim evaluations, because of their more comprehensive focus, should be seen as a supplement to, and not a substitute for, ongoing monitoring activities.

The aim of an interim evaluations is to assess the progress of system implementation and to ensure that the technical and organizational capabilities necessary for system sustainability are being developed. The emphasis of the interim evaluation on providing useful feedback on project management is depicted in the automation project cycle diagram in Figure 6-2.

Because the evaluation points that are a priority during an interim evaluation are not particularly technical, this type of evaluation can usually be performed by local project and mission staff without the assistance of outside experts. By the same token, this type of evaluation provides a good opportunity for a joint-learning exercise with host-country project staff.

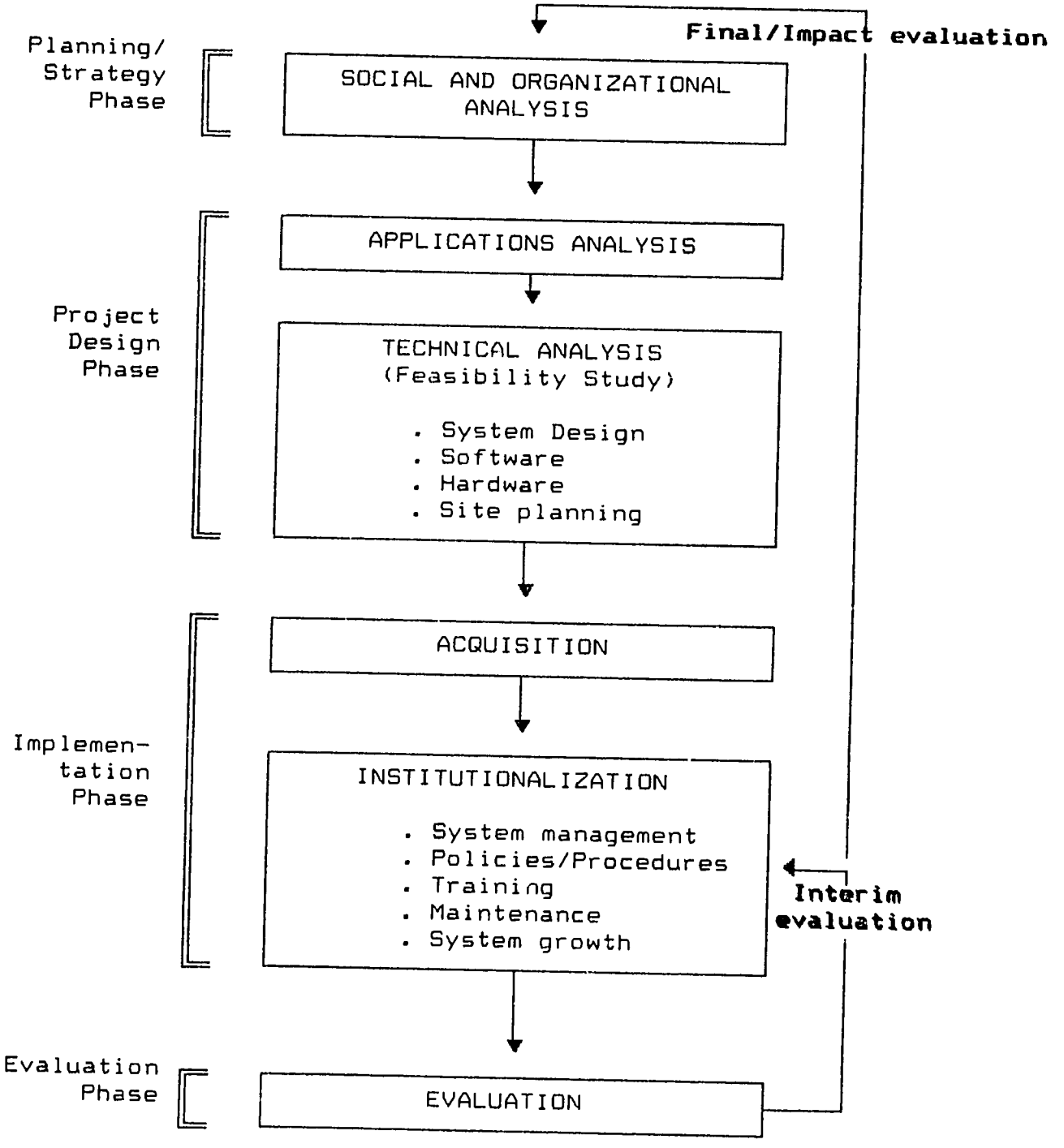
Ideally, an interim evaluation should be timed to coincide with the onset of the maturation stage of system growth (see Section Five). At this point it is vital to determine whether the initial bugs in the system have been worked out and the foundation has been laid for the anticipated expansion in demand for automated services. If not, demand may overwhelm the system, leading to widespread dissatisfaction. Depending on the complexity of the system and readiness for automation, this transition usually will occur somewhere between 3 and 12 months after installation.

