United States General Accounting Office

GAO

Information Management and Technology Division

August 1990

Information Technology: A Model to Help Managers Decrease Acquisition Risks

GAO/IMTEC 8.1.6

Preface

Managing the federal government's information technology is a difficult task. Government computer and telecommunications systems touch the lives of Americans each day. Government leaders must increasingly rely upon information technology to streamline operations, improve service to the public, and manage the high rate of technological change that has been accelerating during the past few years.

Attempts to modernize the government's information systems have produced many costly failures. Over the past several years we have found costs skyrocketing into the billions of dollars, long delays in development, and systems that do not meet users' needs. The causes most often cited are a lack of effective leadership by senior managers, ineffective communication among those involved in developing information systems, incomplete knowledge of the customer's needs, the absence of a clear and complete systems architecture, frequent turnover among project managers and other key personnel, and inadequate training. This record of failure has resulted in a lack of public confidence regarding the government's ability to manage information systems projects.

Modernizing the federal government's information technology is an enormous and complex undertaking. Given the government's need for improvement in this area, a consensus has been building among federal leaders that new ways of addressing this challenge must be explored. As part of the effort, we developed this information technology acquisition model to help managers identify the critical factors needed to manage and control large-scale systems development and acquisition projects that are significant enough to require formal project management. The model represents a consensus of opinion among information technology experts in the federal government, private industry, and academia. It summarizes those critical factors that acquisition managers should focus on to decrease

their risks in acquiring hardware, software, and telecommunications. While the model should help acquisition managers decrease risk, it is not binding on federal agencies, and will not ensure that an acquisition and subsequent implementation will be successful.

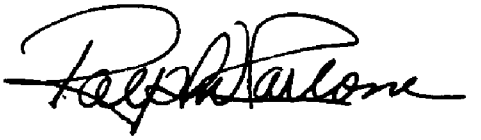
The model may also be used as a "lessons learned" guide to decrease risks when planning for an acquisition or for identifying the potential risks when reviewing an ongoing acquisition. It is intended for use by managers, internal and external auditors, and oversight organizations.

The model is just one way GAO is addressing the inherent risks in acquiring information technology. As a follow-on product, we plan to publish a Risk Assessment Methodology that will provide a means to conduct quick, comprehensive assessments of acquisition risks.

We hope the users of this model will find it helpful in identifying and implementing those critical factors that are key to economical and efficient information technology acquisitions. A questionnaire has been included at the back of this document to assist us in identifying suggestions for improving the model.

This model was prepared under the direction of Jack L. Brock, Jr., Director, Government Information and Financial Management, who can be

reached at (202) 275-3195. Other major contributors to the model are listed in appendix I.



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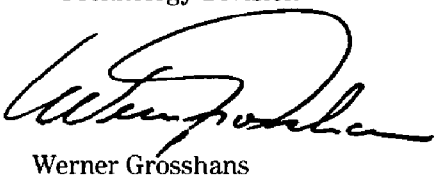

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Contents

Abbreviations

GAO	U.S. General Accounting Office
GSA	General Services Administration
IMTEC	Information Management and Technology Division
IRM	information resources management
IRMS	Information Resources Management Service
OMB	Office of Management and Budget
PM	program manager

Information Technology Acquisition Model: Focus on Critical Factors to Decrease Risks

This model summarizes at a relatively high or "macro" level the current federal process to acquire large-scale hardware, software, and telecommunications. The model highlights those critical factors that should be addressed in such acquisitions. Focusing on these critical factors should provide managers with a comprehensive oversight of the acquisition process and help them decrease acquisition risks.

Federal managers may apply this model to (1) identify alternatives for meeting an agency's specific needs, (2) acquire complete information systems either in full or through an incremental acquisition of a prototype, or (3) acquire equipment or software necessary to support or upgrade existing systems. Performing the steps in the model, however, will not ensure that an acquisition and subsequent implementation will be successful. Instead, the model offers a summary of what an agency can do to minimize the risks inherent in acquiring complex and highly technical information technology hardware, software, and telecommunications under present procedures.

Organization and Scope of the Model

The model covers the entire acquisition process as described in the Federal Acquisition Regulation and the Federal Information Resources Management Regulation. On the basis of this definition, the acquisition process begins at the point where agency needs are established, includes those technical and management functions directly related to the process of fulfilling agency needs by contract, and ends with contract administration. The model is divided into three phases:

- presolicitation, which includes broad management functions that must be completed whether or not the agency contracts for automated data processing hardware, software, telecommunications, or services;

- solicitation and award, which incorporates the steps necessary to formally notify the public of an agency's requirements, solicit and evaluate alternative proposals, and award a contract; and
- postaward, which consists of processes necessary to administer a contract after award to ensure that cost, schedule, and performance goals are met.

