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management advisory services

GUIDELINE SERIES NUMBER 4

**Guidelines for Development and
Implementation of Computer-Based
Application Systems**

NOTICE TO READERS

Management Advisory Services guidelines are published to assist members in carrying out various types of services. This publication, *Guidelines for Development and Implementation of Computer-Based Application Systems*, was developed by the EDP Applications Systems Design Task Force and approved for publication by the Management Advisory Services Executive Committee.

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GUIDELINE SERIES NUMBER 4

Guidelines for Development and
Implementation of Computer-Based
Application Systems

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Guidelines for Development and Implementation of Computer-Based Application Systems

Introduction

Purpose of These Guidelines

These guidelines present a step-by-step approach to a management advisory services (MAS) engagement for the development and implementation of an EDP application system. Their primary purpose is to assist the MAS practitioner in planning and conducting such engagements.

The guidelines are procedural rather than technical—explaining *what to do*, not *how to do it*. Accordingly, these guidelines will be most useful to the practitioner already technically proficient in the EDP field in that they will guide him in the systematic application of technical skills to a client's situation.

The guidelines will also be helpful to CPAs who depend on specialized partners or associates for technical EDP expertise but who themselves remain involved in and responsible for the overall success of the engagement. For these CPAs the guidelines provide a means of effectively participating in the administrative planning and control of EDP engagements and assessing their progress.

While all the tasks enumerated may not apply to each engagement, together they can constitute a checklist for systematically

evaluating both the work plan and subsequent adherence to it. In evaluating the work plan, the practitioner will want to know (1) whether each listed task is to be done; (2) if so, by whom, when, and how; and (3) if not, why not.

A similar line of inquiry will be helpful in assessing the engagement's progress in relation to the plan and in reviewing the documentary outputs of each task. The guidelines are intentionally presented in a format that can be used for indexing the workpapers of an EDP design engagement. This workpaper indexing will further facilitate monitoring of an EDP engagement by a partner who is not a participant in its day-to-day conduct.

Though developed specifically to assist the MAS practice within CPA firms, the guidelines will be useful to any executive responsible for designing and installing EDP systems. When a CPA is called on for assistance, the guidelines will help an executive understand, appreciate, and coordinate with the CPA's orderly and systematic approach. When a CPA is not involved, the guidelines should help the executive in planning and evaluating the efforts of his own staff.

Flexibility

This publication presents guidelines—not standards—developed by a knowledgeable and experienced task force of senior MAS practitioners. The guidelines illustrate one way of structuring an EDP engagement; they do not prescribe the *only* way of doing so. The task force fully recognizes the existence of other valid and effective approaches to the design of EDP systems. These guidelines are not intended to supersede these approaches or inhibit their further development. Instead, the guidelines are presented as an aid to practitioners who have not yet developed and fully refined their own structured approaches to the design and installation of EDP application systems. CPAs should recognize that the guidelines are flexible and modular in their application. Examples of the required flexibility are given in the following paragraphs.

Size of System. These generalized guidelines are intended for engagements involving applications of varying complexity and computer installations of all sizes. In a particularly large-scale environment, the number of discrete tasks required may exceed those listed in this publication. In a smaller and less complex environment, many of the tasks may be combined or resequenced.

Engagement Span. In general, the guidelines cover the entire design and implementation process. However, a typical engagement may start and stop at any of the phases, or within one of these phases. In a broad-span engagement a practitioner may agree that his client will undertake certain tasks or phases without assistance. Such factors can affect the nature, sequencing, and assignment of tasks.

Other Factors. Another factor which could make it necessary to combine or resequence certain tasks, or alternatively to “explode” a single task into a series of separate steps, is the placement of the proposal preparation step(s). To avoid repetition, the proposal (or engagement letter) is mentioned only once in the guidelines (task I-5 on page 12), although many situations will involve a series of separate agreements between the CPA and the client. The first of these agreements can precede task I-1.

Phases I, II, and III illustrate possible combinations of tasks which can result from such factors. Each of these phases deals with similar activities, but they are accomplished in progressively greater depth and detail. For example, consider these three tasks—

- I – 17. Develop conceptual system flows and gross cost approximations for alternative solutions.
- II – 25. Prepare comparative analysis of system design alternative(s).
- III – 41. Refine project cost estimates and estimated completion dates.

When the most desirable system design alternative is immediately apparent, for the sake of efficiency these tasks may be combined into one, or the first three phases may even be compressed into one concise phase.

Applicability to Non-EDP System Design

A practitioner may undertake a system design engagement without knowing whether the ultimate solution will involve EDP. The guidelines, with minor modifications, can also be helpful in other types of system development work. Certain tasks, such as those dealing with programming, will be eliminated completely; others will be modified. In a non-EDP environment these guidelines should be used as a checklist, asking, for each task, (1) whether it should be done; (2) if so by whom, when, and how; and (3) if not, why not.

System Controls

A vital aspect of all systems development activity is the provision of adequate accounting and system controls and audit trails within the system design. This aspect becomes more complex and, therefore, more crucial as the size and sophistication of a system increases. The importance of system controls is considered by many to play a strong role in management's selection of CPA firms for assistance in system development.

Accordingly, it would be appropriate to include in each of the nine "Phase Objectives and Commentary" sections a specific reference to ensuring adequate controls. However, in order to avoid repetition, this is mentioned, with strong emphasis, just once and with the admonition that control consciousness must pervade all phases of an EDP system development activity—particularly in the design phases and the post-implementation evaluation. Direct participation of internal and/or external auditors in these phases is often desirable.

Organization of These Guidelines

These guidelines consist of the following sections—

1. Introduction
2. System Development Phases
3. Checklist of System Development Tasks
4. Network of System Development Tasks
5. System Development Task Outputs

Each section deals with essentially the same basic materials, but in varying degrees of detail, and often from different perspectives. The paragraphs that follow indicate the purpose and suggested use of each section.

System Development Phases. The principal use of this summary of the nine phases of an application system development project is in the overall "scoping" of a proposed project and in identifying the starting and finishing points and selected target dates in between. The list of phases can also be used in exploratory conversations with a client about the various phases of a system development project.

The list is followed by a statement of each phase's objectives and comments on possible pitfalls and points requiring particular emphasis. The principal use of the objectives and commentary

material is to convey a broad understanding of the overall phase structure and the contents of any particular phase.

Checklist of System Development Tasks. The checklist is a listing of the specific tasks involved in each phase. This list can be used to develop and evaluate a work program for a specific engagement, estimate costs, monitor the engagement's progress, and organize the engagement's workpapers. A planning sheet, see page 17, can be helpful in planning an engagement and estimating its cost.

Network of System Development Tasks. The network presents the tasks in graphic form, illustrates sequential dependencies of particular tasks, and identifies the tasks by type: planning tasks; activity tasks; and approval or milestone tasks. (Some tasks may include both planning and activity aspects; in these cases the indicated distinction is arbitrary.) Its primary purpose is to convey a more detailed understanding of the phase structure and to facilitate the planning and control of an engagement.

System Development Task Outputs. The task outputs illustrate the tangible work products of each task and identify the purpose of each. While specific task outputs may vary from one engagement to another and therefore have to be tailored for each particular engagement, it is advisable to target a specific output at the time an engagement is planned. This approach assists in estimating the required resources and discourages digressions by the assigned personnel. The output listing can be used to review an engagement's progress and evaluate its orderly completion in accordance with the work plan. It can also be valuable in organizing workpapers.

System Development Phases

List of Phases

The application system development and implementation process is structured into nine phases of activity, any or all of which may be included within an MAS engagement. The phases are as follows:

- I—Requirements Definition and Alternative Approaches
- II—General Systems Design
- III—Detail Systems Design
- IV—Program Specifications and Implementation Planning
- V—Programming and Testing
- VI—Systems Testing
- VII—Conversion and Volume Testing (Note: Volume Testing is sometimes known as Final Testing.)
- VIII—Implementation
- IX—Post-Implementation Evaluation

The following phase definitions can assist the MAS practitioner in identifying for a client the scope and limits of the practitioner's activities in any specific engagement, and in defining the areas of responsibility to be assumed by client personnel.

Phase Objectives and Commentary

Phase 1—Requirements Definition and Alternative Approaches

The principal objectives of Phase I are—

- to provide a clear statement of the application system's overall objectives and requirements.
- to conduct and document a broad study of the existing business systems for attaining those objectives.
- to establish a work program for identifying and developing the new system, and to estimate the required resources.
- to identify, and tentatively evaluate, broad alternative approaches, their preliminary conceptual design, and the feasibility of each.

Commentary. Preliminary research, before the start of field work, is very helpful for this phase. This can include library and other “public record” research into the industry and the client; reviews of available management letters, reports, or workpapers; and conversation with personnel who have served the same client.