If the automation project is a complex one or there is reason to believe that implementation will be problematic, there may be a need for more than one interim evaluation. In that case, the interim evaluation between stages one and two should be supplemented by a evaluation between stages two and three and at other points as deemed necessary.

Final or Impact evaluation: As with other types of projects, the aim of final or impact evaluations is to look back at the project in its entirety after assistance has ended. There are two key perspectives: First, to examine the impact of the automated information system on the organization and its ability to better perform its assigned mission; second, scrutinize the project throughout its cycle to identify generalizable lessons. This second aim is of particular importance for automation projects because of the need to expand the pool of documented experience from which future planners and designers can draw.

Besides looking back at the project during a final evaluation of an automation project, it is also important to look forward.

Figure 6-2
Evaluation and the Project Cycle for Automated Systems **



** This framework and its terminology, which serve as the organizing principle for this manual, are defined in Section One of this Manual.

The organization receiving the automation assistance, not to mention the automated system itself, is expected to continue functioning after the end of project activities. Therefore, it is important that final evaluations also contain recommendations to the organization on how to continue making best use of automated equipment. Thus, a final evaluation may well document the conclusion of one iteration of the project cycle, but it should also provide the basis for subsequent iterations. This relationship is depicted in Figure 6-2 by the fact that the arrow representing a final evaluation lead from the bottom of the project cycle back to the top.

Given the concerns of an impact evaluation, it should occur during the fourth stage of growth (maturation), between a year and two years after installation. However given practical realities, final evaluations will be conducted according to an external timetable. In that event, it is important that those conducting an impact evaluation take into consideration that fact that the automation activities may not have achieved their full potential.

Planning for the evaluation

Key issues to consider while preparing for either type of evaluation are the focus, timing, and the scope of work:

Evaluation Focus: In some cases, as noted above, the automated system is a major project output. In these cases a discrete evaluation is the obvious choice. Where automation is a component of a larger project, the issue become more complicated: A separate evaluation of the automation component may be called for but hard to arrange or finance. More likely, the automation activities will be evaluated at the same time as the larger project allowing very limited specific attention. Another alternative may be to perform a sector study that focuses on information system development. Apart from questions of financial feasibility, the factors arguing in favor of a discrete evaluation include the opportunity to chose optimal timing for the automation evaluation and the need for specialized skills on the evaluation team.

Whether as a discrete evaluation or subset of a larger evaluation, however, the suggestions of this section regarding the scope of work remain valid. The level of detail with which they can be applied will be determined by the broader mandate of the evaluation and the judgement of the involved mission officers.

Timing: Further complicating the issue is the fact that the project cycle for the automation component of a larger project may not coincide with the broader project cycle. Planning, design, and implementation phases for the information system may, for example, take place within the implementation phase of the total project.

Reference to the project cycle throughout this manual refers to the cycle for the ADP component. Ideally, interim or final evaluations of this component should be conducted at the appropriate phase of system development as discussed earlier in this section. Unless the automation activities are evaluated separately, however, this timing may be overridden by the evaluation requirements of the broader project. This may require adjustments in the scope of work to fit the actual circumstances. It adds to the importance of establishing criteria and benchmarks during the automation design so that some evaluative data may be collected on a continuing basis, not entirely dependent on the timing and scope of the formal automation assessment.