Each phase of the acquisition model has two elements. First, the major functions in the acquisition process are described in a logical progression. Second, critical factors are included as indicators of risk and uncertainty in an acquisition project.

Process steps are drawn from various acquisition laws, regulations, and directives. The critical factors are drawn from government reports and from the information technology acquisition experience of over 60 experts we contacted in government, academia, and private industry.

General Considerations

The model emphasizes the involvement of both users and senior managers throughout an acquisition. It stresses that users should ensure that their mission needs drive the acquisition. Top management should include officials appropriate to the scope and impact of the system being acquired. A program sponsor, the person who is responsible and accountable to top management for the successful development and completion of the system, should be included, as should information resources management officials.

Throughout the model, the importance of an experienced, qualified project team is also stressed. This team should be headed by one individual who is responsible and accountable for the day-to-day acquisition duties and who is supported by personnel knowledgeable in user requirements, automated data processing, telecommunications, and acquisition. Project members should have training

in procurement ethics as well as training in their areas of expertise.

Additionally, the model stresses that management reviews should be performed periodically, but does not state how or when an agency should conduct such reviews. An agency may want to implement a process for parallel management reviews in order to expedite the review process. Each agency must determine when management reviews are needed, and at what level, depending on an acquisition's impact on the agency's operations.

Anyone using this model should be aware that although the process steps are shown as sequential, one-time activities, some steps may actually be concurrent or iterative. New legislation, for example, may change an agency's mission and impose new requirements that a system in planning will have to incorporate. Alternatively, an agency may discover, after developing specifications, that it must revise its requirements because of industry limitations, or broaden its alternatives analysis because of technological advancement. The model does not rule out such changes but calls for effectively managing and controlling changes to limit disruptions to the acquisition as a whole.

How the Model Was Developed

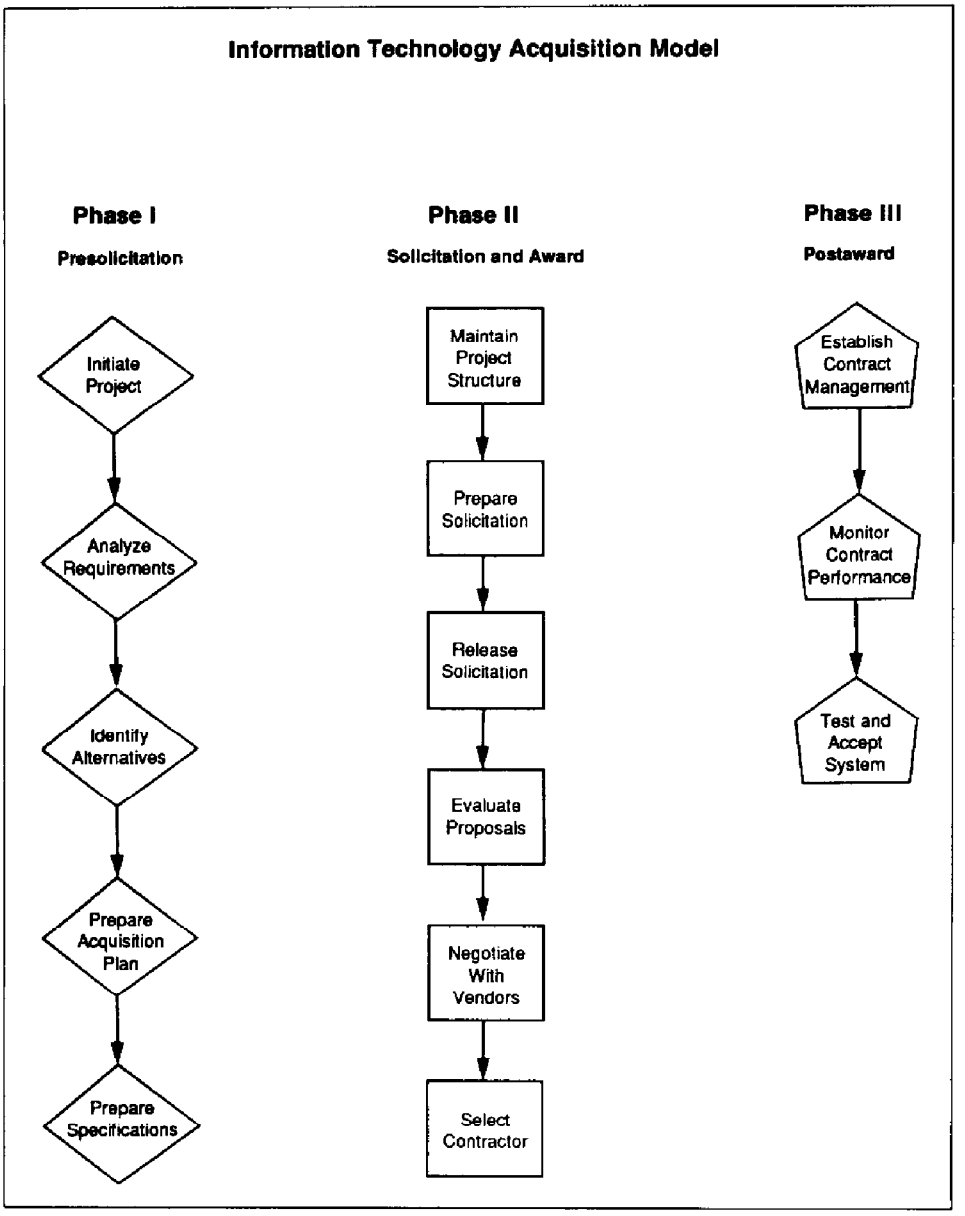
In developing this model, we used a delphi technique to identify a consensus of expert opinion through an iterative survey process. This technique incorporates initial responses to modify the model, which is then given back to the same group of experts for further refinement. We began by drafting a "straw man" of the information technology acquisition process and the critical factors related to each step in the process that acquisition managers should focus on to decrease potential risks. We researched applicable laws and regulations related to federal information technology acquisitions, and reviewed numerous government