Particular care is required in identifying and communicating the proposed work program. The program’s deliverable products and acceptance criteria should be specified. The mutual responsibilities of the MAS practitioner and the client should be detailed, emphasizing that time and cost targets are directly dependent on timely and competent performance by both parties.

This phase should provide a clear definition of scope, approach, and work to be done in future phases. The following points should be covered whenever applicable.

1. Standards for documentation, programming, system organization, and the like.
2. Potential impacts on interfacing systems, and the responsibility for providing for these impacts.
3. Preliminary estimates of future client requirements, including personnel, equipment, and other resources needed for systems and procedures development, programming, conversion, and operation.

This phase provides a feasibility report of the proposed alternative approaches for evaluation by client management. During Phase I it is important for the practitioner to get high level management personnel involved in reviewing the expected outputs of the project. Management involvement here will help ensure ultimate success of the system development project.

Phase II – General Systems Design

The principal objectives of Phase II are—

- to develop functional specifications of the application system requirements.
- to consider alternatives and estimate the development and operating resources required for each.
- to establish the general work flow, information requirements, costs, benefits, and limitations of each probable alternative.
- to evaluate the alternatives and develop a specific proposal for implementing the recommended alternative.

Commentary. Most of the engagement fact finding is done in this phase, and the specifications developed will be used as a

keystone reference throughout the development process. A high degree of accuracy and detail is required. Workpapers should be organized systematically to accommodate frequent reference and should include specific documentation of rejected alternatives, with the reasons for rejection.

In considering alternatives, particular attention must be given to the client's capability to implement the selected system, as evidenced by personnel skills available and the level of sophistication in present application systems.

Phase III – Detail Systems Design

The principal objectives of Phase III are—

- to design the application system/subsystem structure, interfaces, and EDP environment.
- to establish the file, input, output, processing, control, and resource requirements.
- to develop plans, schedules, and time and cost estimates for programming, conversion, and training.

Commentary. This phase includes a significant, and sometimes difficult, transition in orientation—from a conceptual system definition to an operational system structure. Particular attention should be given to the following:

1. Arrange for frequent in-depth reviews, by the engagement partner or manager, to continually evaluate the suitability and completeness of the system design.
2. Include system controls as an integral part of the design, and provide for auditability.
3. Install effective system and programming change control procedures.
4. Seek and obtain adequate client participation in the systems design approach; in the design and acceptance of forms, files, and operational procedures; and in the selection of equipment and software.
5. Avoid an overly complex design in order to facilitate the system's maintenance, flexibility, and growth.

Phase IV – Program Specifications and Implementation Planning

The principal objectives of Phase IV are—

- to develop detailed programming specifications consistent with applicable client standards.
- to prepare test plans.
- to plan for implementation.

Commentary. In this phase, client personnel become more involved in the project. Special attention should be given to the transition of the practitioner's role from a doer to a monitor.

At this point careful and continuing evaluation of developing program specifications can provide a reliable basis for program development in the next phase. Since some MAS engagements may have client personnel performing the major part of this task, engagement management should review the work accomplished in this phase with particular care.

Phase V – Programming and Testing

The principal objective of Phase V is to produce programs that are both unit tested and integration (string) tested.

Commentary. The development of effective program test procedures requires active participation of the user, the practitioner, data processing personnel, and internal and external auditors.

The following are some of this phase's common pitfalls.

1. Conformance to the original functional specifications is not adequately observed.
2. Conformance to programming standards and conventions is not observed.
3. Program documentation is deferred.
4. Schedule compliance is lost, usually in such a way that almost all of the programs are completed, but the whole project is delayed by those which are not.
5. Systems testing is started before unit testing is complete.
6. The opportunity to reevaluate the projected timing, scheduling, operating characteristics, and resource requirements, on the basis of test results, is overlooked.

Phase VI – Systems Testing

The principal objectives of Phase VI are—

- to finalize sets of programs that when processed together interface properly to constitute a single integrated system.
- to test the system thoroughly, evaluating the test results with users to assure compliance with both specifications and current requirements.
- to obtain the user's acceptance.

Commentary. It is important to involve the user in the development of comprehensive test data including normal trans-

actions as well as unusual error conditions.

Preparation for final testing, and the tests themselves, should both include an evaluation of the adequacy of the computer resources available for testing and operation.

A serious pitfall is to delay some systems testing until conversion and implementation—at which time system faults will be far more difficult to correct.

Phase VII – Conversion and Volume Testing

(Note: Volume Testing is sometimes known as Final Testing.)

The principal objectives of Phase VII are—

- to complete and validate the appropriateness of system documentation and training materials.
- to convert and verify files and data.
- to perform volume or final testing, and to obtain the user's approval.

Commentary. This phase presents the final opportunity for pre-implementation assessment and adjustment of the system's operating characteristics, timing, data flow, and overall functioning. Volume (or final) testing will usually include the use of converted master file data either by parallel processing or in a simulation of the live environment.

Phase VIII – Implementation

The principal objectives of Phase VIII are—

- to ensure adequacy of user training.
- to start system operation and to review results.
- to effect any required changes in the system, programs, and documentation.
- to turn over system to user.

Commentary. The MAS practitioner should obtain the user's formal written acceptance of the system, specifically acknowledging that the user has full responsibility for its operation and maintenance.

Phase IX – Post-Implementation Evaluation

The principal objective of Phase IX is to review the system in operation, relating it to the original objectives and subsequent modifications, with emphasis on costs, benefits, and controls.

Commentary. In reviewing the application system in relation to its original objectives, the impact of changes in the business environment and in the client's circumstances should be recognized.

It is normally advantageous to defer minor maintenance and extensions of the system until after this evaluation, so that such changes can be undertaken as a single integrated effort. This evaluation commonly takes place at least six months after implementation.

The participation of internal and external auditors is advisable in this phase, especially with respect to controls.

Checklist of System Development Tasks

Phase I—Requirements Definition and Alternative Approaches

1. Identify the problem or new requirements in their present or future context.
2. Define project objectives, scope, and approach.
3. Define the time/priority elements.
4. Evaluate consistency with and impact on the organization's long range planning.
5. Prepare proposal.
6. Establish project control system.
7. Study system flow and existing documentation, noting discrepancies.
8. Determine present volumes.
9. Cost out present system.
10. Identify any external influences and constraints including other system interfaces.
11. Define advantages and disadvantages of existing business system.
12. Start development of specialized glossary if terminology is unique to this industry or the system.
13. Prepare analysis of existing system.
14. Determine system requirements.
15. Develop criteria for evaluating business system alternatives.
16. Identify alternative solutions.
17. Develop conceptual system flows and gross cost approximations for alternative solutions.
18. Present recommendations to management, reviewing available alternatives and estimated requirements of the recommended program.
19. Obtain authorization to continue, to rework, or to terminate.

Phase II—General Systems Design

20. Define systems requirements in greater detail.
21. Prepare general work flow of the application system design and EDP design alternative(s).
22. Identify any special conversion considerations required for the EDP design alternative(s).
23. Determine equipment, personnel, utility software, outside service, and other resources necessary to implement, convert, operate, and maintain the EDP design alternative(s).
24. Determine the benefits and limitations of each EDP design alternative.
25. Prepare comparative analysis of EDP design alternative(s).
26. Present recommendations to management and obtain authorization either to continue with detailed systems design of selected EDP design alternative, to rework, or to terminate.

Phase III—Detail Systems Design

27. Prepare statement of unique conventions, standards, and restrictions to be observed in the design and programming of the system.
28. Design report formats and identify medium.
29. Design input formats and identify medium.
30. Design files.
31. Develop system and subsystem processing flow and interfaces with other existing systems.
32. Establish processing cycle and estimate computer resource requirements.
33. Define and establish control procedures.
34. Confirm design of input, output, and processing with all affected personnel.
35. Determine conversion requirements.
36. Develop conversion plan.
37. Define system backup and recovery requirements.
38. Confirm conversion and backup/recovery procedures with all affected personnel.
39. Identify program modules and EDP processing flow.
40. Prepare programming schedule.
41. Refine project cost estimates and estimated completion dates.

42. Plan for client staff training.
43. Prepare conversion budget.
44. Refine cost/benefit analysis.
45. Present detailed systems design and implementation budget to management and obtain approval; or terminate.

Phase IV—Program Specifications and Implementation Planning

46. Prepare test plans.
47. Place orders for preprinted forms and any required hardware and purchased software.
48. Arrange for any required programming staff training.
49. Develop outlines for user, operations, and systems and programming manuals.
50. Prepare detailed specifications for common modules, modifications to existing programs, conversion or file creation programs, and new programs.
51. Identify precoding and coding tasks.
52. Evaluate programming specifications with management and obtain approval.