The Evaluation Scope of Work

In an automation project, with a number of factors at play, it is important to specify as the issues to be addressed as precisely as possible. One way to do this is to frame the scope of work in term of specific questions to be answered. To this end, the main evaluation points in Table 6-3 below can be rephrased in terms of questions. Of course, these points and related indicators will have to be tailored to conform to the type of evaluation being conducted and the resources available. A checklist of items to be considered in a scope of work, based on the A.I.D. Evaluation Handbook (April, 1987) includes:

1. **Activity to be Evaluated:** Definition of the scope and purpose of the automation activities in the context of the entire project. Clarification of the boundaries of the evaluation, i.e. AID inputs only, information system only, or broader organizational issues.

2. **Purpose of the Evaluation:** Why is the evaluation needed and what are the key issues to be addressed? Who will use the results? Is the focus on information products *per se* or on the impact of those products on the organization?

3. **Background:** Description of the history and implementation status of the project with particular reference to the automation component. A typical outline will be

   - Description of overall project - Socio-economic and technical setting
     - Project goal and purpose
     - Role of automation component
   - Scope of project, including inputs and activities
   - Expected automation benefits and link to other outputs

4. **Statement of Work:** What are the 10-20 specific questions the evaluation is to address? Are there any identified problems with the automation activities that call for particular attention?

The evaluation points in Table 6-3 may be used as a resource from which to draw a set of questions relevant to the particular evaluation. This table sets suggests input, output, and purpose indicators arrayed across the five steps in the automation project cycle model to yield a matrix. This matrix provides a guide for identifying indicative evaluation points at each stage of the project cycle.

5. **Methods and Procedures:** What data collection and analysis methods are to be used? These will have to be consistent with available funding and the questions defined in the statement of work. In some cases, information should be collected in ahead of the evaluation field work through advance communications, including a questionnaire using selected indicators from the preliminary statement of work. See the following subsection on information for evaluation for suggestions regarding information sources.

6. **Evaluation Team Composition:** If a combined evaluation is selected one technically qualified member usually should be given the responsibility of evaluating the automation component. For a discrete evaluation of an automation initiative, specialized skills may be combined depending on team size. Given the importance of host country involvement (ownership and learning), evaluation teams should include at least one member of the affected organization in either type of evaluation. Particularly during a formative evaluation, an outside perspective (no stake in initial feasibility study or management plan) is useful. Key skills for the automation evaluation are a combination of management understanding and familiarity with automated systems, especially applications and technical analysis. These skills can be supplemented with specialized computer skills (systems analysis, programming, database management, etc.) if the project is complex or if there is feeling that initial technical specifications have gone awry. Developing country experience is very important in view of the unique environmental factors affecting automation. Language or specific country competence will depend on the situation but evaluators should be able to discuss the system with both operators and users.

7. **Reporting Requirements:** These are defined in the Evaluation Handbook. In cases where automation is assessed as part of a larger evaluation, consideration should be given to a special annex to the report prepared by the team's automation specialist. This annex might be addressed specifically to system managers to advise them on recommended system or management improvements.

8. **Funding:** If adding automation expertise to an evaluation team is made difficult by budget limitations, consideration should be given to use of local technical experts, increasingly available in most developing countries.

Table 6-3
Evaluation Points for Automation Projects

How to use this table: These indicators are provided as a resource from which to draw selectively in framing questions for an automation evaluation scope of work. For a typical outcomes-oriented evaluation, the most important categories are the input, output, and purpose indicators across the top. For an evaluation exploring lessons learned from all or part of the automation process the categories in the first column geared to the automation project cycle may be most useful.

Step in the Project Cycle	Input Indicators	Output Indicators	Purpose Indicators
Social and Organizational Analysis	Technical Environment - capacities in org. - host country tech resources - constraints identified and addressed Mgt. support for automation Staff receptivity to automation Resources committed to this analysis	Extent of preliminary organizational and social analysis Analytical reports available Constraints to automation overcome	Information requirements for decision-making at different levels identified Organizational structure and processes appropriate for pre-automation phase Required information flows and use identified Need for automation verified
Applications Analysis	Quality of ongoing data collection Pre-automation information management procedures Resources committed to this analysis	Extent and relevance of applications analysis Analytical reports available Appropriateness of system plan to required applications Transfer of applications analysis skills to host-country personel	Selection of appropriate application(s) Documented link between planned applications and organization's information management needs Quality of information outputs
Technical Analysis	Adequacy of systems configuration (hardware and software) Adequacy of planned system capacity Resources committed to this analysis	Extent and quality of technical analysis Analytical reports available System technical performance (speed, flexibility, etc.) Repair frequency Transfer of technical analysis skills to host-country personnel	System performance in support of information needs of decisons and action System technical reliability Contribution to organizational effectiveness Contribution to organizational efficiency