and private-industry reports on the inherent risks in acquiring information technology.

Using this straw-man model, we interviewed over 60 information technology experts in the federal government, academia, and private industry. These interviews included discussions with presidents of local consulting firms that specialize in information technology acquisitions, vendors, federal procurement policy analysts, information resources management (IRM) officials, and agency acquisition managers. Information obtained during these interviews was incorporated into the model, which was then sent back to all the officials with whom we had previously met. This delphi technique allowed each official to comment on the model as a whole and enabled us to achieve a consensus of expert opinion. We then applied the model against two information technology acquisitions, the Air Force's Headquarters System Replacement Program and the U.S. Geological Survey's Distributed Information System, to determine if the model contained any inadequacies that would invalidate it. Finally, we sought comments on the model from industry executives who had been instrumental in successfully implementing multimillion-dollar systems development projects.

As a result, the model represents a general consensus among a wide range of experts we contacted in private industry, academia, and the federal government. Their knowledge and experiences in the field of information technology were instrumental in helping us determine how the federal government should manage acquisitions. A listing of the experts we contacted to develop this model is on file and is available upon request.

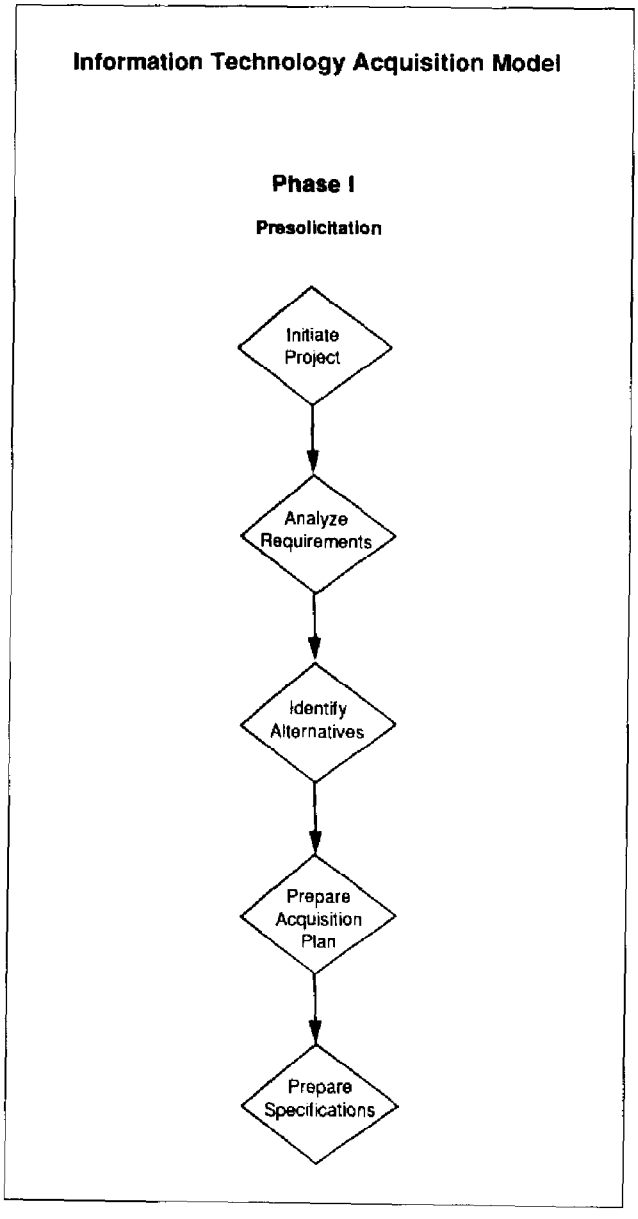
Information Technology Acquisition Model: Overview