Phase V—Programming and Testing

53. Finalize program logic.
54. Code, desk check, and compile programs.
55. Develop program test procedures.
56. Develop program test data.
57. Test programs.

Phase VI—Systems Testing

58. Prepare procedures for data collection for systems test.
59. Prepare systems test master files.
60. Prepare systems test transaction data and expected results, with user participation.
61. Review operations manual and documentation with computer operations and control personnel.

62. Perform systems test and analyze results.
63. Review test results with personnel affected.
64. Correct systems test problems, re-test, and review.

Phase VII—Conversion and Volume Testing

(Note: Volume Testing is sometimes known as Final Testing.)

65. Review conversion responsibilities, criteria, and objectives, and finalize conversion plan.
66. Prepare procedures for data collection for new files.
67. Prepare preliminary user training procedures.
68. Process file conversion programs and check results with user.
69. Develop user manuals.
70. Complete the computer operations documentation.
71. Develop user training materials.
72. Perform volume test on system.
73. Review test results with personnel affected and obtain approval.

Phase VIII—Implementation

74. Prepare final implementation plan and schedule.
75. Complete user training.
76. Review implementation plan and schedule with user and operations.
77. Revise implementation plan and schedule as required.
78. Start system operation according to implementation plan and schedule.
79. Evaluate early results with user.
80. Identify and authorize necessary adjustments and program revisions to fine-tune system.
81. Make changes in system design, programs, and documentation; and complete the systems and programming manual.
82. Turn over system to user and obtain acceptance.

Phase IX—Post-Implementation Evaluation

83. Review actual system performance and schedules.
84. Evaluate system documentation.

85. Evaluate system to determine whether user requirements are being met.
86. Reevaluate cost/benefit effectiveness.
87. Prepare and present report to management—
 - evaluation summary,
 - recommendations, and
 - suggestions for improvement.

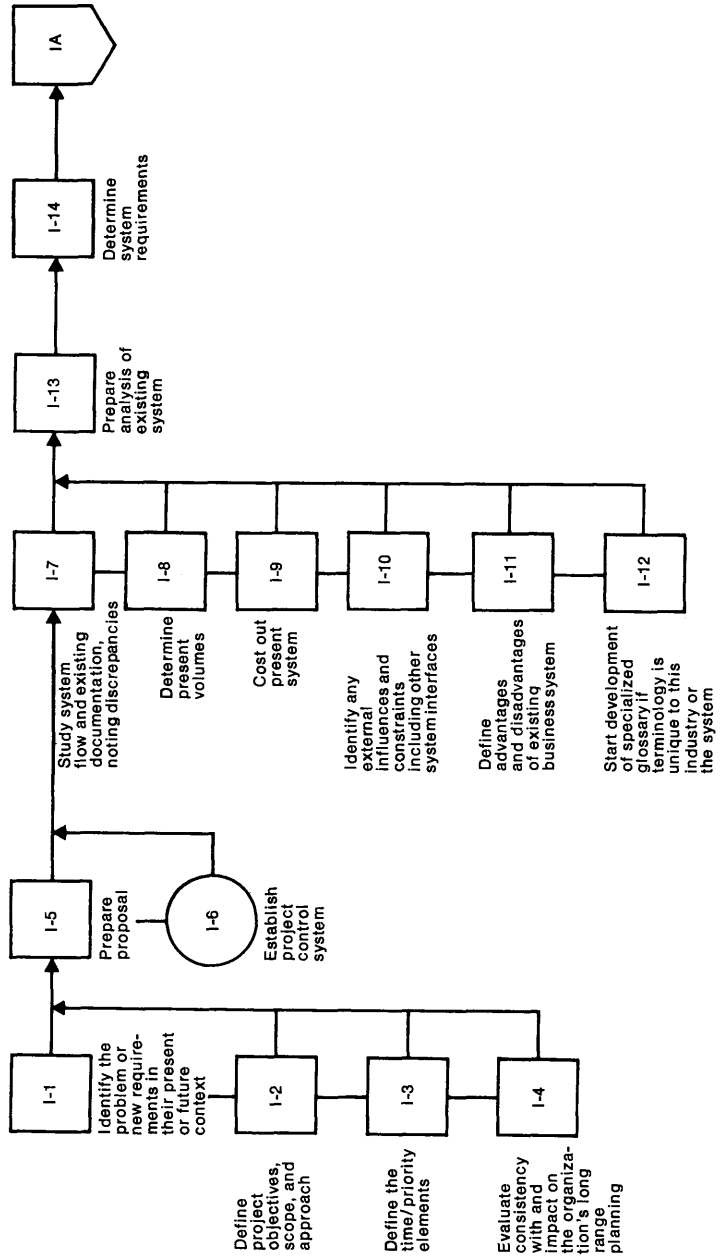
Illustrative Planning Sheet

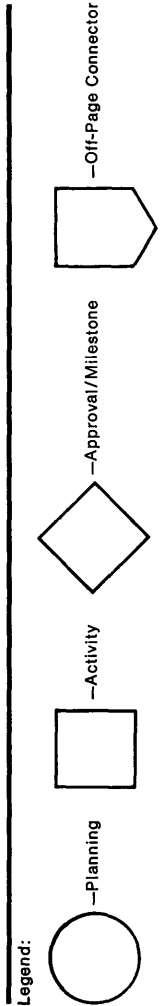
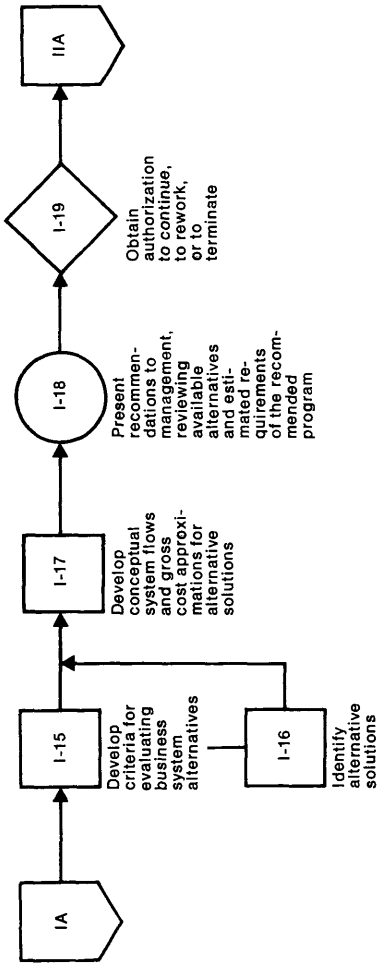
PHASE/Task	TIME (Days or Hours)						DATES	Workpaper Reference
	Management		Staff		Client			
	N	T	N	T	N	T		
1. REQUIREMENTS DEFINITION AND ALTERNATIVE APPROACHES								
1. Identify the problem or new requirements in their present or future context								
2. Define project objectives, scope, and approach								
3. Define the time/priority elements								
4. Evaluate consistency with and impact on the organization's long range planning								
5. Prepare proposal								
6. Establish project control system								
7. Study system flow and existing documentation, noting discrepancies								
8. Determine present volumes								

N = Name.
T = Time (in days or hours).

Network of System Development Tasks

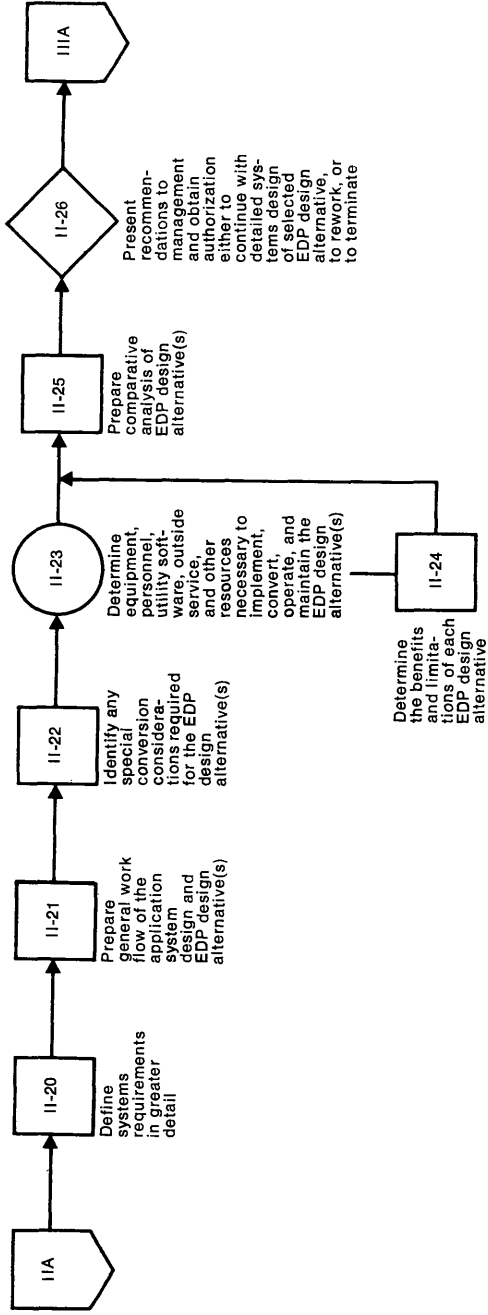
Phase I—Requirements Definition and Alternative Approaches