Table 6-3 (continued)

Acquisition	Relationship of procurement specifications to technical design Cost of acquisition Vendor selection criteria Acquisition training provided to host-county personnel	Adherence to US/host-country procurement regulations Pace and cost of acquisition Acquisition process well documented Acquisition specs compatible with system design requirements System as delivered fully operational	System maintained with internal staff and/or budgeted resources Level of disruption to org. processes during acquisition and installation
Institutionalization	Sr. management support in host agency Qualified/trained staff available for system management Staff acceptance of new systems Adequacy of repair and maintenance arrangements Adequacy of technical monitoring Adequacy of system policies and procedures Recurrent cost and capital replacement coverage	Pace and cost of installation Documentation of system performance System maintenance procedures in place Quality of information products - relevance - accuracy - timeliness - quality User training in place Reporting systems functioning as intended	Integration of system management into the organization Appropriateness of information system to organizational decisions and actions Documented changes in decision quality Effective information flows within organization

Information for evaluation

As noted earlier, an evaluation will be much more effective if relevant information needs have been defined throughout the automation project cycle. If so, an evaluation can draw on the key planning documents, including the social and organizational analysis, the applications and technical analysis contained in the feasibility study, various acquisition documents and the implementation plan with its milestones and budget. Evaluators will also have access to periodic reports on implementation progress. In the event that these documents or analyses have not been prepared, the information they contain can be generated through retrospective interviews and questionnaires.

Table 6-4 lists major potential sources of information for evaluating automation activities, divided between internal and external sources. The only unusual source listed is the self-audit program. These programs usually are a standard part of any multi-user operating system and can be purchased for stand-alone computers as well. Depending on the sophistication of the system or application, these programs can monitor who used a particular computer or program, which files were accessed, and even the rate at which key strokes were entered into the computer. These programs can generate useful data on usage rates and operator efficiency that cannot be gathered any other way.

USING EVALUATION INFORMATION

As stressed earlier in this section, the broad purpose of evaluation is to help managers make more informed decisions by documenting the benefits and outcomes of specific development activities and by capturing the lesson's learned during the course of the project cycle. At the management level, evaluation should provide information about the use of resources and should track progress toward a project's development objectives as defined in the Project Paper and Logical Framework. In every case, the purpose of evaluative information is to aid decision making. Throughout the project cycle, there is potential for evaluation results to be input into the decision making process.

Development projects are, of course, the results of political decisions by host country and donor officials. In any political system that is sensitive to weighing and balancing the conflicting claims and interests of a number of constituencies, evaluation information may be but one of many inputs and its role may not necessarily be determinative. Good evaluation information, however, should play an important role. In the case of automation

Table 6-4
Sources of Information for Evaluation of Automation Activities*

Internal Sources	External Sources
Secondary and Contextual Data PIDs and Project Papers of related projects in the Mission portfolio Project papers and evaluations of AID projects with automation components Mission project files (letters, cables, reports, memorandums) Specific automation documentation: -organizational and social analysis -feasibility study (applications analysis, technical analysis) -acquisition documents (RFP, IFB, vendor selection criteria) -implementation plan	**Secondary and Contextual Data** Host country development plans as they relate to technology transfer, information resources, and communications Host country import/procurement regulations related to computers U.S. procurement regulations Case studies from other automation projects in the country/region Reports or other material by local hardware/software vendors
Primary Data Information System reports Internal project files (letters, memorandums, meeting minutes) Periodic data collected against key indicators: budgets, implementation milestones, training targets Documentation of USAID and host-country inputs (people, procedures, data, software, hardware) Maintenance records Self-audit programs Interview and questionnaire data from US and host-country project staff (users, operators, and report recipients from automated system) USAID staff, other host-country staff	**Primary Data** Documentation (especially evaluations or internal assessments) from automation activities in other departments of host agency or from other agencies in country (Other relevant primary data on automation from external sources is generally unavailable.)

* This table follows the format of Table 2, "Sources of Information and Data for AID Evaluations," AID Evaluation Handbook, April 1987, p. 22.

projects, many evaluation issues may be technical and thus relatively neutral as far as policy and values are concerned. On the other hand, evaluative information that suggests major changes in organizational arrangements or information flows may generate political opposition.