Overview

I. Presolicitation	Initiate project Analyze requirements Identify alternatives for meeting requirements Prepare acquisition plan Prepare specifications
II. Solicitation and Award	Maintain project structure Prepare solicitation Release solicitation Evaluate proposals or bids Negotiate with vendors Select contractor for award
III. Postaward	Establish contract management structure Monitor contract performance Test and accept system

Phase I: Presolicitation



I. Presolicitation[1]

Process	Critical Factors
Initiate Project	
1. Perform needs determination with the participation of end users.	1. Needs determination should: a. Clearly and accurately define needs in relation to agency's mission, strategic objectives, and its strategic information and computer security plans. b. Address the agency's system architecture and functions, new or changed program requirements, deficiencies in existing capabilities, and opportunities for increased economy and efficiency.
2. Identify agency management officials whose support and approvals are needed.	2. Top management should: a. Provide initial support. — Approve project goals and objectives of the acquisition. — Designate a program sponsor or owner who is responsible and accountable to top management for the successful development and completion of the system.

[1]The model is arranged in columnar format so that the critical factors can be shown in relation to the process step to which they apply. However, it is important to note that only the numbers in each column relate to each other. Information highlighted with letters or bullets in a column applies only to the narrative directly preceding it.

Process	Critical Factors
	— Establish a formal process for managing information dissemination to keep concerned parties informed at key points. b. Give continuing support. — Participate actively in reviews and key decisions. — Foster a good working relationship among the sponsor, program manager, other top management, and contracting community. c. Secure support of key external organizations—OMB, GSA's Information Resources Management Service (IRMS), and key congressional committees, depending on the size of the acquisition.
3. Identify functional or end users and secure their involvement in project.	3. Acquisition planning should encourage active user involvement. a. Actively involve users in project team and in periodic reviews. b. Have users validate requirements and solutions when developed. c. Develop a review mechanism where users analyze system performance for the life of the project.
4. Secure funds to support initial activities.	4. Initial funds must be justified and made available.
5. Establish project organization and designate program manager.	5. The organization, to be effective, should have: a. Management structure. — A single program manager (PM), trained in information technology acquisition matters, who is authorized, responsible, and accountable for the acquisition through implementation.

Process	Critical Factors
	— A PM with sufficient authority over the acquisition and access to senior agency officials. The PM should manage program funds and have input in the budgetary process. b. Adequate and skilled staff with clear roles; if necessary, provide staff through a support contract. — Contracting officer and personnel experienced in information technology acquisition. — Staff experienced in managing contractor or in-house personnel performance. — Staff experienced in relevant technology. — User representative knowledgeable of user needs and concerns. c. Independent officials, including certifying official, counsel, and auditors. — Certifying official to ensure that adequate security controls are built into the system. — Counsel to provide necessary legal assistance. — Auditors to provide independent and objective perspectives on internal controls.
Analyze Requirements 6. Perform requirements analysis to support need; consider functions to be automated or processes to be restructured, nature of the data to be processed, present and projected work load, length of system life and performance and capability validation techniques to be used.	6. Requirements analysis should: a. Define information needs on the basis of the agency's strategic information plan, and current agency data bases and information architectures.