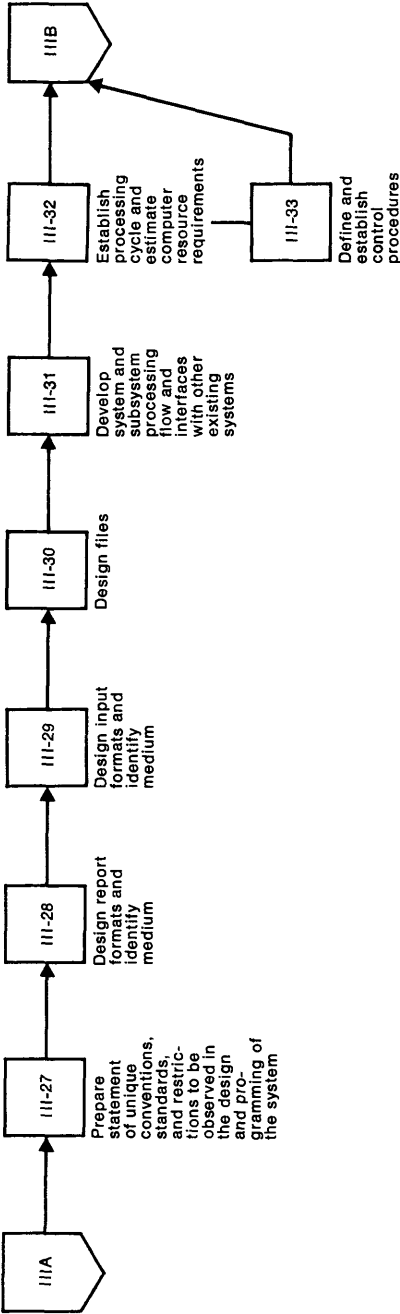


Network of System Development Tasks

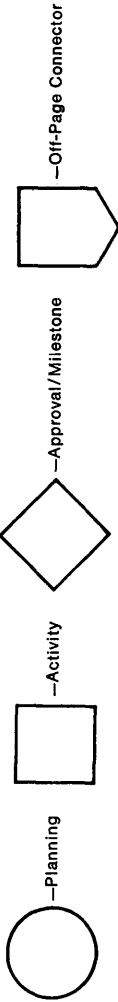
Phase II—General Systems Design



Phase III—Detail Systems Design

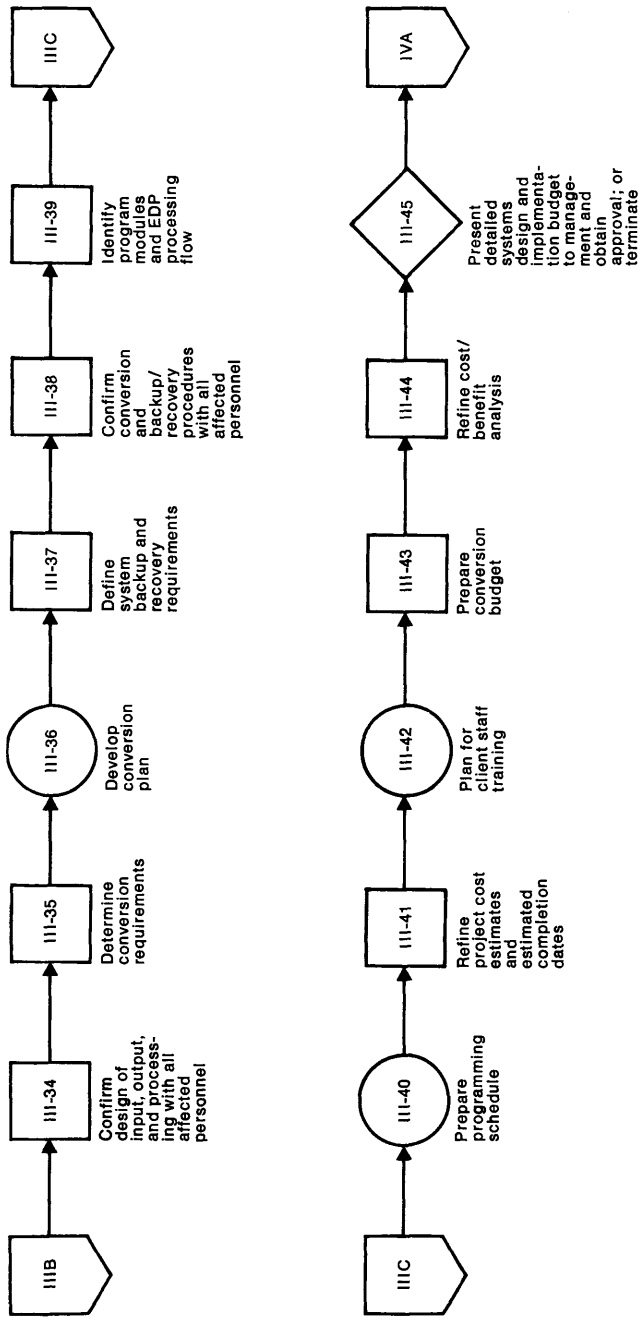


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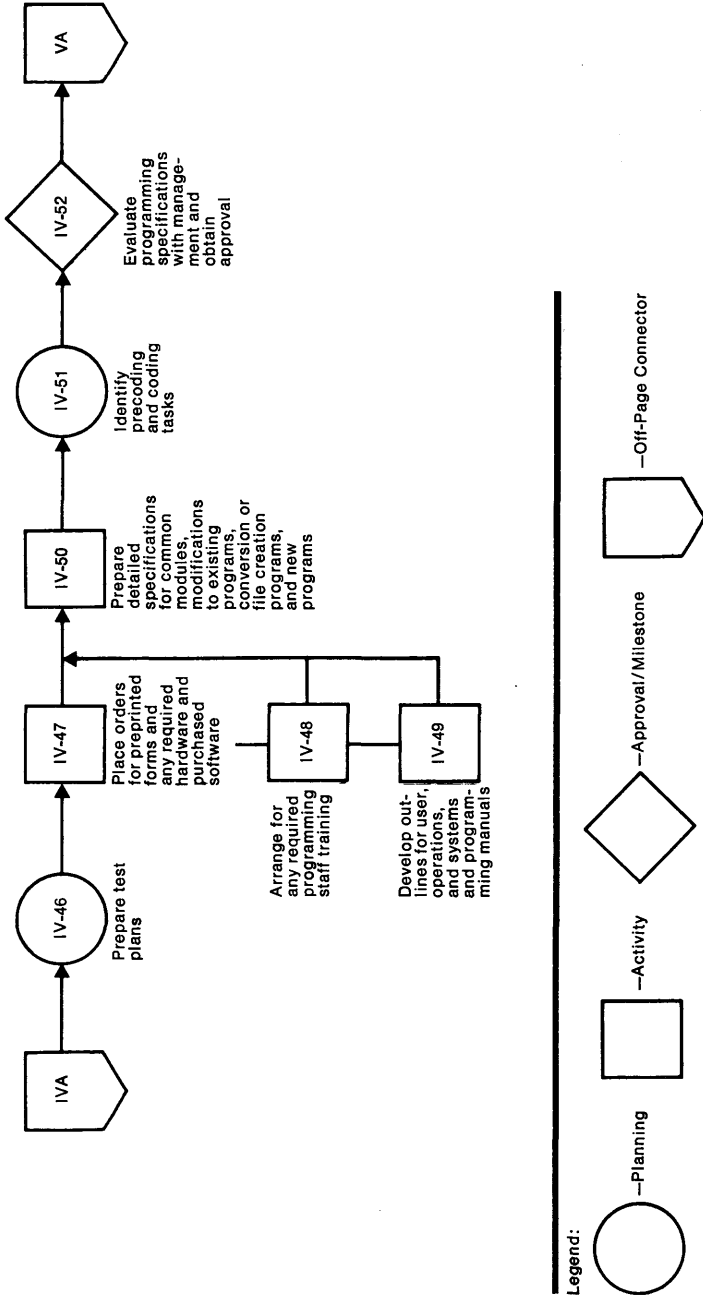


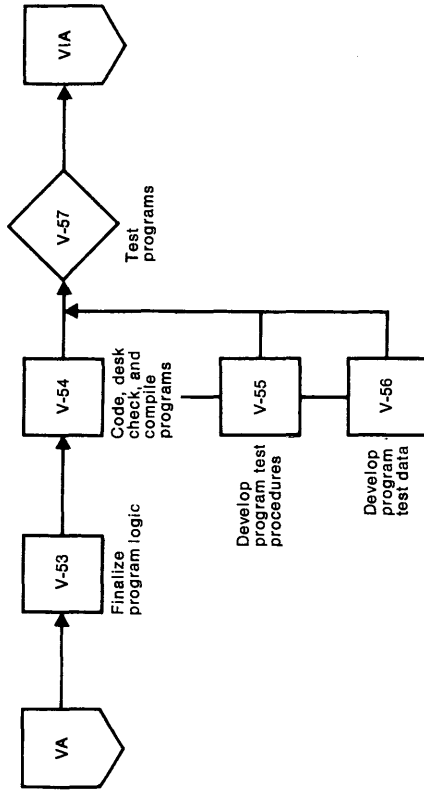
Network of System Development Tasks

Phase III—Detail Systems Design (cont.)