In any case, evaluative information will carry more weight if it perceived as relevant, accurate, and unbiased. It must also be accessible to potential users. Evaluation reports should be brief and to the point. Major findings and recommendations should be tailored to the anticipated users of the information and their decision needs. This means that flows of evaluation information should be restricted to what is necessary for informed decision making at various levels of the management hierarchy. This does not mean that the information should never be accessible to other levels but that it should not be fed routinely into the flow of documents and reports from one level to another. In this way, decision makers will not be overwhelmed or distracted by irrelevant or inappropriate information.

AID requirements for evaluation use, as reported in the AID Evaluation Handbook (1987), include:

- the use of relevant past experience in the design of new activities, and evidence in the design document that the designers have considered and applied this experience; and

- the inclusion in all projects of an information component that will provide the data necessary for adequate monitoring and evaluation during implementation.

The best way to ensure that evaluation information is analyzed and used is to integrate data-related activities into the project design and, especially, into its management plan. This builds ownership of evaluation processes and results within the host agency for the project. For an automation project that aims to improve an organization's information system, effective management of evaluation information regarding the project itself provides an early and relevant test of new information management capacities.

ANNEX 1

AUTOMATION POLICY ISSUES

ANNEX 1

AUTOMATION POLICY ISSUES

(Adapted from "The Informatics Revolution and the Developing Countries," Summary Report of a Consultative Meeting of the North-South Roundtable, Scheveningen, The Netherlands, September 13-15, 1985.)

1. The pressure for change from the new information technologies cannot be ignored. At best, developing countries can think through their options and develop internally consistent policies that potentially can offer useful new tools for enhancing human development. But any viable policy will need to harmonize the relationships between traditional technologies with modern ones, and both with the kind of human development that is required in a particular society.

2. Most of the information technology available to developing countries is designed and produced in the industrialized countries. Circumstances governing the use of these technologies are enormously different in the two regions. Thus, developed-country experience (and software) are of somewhat limited relevance to the developing countries. Much responsibility for designing national information policies and producing software must, therefore, reside with the governments of the poorer countries. In this respect, there are great possibilities for technical cooperation among developing countries.

3. The process of designing effective plans and policies could be aided substantially by associations of users that can balance the power of the producers.

4. The benefits of computers cannot be fully realized without a mature telecommunications system, an educated labor force, effective national institutions or monitoring developments and establishing general policies, and reliable power grids. However, many substantial gains can be realized even by installing isolated systems in present institutions. It is unwise to ignore the importance of infrastructure, but it is also impossible to wait until computers are ideal for implementing a complete national automation program.

5. The costs of implementation programs must be assessed candidly. It is unrealistic for any country to expect that grants and gifts will provide the foundation for its extensive use of the new information technologies. However, it is possible that innumerable applications can return many times their costs by raising export earnings or reducing import needs. Thus, eventually, the automation programs of most developing nations can be largely self-financing.

6. National standards are required to ensure that proliferation of hardware and software does not diffuse the energies of the scarce personnel resources of the developing countries. These standards must be set with sophistication so that they do not stifle national spirit, innovation, and initiative. The standards should not narrowly specify hardware types; this would preclude competition among alternative suppliers.

7. Even before a comprehensive national plan is established, there are many concrete applications for computers that offer tangible, short-term gains, and that will provide experience and expertise relevant to the larger and longer-term policy issues. Many of these early efforts should focus on the computer skills of teachers so that trained personnel are produced quickly.

8. Explicit policies related to networking and computer telecommunications are essential. Networking has two functions: It can bring data from the periphery to facilitate centralized monitoring and control; or it can provide data to those on the periphery, so that their decisions can be based on more comprehensive considerations. These two options have very different implications for diversity, initiative, and power. Any national effort to develop guidelines for the telecommunications industry should recognize the social implications of the technology.

9. Numerous examples prove that computers and related technologies can already produce significant gains in th effectiveness of developing nations' limited teaching and administrative staff. New technologies are not required to achieve major advances. But much work is required to refine the software and develop implementation procedures appropriate to Third World settings.