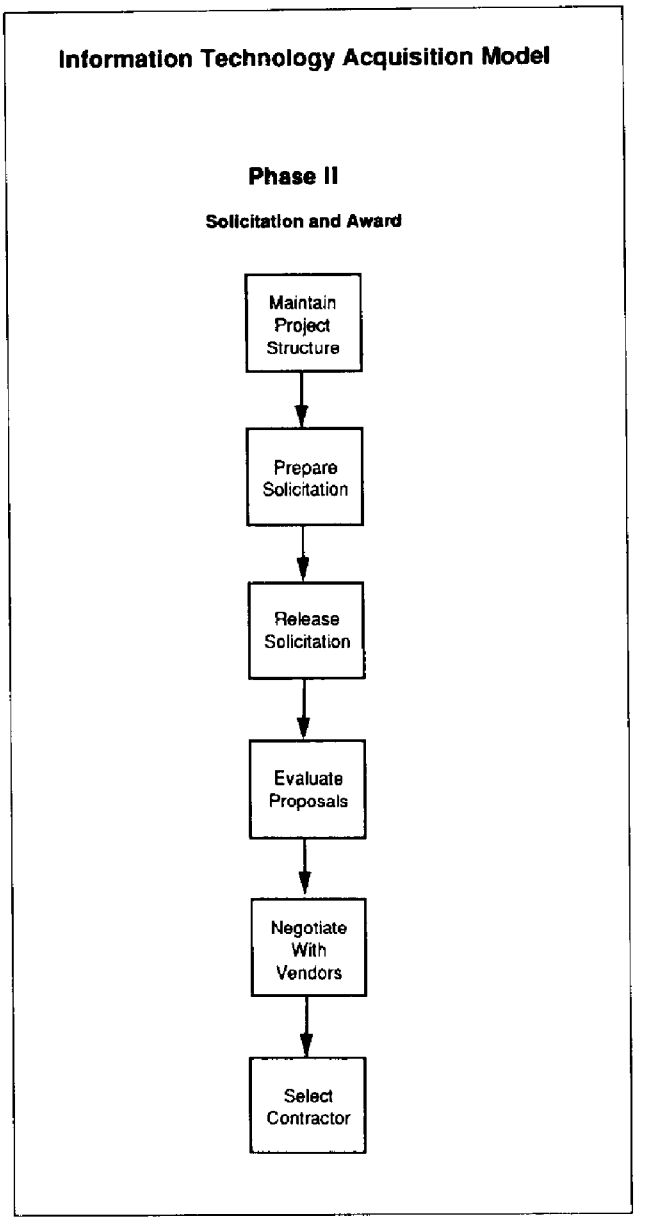
Process	Critical Factors
a. Identify and document existing system functions that the new technology must perform.	b. Include organizational needs, such as training and security requirements.
b. Specify requirements for interfacing with existing technology.	c. Define user validation methodology.
c. Identify the standards with which the new technology must comply.	d. State needs in functional or performance terms to maximum extent practical, with consideration of full and open competition.
	e. Establish minimum mandatory requirements versus would-like-to-have features.
	f. Select performance validation techniques to ensure the system has sufficient capacity.
	g. Establish a formal change control process to be used throughout the acquisition. However, the core of basic requirements should be kept stable to maintain project scope.
	h. Eliminate unduly restrictive requirements in order to promote competition.

Process	Critical Factors
Identify Alternatives for Meeting Requirements	
7. Identify alternatives for meeting requirements. a. Determine whether the technology exists to meet the agency's needs. b. Evaluate the choice of commercial off-the-shelf resources or custom development. c. Identify any resources owned by the government that may meet the needs. d. Identify GSA or agency mandatory contracts that may apply. e. Identify opportunities for prototyping to test the system concept with users. f. Conduct market research, including active industry participation, to determine if needs can be met. g. Prepare risk analyses of the project (e.g., staff and turnover, cost, and technical considerations) and of security.	7. Reviews with user involvement should be conducted to validate alternatives against original requirements. a. Review results of similar acquisitions and of protest decisions. b. Involve contracting officer in alternatives analysis to ensure that a feasible acquisition approach is selected. c. Ensure that the range of alternatives is not unnecessarily restricted by resource assumptions. d. Obtain management approval and agreement with end users on the alternative selected. e. Determine whether the alternatives considered fit within the agency's information architecture. f. Ensure that risk analysis is in accordance with government standards.
8. Prepare an economic analysis of costs and benefits for each viable alternative.	8. Quantify costs and benefits of reasonable alternatives.