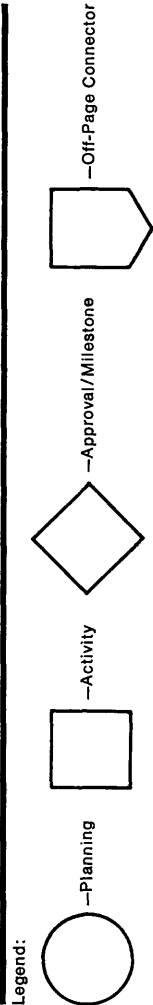
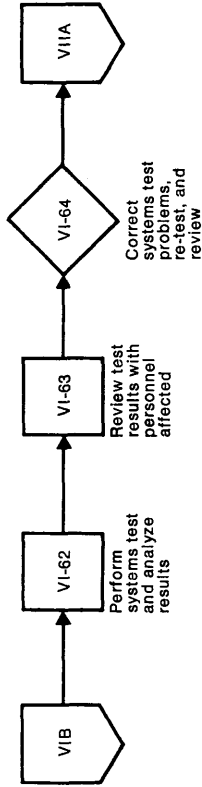
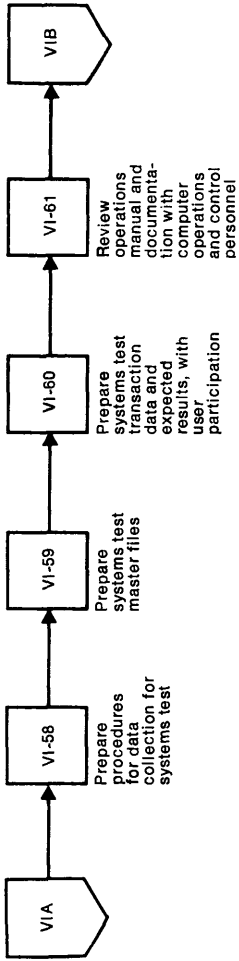


Phase IV—Program Specifications and Implementation Planning

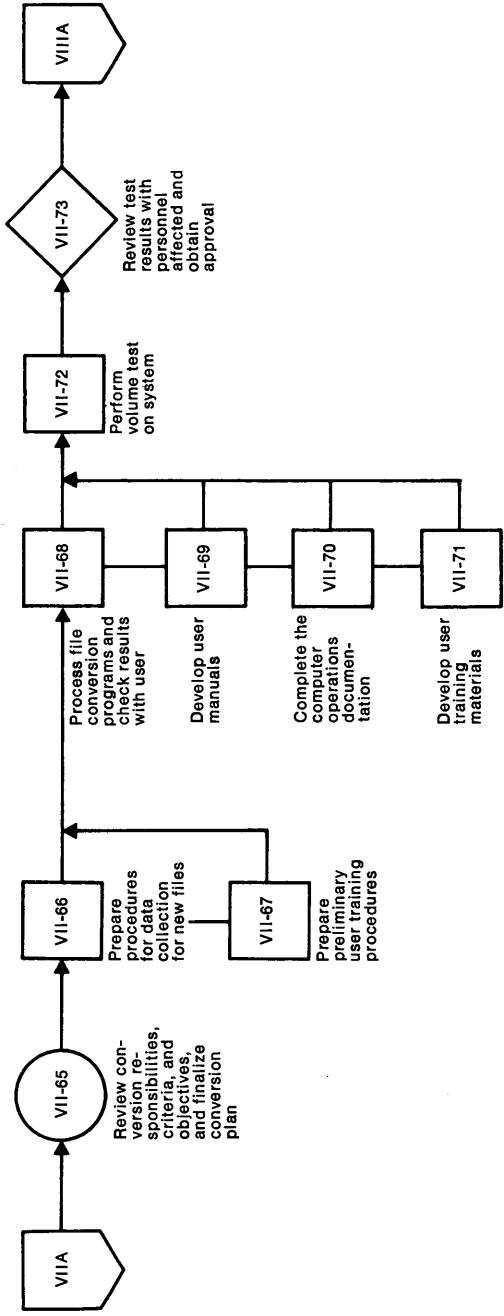


Phase V—Programming and Testing

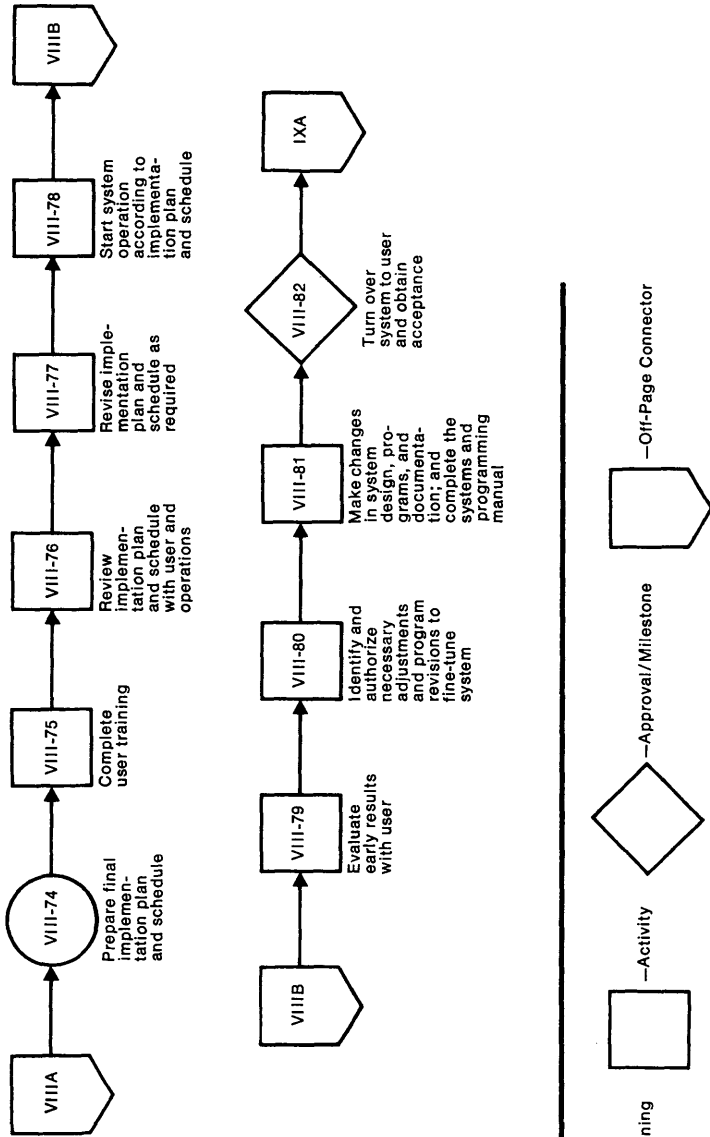
Phase VI—Systems Testing



Phase VII—Conversion and Volume (or Final) Testing



Phase VIII—Implementation



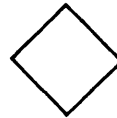
Legend:



—Planning



—Activity

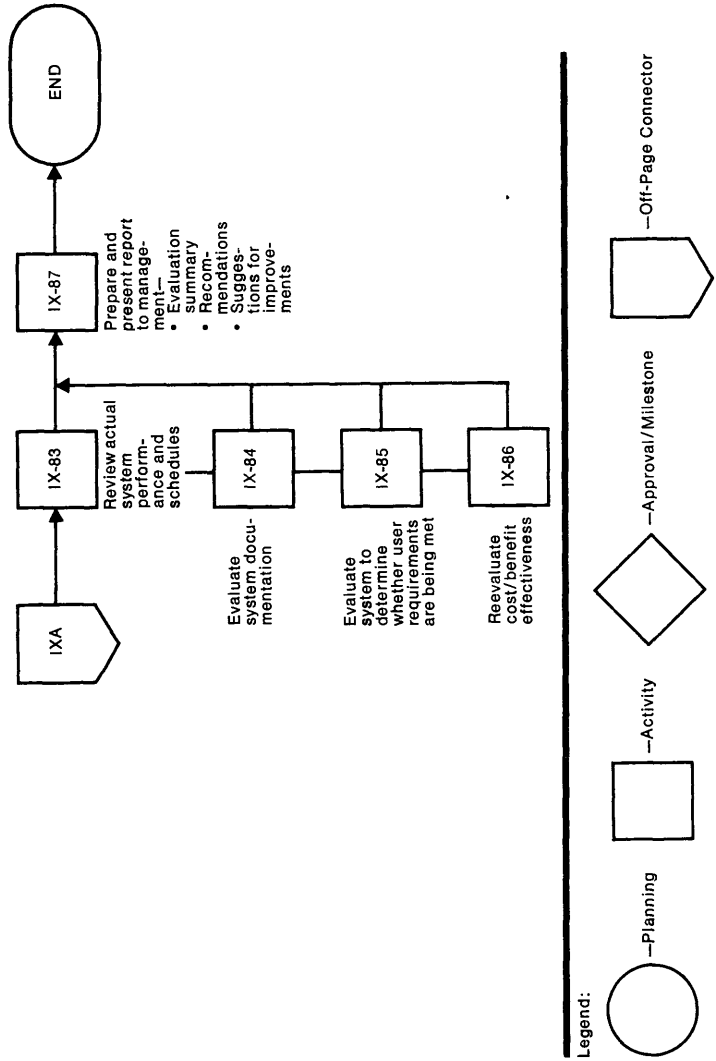


—Approval/Milestone



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Phase IX—Post-Implementation Evaluation



System Development Task Outputs

Phase 1—Requirements Definition and Alternative Approaches

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
1. Identify the problem or new requirements in their present or future context	<i>Initial statement of requirements.</i> To define potential benefits, to provide a formal means of communicating the scope of the project, and to provide a document for continuing reference. <i>Work program for Phase I.</i> To record plan for Phase I evaluation effort.	Memo Worksheet
2. Define project objectives, scope, and approach	<i>Scope and objectives memorandum.</i> To communicate to top management scope, objectives, and the general nature and cost implications of the development project.	Memo
3. Define the time/priority elements	<i>Section of scope and objectives memorandum.</i> To identify any absolute timing requirements and to prioritize various aspects of the project.	Memo
4. Evaluate consistency with and impact on the organization's long range planning	<i>Development plan consistency memorandum.</i> To reconcile the project's objectives and time frame with the long range plan, either reinforcing the long range plan or updating it.	Memo

System Development Task Outputs

Phase I—Requirements Definition and Alternative Approaches (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
5. Prepare proposal	<i>Proposal letter.</i> To present to client management a clear statement of the requirements and the proposed approach to the project.	Letter
6. Establish project control system	<i>Employee time report.</i> To provide a means for reporting time worked by individuals assigned to the project. <i>Project analysis.</i> To provide cumulative time summaries and task completion data for project control purposes. <i>Personnel analysis.</i> To provide information on the progress of the project personnel by providing an estimated completion date and work load analysis for all assignments. <i>Project status.</i> To summarize the status of the major steps in the work program and to identify areas requiring review, action, or decision by management.	Preprinted Form Preprinted Form Preprinted Form
7. Study system flow and existing documentation, noting discrepancies	<i>Current system documentation evaluation.</i> To document observations and results of interviews and to reconcile existing system documentation with actual system operation. Discrepancies will be noted in order to update existing documentation and to provide a starting point for future systems development.	Memo or Chart Worksheet

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| 8. Determine present volumes | <i>Volume analysis.</i> To analyze the volume and flow of system inputs and outputs, including source documents for each application, recycled errors, output reports, turnaround documents, control listings, and so forth. | Worksheet |
| 9. Cost out present system | <i>Analysis of equipment costs.</i> To provide a basis for economic evaluation by summarizing the equipment costs of the present system by department and function.
<i>Analysis of personnel costs.</i> To provide a basis for economic evaluation by summarizing the personnel costs of the present system by department and function.
<i>Analysis of other costs.</i> To provide a basis for economic evaluation by summarizing all significant costs other than personnel and equipment by department and function. | Worksheet |
| 10. Identify any external influences and constraints including other system interfaces | <i>Current system influences and constraints (detail).</i> To document existing system influences and constraints related to data flow, reporting frequency, other system interfaces or dependencies, hardware/software availability, and the like.
<i>Current system influences and constraints (summary).</i> To ensure adequate consideration in design of new system by highlighting design interfaces with other systems, special processing conditions, and so forth. | Worksheet |
| 11. Define advantages and disadvantages of existing business system | <i>Current system evaluation.</i> To document the advantages and disadvantages of the existing system for use in this and subsequent phases. | Worksheet |

System Development Task Outputs

Phase I—Requirements Definition and Alternative Approaches (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
12. Start development of specialized glossary if terminology is unique to this industry or the system	<i>Glossary file.</i> To serve as a ready reference for "jargon" peculiar to the particular industry, the firm, or the system being studied.	Worksheet
13. Prepare analysis of existing system	<i>Current system analysis.</i> To analyze aspects of the existing system, including documentation, volume analysis, costs, interactions, constraints, and advantages/disadvantages. This memo will communicate the work performed to management and serve as a basis for deciding on future system development.	Memo
14. Determine system requirements	<i>System requirements statement.</i> To document the system requirements, including business functions served, service levels (frequency of processing, availability of reports or data, and so forth), processing approach, and the like.	Worksheet
15. Develop criteria for evaluating business system alternatives	<i>System evaluation guide.</i> To provide a comprehensive list of the evaluation criteria, such as operating cost, response times, and the like.	Memo

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| 16. Identify alternative solutions | <i>Alternative solution analysis.</i> To record the potential practical methods available (manual/mechanical, batch/on-line, and so forth). | Worksheet |
| 17. Develop conceptual system flows and gross cost approximations for alternative solutions | <i>System flow (overview).</i> To portray the processing flow of the alternative systems, showing inputs, outputs, and major functions.
<i>Cost estimates (equipment, personnel, and other costs).</i> To provide gross cost estimates of the development and operating costs of alternative systems. | Flowchart

Worksheet |
| 18. Present recommendations to management, reviewing available alternatives and estimated requirements of the recommended program | <i>System recommendation.</i> To outline to management the recommendations for future system development based on the analysis made to date.
<i>Cost/benefit analysis.</i> To present gross costs and benefits related to the long range plan and to the specific problems identified.
<i>Requirements and work program.</i> To present the recommended system development work program, including specific tasks, man-days required, and timetable. | Memo/
Report

Worksheet

Work
Program |
| 19. Obtain authorization to continue, to rework, or to terminate | <i>Authorization memo.</i> To obtain management's evaluation of progress to date and authorization to continue, to rework, or to terminate. | Memo |

System Development Task Outputs

Phase II—General Systems Design

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
20. Define systems requirements in greater detail	<p data-bbox="357 300 417 1094"><i>Functional specifications.</i> To facilitate system design by summarizing application system requirements in terms of—</p> <ul data-bbox="422 300 709 1094" style="list-style-type: none"> • major business functions, service levels, concepts, and objectives, • possible additional improvements in present business functions, • output requirements, • input requirements, • file requirements, • control requirements, and • processing and timing requirements. 	Report
21. Prepare general work flow of the application system design and EDP design alternative(s)	<p data-bbox="727 300 788 1094"><i>Work flows.</i> To provide a basis for explaining the system to key personnel and for evaluating alternative flows.</p>	Flowchart
22. Identify any special conversion considerations required for the EDP design alternative(s)	<p data-bbox="869 300 929 1094"><i>Special condition analysis.</i> To provide an analysis of special conversion considerations for alternative systems.</p>	Worksheet