ANNEX 2

SAMPLE REQUEST FOR IRM SERVICES

Sample IRM Approval Request

MEMORANDUM

August 8, 1986

TO: AID/M/SER/IRM/MPS, Project Review Section
FROM: John Smith, Project Officer, USAID/XXXXX
SUBJECT: Request for IRM Approval of Project-sponsored Automation Components for the Energy Planning and Development Project (No. XXX-XXXX)

The Mission is seeking SER/IRM approval to procure computer equipment and services for implementation of the Energy Conservation Program. An AID contractor, Generic Consulting Associates of Washington, D.C., has performed a needs assessment on 8/2/86 which is available to IRM analysts for their review. If you need to obtain additional information about the project please contact the consultants or June Smithe of ANE/TR, the project backstop.

Information Application. The primary objective of this component of the project is for the host country to acquire a capability to perform audits, statistical analyses, energy modeling, forecasting, and other analysis capabilities needed for energy conservation. The primary means suggested to achieve this goal is the development of databases of energy conservation data specific to the area, provision of a small amount of computer capacity to automate certain phases of information retrieval, storage and analysis, and provision of the necessary technical assistance to train government personnel in the use of the analysis techniques. The needs assessment previously mentioned contains detailed estimates of specific applications and storage requirements. The size of the largest database is around 6 megabytes per province, assuming 6000 cases and 100 variables per case. Other smaller databases wil increase storage needs to around 11 megabytes in the smaller administrative areas, up to 17 megabytes in the largest administrative areas. Beyond database needs, there will be some need for spreadsheet analysis, graphics, and project management applications, with lesser needs for word processing. For the short- and medium-term, it is anticipated that stand-alone microcomputers will have sufficient capacity to handle the application, as no multiuser or multitasking needs are foreseen and since the quality of telephone lines over the Northeast Mountains to the capitol city make communication between the remote locations and a centralized database infeasible. Very little custom programming will be performed, as the project will primarily rely on off-the-shelf software packages.

Hardware and Software. Microcomputers compatible with the following IBM and Hewlett-Packard equipment are desired:

- Fifteen (15) IBM PC/XT units (uses Intel 8088 microprocessor) with at least 512K RAM, 20MB hard disk, enhanced keyboard, one 360KB floppy diskette drive and adapter, monochrome display, monochrome adapter and parallel port. Estimated per unit price, $2,223.00.

- Twelve (12) IBM PC/AT units (uses Intel 80286 microprocessor) with at least 512KB RAM, 30MB hard disk and adapter, 8Mhz clock, enhanced keyboard, one 360KB (preferred) or 1.2MB floppy diskette drive, serial and parallel interface, enhanced graphics display adapter and enhanced color display. Estimated per unit price, $4,390.00.

- Fifteen (15) Hewlett Packard Portable Plus microcomputers with 512KB, parallel port and floppy disk drive. Estimated per unit price $3,000.00

- Ten (10) Hewlett Packard Thinkjet printers. Estimated price $350.00 ea.

- Five (5) Hewlett Packard Laserjet Plus printers. Estimated price $3995.00 ea.
- Twenty-seven (27) Epson FX-286 dot matrix printers plus parallel interface cables. Estimated price $646.00 ea.
- Five (5) Hewlett Packard 7475A plotters. Estimated price $1300.00 ea.
- Fifteen (15) ea. of Lotus, SPSS/PC+, and Wordperfect for the HP Portable Plus. Estimated price, $1000 per unit.
- Twenty-seven (27) ea. of Lotus, SPSS/PC+, and Wordperfect for the IBM PC/XT and IBM PC/AT. Estimated price, $1000 per unit.

TOTAL cost of the hardware and software is estimated at $220,000

Training. Training will be achieved through the use of technical assistance. Estimated level of effort from technical assistance over the 5 year life of the project is 1000 person months. Training will encompass database development, auditing, statistical analysis, program analysis, modeling, and forecasting. A training program wiill be set up to ensure a continuous supply of trained analysts. The Energy Ministry has recently a number of incentive changes, meanwhile, which should increase their ability to retain qualified analysts after the project is completed.

Maintenance and Support. Vendor will be required to demonstrate capability to provide hardware support throughout the host country, through service contracts, and will be required to stock spare parts at the board level for all equipment procured. Software support will be provided through the planned technical assistance.

Please contact the project consultant in Washington for additional information. We would like to begin procurement on or around 9/2/86.