Process	Critical Factors
9. Choose most advantageous alternative and prepare budget requests to secure necessary funding.	9. Establish an appropriate and affordable scope for the project based on economic and risk analyses. Have users and senior managers approve changes to the scope. Balance benefits with risk of failure. a. Control risk in the selection of hardware and software to be bought or developed. Assess feasibility, funding, etc., of acquisition strategies. b. Use appropriate standards and development methodologies.
 **Prepare Acquisition Plan**	
10. Initiate acquisition plan, incorporating strategy for managing the acquisition, preaward, and postaward. The acquisition plan should describe the following: objectives; cost goals; responsible decisionmakers; capability or performance characteristics; risks associated with technical matters, scheduling, and costs; plan of action; competition; source-selection procedures; contract type and any special contract provisions; contract management procedures or organization; budget and funding; information needed to monitor contractor performance; test and evaluation; security and privacy; and acquisition milestones. The plan should also identify the acquisition method, key "go/no-go" points, a formal training plan, and a contingency plan to minimize losses.	10. Acquisition strategy should: a. Plan for full and open competition unless a noncompetitive or a limited competition has been justified and approved. b. Plan to demonstrate results during the tenure of key managers. Seriously consider organizing the acquisition in modules rather than a grand design to ensure accountability and control risk. c. Establish effective project management tools and techniques to track progress against the acquisition plan, and take action if delay occurs. d. Establish realistic schedules for the planned source-selection process and document.
 **Prepare Specifications**	
11. Prepare functional specifications based on requirements:	11. Develop specifications consistent with requirements and approved acquisition strategy:

Process	Critical Factors
a. Supplement functional specifications with equipment characteristics and performance elements if necessary and justifiable. b. Identify performance evaluation requirements to demonstrate system capability. c. Fully justify and document any restrictive specifications based on the requirements analysis.	a. Involve functional users in validating the specifications. b. Define specifications that do not preclude the latest advances in technology. c. Generate specifications that are aimed at developing a system that is simple to operate and maintain. d. Use full and open competition unless necessary restrictions are justified and approved.
12. Submit Agency Procurement Request to General Services Administration, if needed.	12. Reflect the acquisition strategy in the Agency Procurement Request.
13. If appropriate, release draft specifications and acceptance criteria internally for end user feedback and externally for industry comments. Revise, as necessary, on the basis of comments.	13. Validate specifications, terms and conditions, and performance evaluation plan prior to developing solicitation document. Validate specifications against requirements continually, on the basis of feedback from users and industry. Account for all comments and questions.
14. Develop acceptance test plans, security test plans, and certification requirements.	14. Base test plans on user-furnished acceptance criteria. a. Develop acceptance plans to determine whether mandatory requirements have been met. b. Develop security test plans for identifying security requirements arising from governmental policy, agency mission needs, and specific user needs. Develop certification requirements for establishing the extent to which the security requirements have been met.

Phase II: Solicitation and Award



II. Solicitation and Award

Process	Critical Factors
Maintain Project Structure	
1. Maintain the project by continuing to: a. Obtain the support of management officials, including the Source Selection Authority. b. Maintain project management and staff through a formal succession and turnover plan. c. Involve users in preparing the solicitation and awarding the contract. d. Obtain needed funds through the budget process.	1. Provide for continuing involvement of management, staff, and users. Internal management should: a. Support the project, provide required resources, participate in reviews and key decisions, and foster good working relationships among the key players. b. Coordinate an agreement between the program (user), technical, and contracting offices in developing the evaluation and source selection plans and gaining their acceptance of the evaluation process and criteria. c. Maintain the organizational continuity of the management structure and the technical, contracting, and auditing staff. d. Provide funding commitments for the near term and the long term, and inform Congress periodically. Users should: a. Remain active in the acquisition.