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| <p>23. Determine equipment, personnel, utility software, outside service, and other resources necessary to implement, convert, operate, and maintain the EDP design alternative(s)</p> | <p><i>Equipment, personnel, and other cost analyses for the most probable alternative(s).</i> To provide an updated picture of steps and costs necessary to implement the most probable alternative(s).</p> | <p>Worksheet</p> |
| <p></p> | <p><i>Equipment, personnel, and other cost analyses for other alternatives.</i> To provide comparative data on less probable alternatives.</p> | <p>Summary
Worksheets</p> |
| <p>24. Determine the benefits and limitations of each EDP design alternative</p> | <p><i>Alternative system benefits and comparisons.</i> To facilitate subsequent analysis and decision by documenting the benefits and limitations of each alternative system.</p> | <p>Worksheet</p> |
| <p>25. Prepare comparative analysis of EDP design alternative(s)</p> | <p><i>Alternative system comparisons and cost/benefit analysis.</i> To provide a systematic analysis and comparison of alternatives.</p> | <p>Worksheet</p> |
| <p>26. Present recommendations to management and obtain authorization either to continue with detailed systems design of selected EDP design alternative, to rework, or to terminate</p> | <p><i>EDP design specifications.</i> To present the EDP system specification to client management for evaluation and analysis.
<i>Authorization.</i> To obtain management authorization to continue into the design phase, to rework the tasks previously completed, or to terminate the project.</p> | <p>Report
Memo/
Letter</p> |

System Development Task Outputs

Phase III—Detail Systems Design

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
27. Prepare statement of unique conventions, standards, and restrictions to be observed in the design and programming of the system	<i>Standards.</i> To communicate to all project personnel (particularly analysts and programmers) all unique conventions, standards, and restrictions observed while designing or programming the system.	Memo
28. Design report formats and identify medium	<i>Report descriptions.</i> To include representative data, keys, data sequence, control breaks, totals, page numbers, and so forth. <i>Report layout sheets.</i> To provide a detailed layout of the report for programming purposes and for the form vendor.	Worksheet Preprinted Form
29. Design input formats and identify medium	<i>Input worksheets and coding forms.</i> To specify the type, frequency, method, and forms for entering information into the system. Will identify source documents to be used directly and those to be re-coded.	Worksheet
30. Design files	<i>File description.</i> To identify the content and specific characteristics of each file including relationships, access schema, and the like.	Preprinted Form

	<i>Record information.</i> To provide a detailed definition of each record in each file in the system.	Preprinted Form
	<i>Field information.</i> To describe each field or data element to be used in all records in all files.	Form/Worksheet
31.	Develop system and subsystem processing flow and interfaces with other existing systems	Flowchart
	<i>System flowchart.</i> To provide a schematic representation, work flow, and general information about the system.	
	<i>Subsystem flowchart.</i> To provide the detail design for each subsystem, its data flow, and its interfaces with other subsystems, files, and processes.	Flowchart
	<i>System and subsystem narratives.</i> To provide, in narrative form, the logic requirements of the system and subsystem design.	Worksheet
32.	Establish processing cycle and estimate computer resource requirements	Worksheet
	<i>Processing cycle evaluation.</i> To clearly establish the systems processing cycle by considering the detail design criteria, new information requirements, control reports, and so forth.	
	<i>Preliminary computer resource requirements.</i> (Based on the worksheet above.) To estimate the computer resource requirements, and to estimate whether the equipment configuration is adequate for the required processing cycle.	Worksheet
33.	Define and establish control procedures	Worksheet
	<i>Control procedures.</i> To design operating procedures for the handling of input, the maintenance of run-to-run controls, and the reconciliation and distribution of output.	

System Development Task Outputs

Phase III—Detail Systems Design (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
34. Confirm design of input, output, and processing with all affected personnel	<i>Review memo.</i> To confirm that work completed in tasks III-28-33 is acceptable and consistent with system needs and functional capabilities.	Memo/ Letter
35. Determine conversion requirements	<i>Conversion requirements inventory.</i> To specify conversion requirements (computer time, personnel, and so forth) needed to carry out development of the conversion plan.	Worksheet
36. Develop conversion plan	<i>Conversion plan.</i> To detail the nature and sequence of conversion activities, specific responsibilities, timetables, and the like.	Worksheet
37. Define system backup and recovery requirements	<i>System backup plan.</i> To define the system backup and recovery plan, specifying alternate processing, personnel to be used, recovery techniques, programs, and so forth.	Worksheet
38. Confirm conversion and backup/recovery procedures with all affected personnel	<i>Review memo.</i> To ensure that the conversion and backup/recovery procedures are consistent with client needs and capabilities.	Memo/ Letter

39. Identify program modules and EDP processing flow
Program mainline block diagram. To provide the design of program modules and their relationship to each other, to master files, to transactions, and to reports.
 Block Diagram of Program Module Flow
 Worksheet
40. Prepare programming schedule
Program summary. To provide general information about each program module and to facilitate subsequent preparation of design documentation.
 Worksheet
41. Refine project cost estimates and estimated completion dates
Programming schedule. To enable assignment of programming personnel and to facilitate monitoring of programming progress.
 Worksheet
42. Plan for client staff training
Updated project plans. To confirm and document changes in either the budget or the target dates.
 Worksheet
43. Prepare conversion budget
Training plan. To communicate to management the personnel requirements, location, and dates for training, and an outline of the topics to be covered.
 Worksheet
43. Prepare conversion budget
Conversion budget. To present to management an updated estimate of conversion costs.
 Worksheet

System Development Task Outputs

Phase III—Detail Systems Design (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
44. Refine cost/benefit analysis	<i>Cost/benefit revision.</i> To document any revisions in the cost/benefit analysis that may affect system choice and development.	Worksheet
45. Present detailed systems design and implementation budget to management and obtain approval; or terminate	<i>Detailed design specifications.</i> To obtain management's approval on the budget for the implementation phase and the continuation of the project; or authorization to terminate.	Report

Phase IV—Program Specifications and Implementation Planning

46. Prepare test plans	<p><i>Test specifications and plans.</i> Describe testing philosophy, objectives, procedures, constraints, personnel responsibilities, and success criteria for each level of test, specifically—</p> <ul style="list-style-type: none"> • the program test plan, • the system test plan, and • the volume test plan. 	Worksheet
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47. Place orders for preprinted forms and any required hardware and purchased software
Purchase requisitions. To authorize timely procurement of all needed forms.
Equipment leases or contracts. To establish the exact machine requirements including software provided, length of contract, termination clauses, penalty clauses, rental, service, installation, freight, training provisions, and vendor support commitments.
Software contracts. To establish the length of contract, termination clauses, ownership, usage restrictions, penalty clauses, and other commitments.
Purchase Requisition
Lease or Contract
48. Arrange for any required programming staff training
Training schedule. To familiarize programmers with the user's objectives; to provide a general introduction to the software and standard programs; and to establish standards for documentation, procedures, flowcharting, data organization, program testing, and conversion.
Purchase Requisition and Contract
Worksheet
49. Develop outlines for user, operations, and systems and programming manuals
User manual outline. To identify the required content of the user manual.
Operations manual outline. To identify the required content of the data center operations manual, including computer operations, control groups, and data preparation.
Systems and programming manual outline. To identify the required content of the systems and programming manual in sufficient detail for meeting documentation requirements.
Worksheet
Worksheet
Worksheet

System Development Task Outputs

Phase IV—Program Specifications and Implementation Planning (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
50. Prepare detailed specifications for common modules, modifications to existing programs, conversion or file creation programs, and new programs	<p><i>Programming and coding specifications.</i> To specify the relationship of each module with other modules in the subsystem; purpose of each module; development restrictions; and processing characteristics. Describes the hardware, software, and programming language to be used. Specifies, for each program, inputs; outputs; files; decision tables; formulae; algorithms and tables to be used; field naming conventions; glossary of terms used in the modules/programs; and the control scheme. The task includes preparation of—</p> <ul style="list-style-type: none"> • coding specifications, • file conversion specifications, • conversion program specifications, and • new program specifications. 	Preprinted Form or Worksheet
	<p><i>Change notice procedure.</i> To define the procedures used for controlling changes. Highlights the impact of changes on schedules and costs. Affords management an opportunity to assess the benefit(s) of proposed changes.</p>	Preprinted Form or Worksheet

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| 51. Identify precoding and coding tasks | <i>Coding task list.</i> To identify specific tasks and to indicate which programs will utilize precoded modules or general file processing software. | Worksheet |
| 52. Evaluate programming specifications with management and obtain approval | <i>Programming specification approval.</i> To obtain client approval of programming specifications. | Memo/
Letter |

Phase V—Programming and Testing

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| 53. Finalize program logic | <i>Program logic documentation.</i> To finalize and document program logic. | Worksheet |
| 54. Code, desk check, and compile programs | <i>Program listing.</i> To provide usable programs in accordance with specifications. | Clean Compilation |
| 55. Develop program test procedures | <i>Unit program test procedures.</i> To provide the procedure for testing each program module in an isolated environment before combining it with other tested units, in order to ensure that the unit will function properly when inserted into the system.
<i>Integration (string) test procedures.</i> To provide the procedures for conducting integration tests (modules combined to form components). | Unit Test
Procedure
Worksheet

Integration
Test
Procedure
Worksheet |
| | <i>Preliminary computer operations documentation.</i> To specify operations test procedures. | Preliminary
Run Book |

System Development Task Outputs

Phase V—Programming and Testing (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
56. Develop program test data	<i>Test data.</i> To provide test data for the testing of all programs.	Machine Processable Media Worksheet
57. Test programs	<i>Expected results.</i> To predetermine the test results prior to testing for comparison and analytical purposes. <i>Test output.</i> To provide assurance and documentation of program performance. <i>Acceptance memo.</i> To review program results with users (when appropriate) and to obtain acceptance.	Computer Output Memo

Phase VI—Systems Testing

58. Prepare procedures for data collection for systems test	<i>Systems test procedures.</i> To specify standards and procedures for systems test generation; criteria for measuring the accuracy of test files to be created; and individual(s) responsible for the various test files to be developed and maintained. Indicates	Test Instructions
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where to collect data to develop the test files, and deadlines for test file development. Specifies the individual or group responsible for the overall test file package. Orients selected user personnel, utilizing user manual outlines.