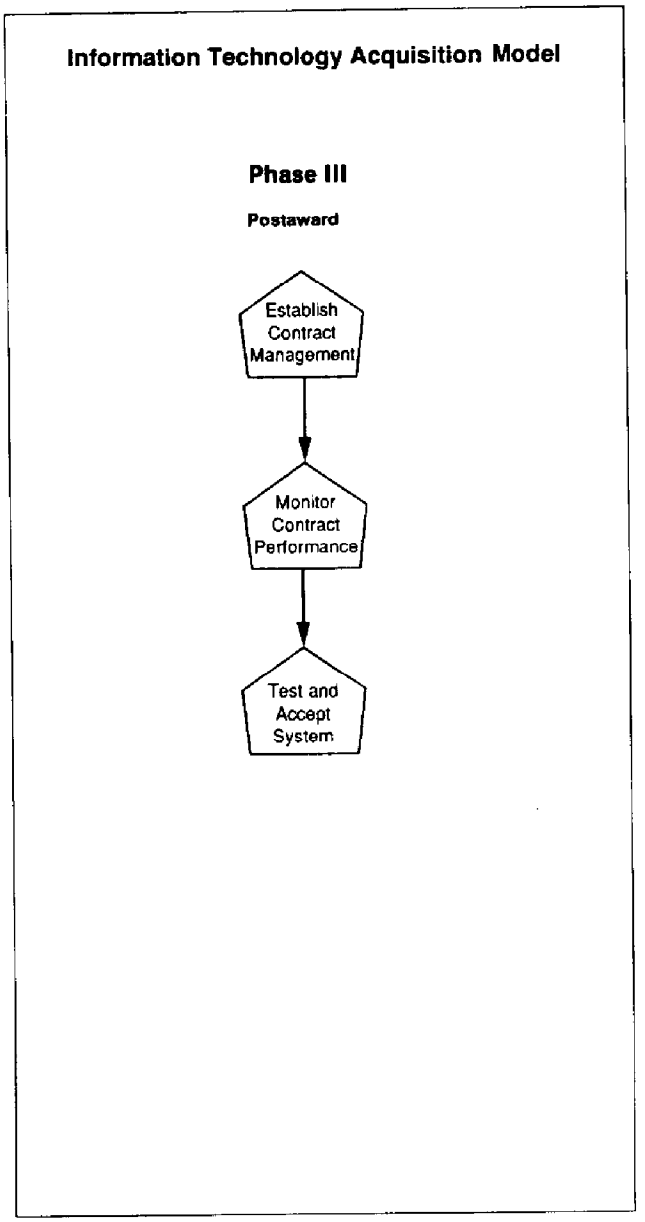
Process	Critical Factors
Prepare Solicitation	
2. Prepare solicitation document (Request for Proposals or Invitation for Bids) including, but not limited to: statement of work to be done, interoperability requirements, evaluation criteria (including relative importance of technical and cost factors), software and data rights, mandatory standards, proposed quality assurance plans, technology upgrades, warranties, training needs, milestones, management controls and reviews, security and privacy considerations, deliverables, delivery schedule, and acceptance payment criteria. a. Prepare performance evaluation package (benchmarks or other capability and performance validation measures to be used) to be released with the solicitation. b. Prepare source-selection plan for evaluating competing proposals and selecting the contractor. The plan should include a provision that ensures coordination among team members, the PM, the program sponsor, and the various oversight panels and councils. It should be approved by the Source-Selection Authority.	2. Solicitation document should: a. Identify the relative importance of evaluation factors. It should also define all deliverables and the conditions of acceptability. b. Include in the evaluation criteria all factors to be considered in evaluating offers. These factors should be consistent with the requirements analysis, specifications, and proposal preparation instructions. c. Identify all applicable government and contractor responsibilities. d. Include provisions to protect the agency or to give incentives to contractors. e. Separate the cost and technical elements of the proposal.

Process	Critical Factors
Release Solicitation	
3. If appropriate, release draft solicitation and performance evaluation package. Hold prebid or preproposal conference to seek industry views on the solicitation documents and ways to mitigate technical, cost, and schedule risks. (Ensure the discussions are focused on the problems to be solved and do not become forums for vendors to present their product lines.) Revise solicitation, if necessary, on the basis of comments and questions (consulting users to get agreement on changes to requirements). Publish a statement of agency architecture in general terms to avoid restricting competition. This statement should include such things as information technology goals and plans, and the basis for technical and nontechnical standards. It should also encourage the use of proven technology.	3. Secure feedback from industry to identify concerns with the solicitation document and to determine what is available in the market. a. Promptly respond to industry requests for clarification, change, etc. b. Use an ombudsman, if necessary, to respond to and address vendor concerns, disputes, and grievances.
4. Secure agency approval for release of solicitation.	4. If a delegation of procurement authority is required, ensure that it is received before releasing the solicitation document.
5. Publicize proposed contracting actions.	
6. Issue solicitation and performance evaluation package. a. Establish a process to resolve vendor complaints. b. Receive proposals or bids.	
7. Amend request for proposals, as needed, in a timely manner.	

Process	Critical Factors
Evaluate Proposals or Bids	
8. Evaluate proposals or bids in accordance with the source-selection plan. Include an evaluation of contractor capability and risk. a. Establish the competitive range of proposals. b. Use a benchmark, live test demonstration, or operational capability demonstration as required in the solicitation.	8. Maintain strict adherence to the publicized evaluation process and criteria in the solicitation, and keep cost and technical evaluations separate. Document evaluation process, including establishment of competitive range. a. Obtain approval from the Source Selection Authority to remove offerors from further consideration.
Negotiate With Vendors	
9. Negotiate with vendors unless acquisition is based on sealed bids.	9. Maintain security of negotiation and award process, and assure that meaningful discussions are held with all in the competitive range. Avoid technical transfusion and leveling. Reconcile life cycle cost.
10. Solicit and evaluate Best and Final Offers in accordance with the source-selection plan. a. Prepare debriefing plan. Anticipate issues that may cause concern and complaints.	10. Avoid multiple calls for Best and Final Offers. The need to ask for multiple Best and Final Offers should be approved at a level above the contracting officer.

Process	Critical Factors
Select Contractor for Award	
11. Award contract.	
12. Meet with losing vendors after award, for debriefing.	12. A debriefing is required, if requested, when a contract is awarded on a basis other than price alone. a. Schedule the debriefing as soon as possible. b. Discuss the basis for the selection decision, including the government's evaluation of significantly weak or deficient factors in the proposal. Point-by-point comparisons with other offerors' proposals are not allowed. c. Document the debriefing.
13. Conduct lessons learned.	13. Compare preaward activities to the acquisition plans to identify lessons learned.

Phase III: Postaward



III. Postaward

Process	Critical Factors
Establish Contract Management Structure	
1. With the support of management officials: a. Select certain key members from the earlier project team to provide continuity of previously involved users, project management, and project staff. Identify contracting officer's representative, as necessary. b. Obtain needed funds through the budget process to perform contract management.	1. Provide for continuing involvement of management, staff, and users. Internal management should: a. Support the project by providing required resources, actively participating in reviews and key decisions, and fostering good working relationships among the key players. Also, management must certify that adequate security controls were built into the system. b. Coordinate an agreement between the program (user), technical, and contracting offices for managing the contract. c. Maintain the organizational continuity of the management structure and the technical and contracting staff. d. Provide funding commitments for both the near and long terms. e. Periodically inform the Congress of project status. Users should: a. Continue to be directly involved in the acquisition during the installation, test, and acceptance period.

Process	Critical Factors
Monitor Contract Performance	
2. Implement contract management provisions of the contract. Monitor contractor performance through periodic reports and inspections. a. Analyze status and cost reports from the contractor as called for in the contract and any other management indicator to facilitate project management. b. Conduct in-process reviews of prototypes and incremental system deliverables (modules). c. Implement configuration management procedures, including change controls and configuration audits. d. Assure that milestones are met and that the contractor performs in a timely manner.	2. Establish an effective working relationship with the contractor and monitor contractor performance. a. Require contractor to have an adequate quality assurance process in place. b. Rigorously control changes and integrate this process into the project management structure. c. Ensure that corrections are made, awards are implemented, and damages assessed, as appropriate.
3. Modify contract, if necessary, monitoring contract changes with regard to cost, time frames, and deliverables.	3. Maintain effective process for controlling contract modifications. a. Ensure that changes are within the scope of the contract.

Process	Critical Factors
Test and Accept System	
4. Perform system tests and evaluations with user involvement on the basis of test plans.	4. Validate that the new system is integrated into the existing environment.
5. Identify any requirements that are not met by delivered hardware, software, telecommunications, or services.	
6. Accept contract deliverables or ensure that deficiencies are resolved.	6. In transition from contracting to maintenance, address supply support, maintenance procedures, and training.
7. Maintain system documentation or ensure that contractor maintains documentation.	7. Keep current and complete documentation to facilitate system maintainability.
8. Make periodic payments contingent on acceptance criteria.	
9. Analyze the acquired system periodically for degradation, obsolescence, augmentation, or replacement.	9. Conduct a postimplementation audit to assess the benefits achieved versus the original goals of the acquisition.

Appendix

Major GAO Contributors to This Publication

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Questionnaire*

Request:	We are interested in knowing how useful this model is in helping acquisition managers acquire information technology. We would also appreciate any comments and suggestions you may have on ways to improve the model. Please take the time to respond using this tear sheet. A prestamped return envelope is included for your convenience.

1. How do you rate this document's job-related usefulness?

	Little or no usefulness	Moderate usefulness	Substantial usefulness
Process steps			
Critical factors			
Document as a whole			

(continued)

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2. Has the document been useful in fulfilling your responsibilities in acquiring information technology? If so, please explain.

3. What suggestions do you have for improving this document?

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