59. Prepare systems test master files

Test master files. To provide test files for testing the system and its components to ensure that the program handles the inputs, processing, and outputs in accordance with design and program specifications.

Computer File

60. Prepare systems test transaction data and expected results, with user participation

Systems test transaction data. To prepare the test cases to subject the program(s) and systems to a thorough set of tests representative of a full range of valid and invalid operational possibilities, with outside participation of users, auditors, management, and others as appropriate.

Transaction Data

61. Review operations manual and documentation with computer operations and control personnel

Interim computer operations documentation. To specify the computer and control operating procedures and output of each program and of the system. Describes the principles of operation; configuration possibilities; utility programs and operating rules; restart procedures; processing options; and system control procedures.

Operations Manual and Documentation

62. Perform systems test and analyze results

Systems test results. To test the system thoroughly and analyze test results independently of the programmers assigned to this project.

Computer Output and Memo

System Development Task Outputs

Phase VI—Systems Testing (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
63. Review test results with personnel affected	<i>User's evaluation of test results.</i> To satisfy the user that the system functions in accordance with problem definition and design specifications, making any modifications required, and to reconcile any differences between data processing and user personnel.	Memo
64. Correct systems test problems, re-test, and review	<i>Approved systems test results.</i> To ensure that all problems encountered in the test are corrected, tested, and properly documented, and that all modules submitted are clearly assembled and compiled.	Test Plan, Test Data, Computer Output, and Memo

Phase VII—Conversion and Volume (or Final) Testing

65. Review conversion responsibilities, criteria, and objectives, and finalize conversion plan	<i>Detail system conversion plan.</i> To establish detailed plans for each phase of the conversion, specifying the individuals responsible for each. Defines the conversion objectives, data collection criteria, documents, inputs, and outputs required. Defines	Memo
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the timetable for conversion of all files and programs, the tasks required and the forms to be used. Specifies error handling procedures, essential relationships between specific modules, data fields, etc. Specifies the criteria for checking the accuracy of the converted files. Specifies rules for the maintenance of old and converted files, conversion utility programs and parallel operations.

Memo

Data collection procedures. To describe the procedures, forms, methods, and supplemental data to be used to produce new files, including timetable and responsibilities for completion.

Memo

User training procedures. To provide training materials which will enable users to understand the new system, its use and its operating requirements.

Conversion
Output and
User Appro-
val Memo

File conversion output-test report. To convert files to the new system and to check the accuracy of the converted files.

User
Manuals

Completed user manuals. To provide the information necessary to enable users to understand the system and work with it.

- Provides a work flow description to indicate significant events that occur from the time the user submits input to be processed until he gets output back.

66. Prepare procedures for data collection for new files

67. Prepare preliminary user training procedures

68. Process file conversion programs and check results with user

69. Develop user manuals

System Development Task Outputs

Phase VII—Conversion and Volume (or Final) Testing (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
69. Develop user manuals (cont.)	<ul style="list-style-type: none"> • Provides information to enable the user to check the accuracy of the output. • Provides schedules for submission of input and availability of output. • Includes instructions for the completion of all forms. • Provides report descriptions including report name, purpose, and programs used. • Specifies the individual responsible for producing each report. • Specifies deadlines, frequency of production, anticipated volume, and distribution plans. • Illustrates report formats and derivation of data elements. • Provides procedures to ensure that input is complete and output is accurate. • Specifies security requirements. • Includes graphic representation of the flow of work from the user through data processing and back to the user. 	Operations Manual
70. Complete the computer operations documentation	<p><i>Final computer operations documentation.</i> To specify instructions for the operation of the system, file requirements, hardware</p>	Operations Manual

and software constraints, error messages, restart procedures, paper requirements, file labelling requirements, and retention requirements.

71. Develop user training materials

Completed user training materials. To provide all materials and aids needed for effective user training. Includes relevant documentation, all forms, and the name(s) of the individuals in the user organization responsible for training.

Procedure
Memo

72. Perform volume test on system

Volume test output. To test the system using converted master files of data in "live" environment and to correct any deficiencies.

Volume Test
Computer
Output &
Analysis
Memo

73. Review test results with personnel affected and obtain approval

Volume test review. To ensure that the system is functioning in accordance with the requirements and design specifications. To demonstrate to the user that the program(s) produce valid results using actual data. To record the user's agreement to implement.

Acceptance
Memo

Phase VIII—Implementation

74. Prepare final implementation plan and schedule

Implementation schedule. To specify the timetable, procedures, user and operating requirements, and post-processing requirements.

Memo

System Development Task Outputs

Phase VIII—Implementation (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
75. Complete user training	<i>Training memorandum.</i> To train all user personnel affected by the system.	Memo
76. Review implementation plan and schedule with user and operations	<i>Implementation schedule review.</i> To ensure that the user(s) and the operations department can provide the required personnel and computer resources at the scheduled times. To enable the user(s) and operations to identify and resolve any potential problems.	Meeting
77. Revise implementation plan and schedule as required	<i>Revised implementation schedule.</i> To document final plans.	Memo
78. Start system operation according to implementation plan and schedule	<i>System conversion memo.</i> To communicate to users the completion of all of the conversion steps and the beginning of production processing.	Memo
79. Evaluate early results with user	<i>Conversion and implementation analysis.</i> To determine the effectiveness of the system by identifying any deficiencies and developing the steps needed to correct them and to provide a formal record of outstanding problems for followup.	Worksheet and Memo

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| 80. Identify and authorize necessary adjustments and program revisions to fine-tune system | <i>Program change control sheet.</i> To control the timely completion of the program changes.
<i>Program change authorizations.</i> To assure appropriate review and authorization of changes and to provide a formal record and control of program changes. | Change Control Log
Preprinted Form |
| 81. Make changes in system design, programs, and documentation; and complete the systems and programming manual | <i>Systems and programming manual.</i> To make final changes to the system and its documentation. These changes should be made to all documentation involved (system and program flows, narratives, layouts, manuals, and so forth) to ensure an up-to-date and ready reference for current and future use. | Manual |
| 82. Turn over system to user and obtain acceptance | <i>System turnover memo.</i> To communicate to management that the system is operational and has been turned over to the client. Should also identify any desirable changes that remain. | Memo |

Phase IX—Post-Implementation Evaluation

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| 83. Review actual system performance and schedules | <i>Manpower and time estimates—actual vs. planned.</i> To identify significant variances in personnel and elapsed time required for each function affected by the system.
<i>Computer estimates—actual vs. planned.</i> To identify significant variances in computer timing for each processing function and to measure the effectiveness of computer operating procedures. | Worksheet
Worksheet |
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System Development Task Outputs

Phase IX—Post-Implementation Evaluation (cont.)

<u>Task</u>	<u>Output and Purpose</u>	<u>Suggested Form</u>
84. Evaluate system documentation	<i>System documentation memo.</i> To convey to management the state of existing system documentation with regard to clarity, completeness, and appropriateness.	Memo
85. Evaluate system to determine whether user requirements are being met	<i>System memo.</i> To review users' statements in order to evaluate the effect of the system, considering all stated requirements, actual system performance, and rate of change requests.	Memo
86. Reevaluate cost/benefit effectiveness	<i>System cost/benefit analysis—actual vs. planned.</i> To compare actual costs and benefits with earlier projections.	Worksheet
87. Prepare and present report to management— <ul style="list-style-type: none"> • evaluation summary, • recommendations, and • suggestions for improvements 	<i>Final system report.</i> To communicate to management the results of the evaluation and to provide recommendations and suggestions.	Report