TOTAL SYSTEM DEVELOPMENT

PRELIMINARY DESIGN PHASE GUIDELINES

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1. GENERAL

1.01 The purpose of the Preliminary Design Phase is to develop the overall architecture of the system and to produce specifications reflecting the logical view of the system.

1.02 Whenever this section is reissued, the reason(s) for reissue will be included in this paragraph.

1.03 This section is a guideline. It provides expanded information in support of the concepts of Total System Development specified in Section 007-220-300*, Total System Development — Milestones.

1.04 During Preliminary Design, the system model selected at the completion of the Feasibility Phase must be reevaluated to determine if that approach is still valid and can be satisfied by the system requirements developed during Definition Phase. Also, the reasonable architectural options must be examined in terms of their technical, operational, and economic feasibility. Once a generalized architectural approach has been established, the design of the system must be developed. Also during this design activity, system control features and performance and reliability requirements must be integrated into the total system design.

1.05 During this phase, the strategies and requirements for system test and conversion should be established. Typically, the selected conversion strategy will influence selection of a specific test strategy. For example, a flash cut of the entire system would require that each portion of the system be fully tested before conversion. On the other hand, sequential conversion of subsystems or system versions would dictate a phase and cumulative test strategy. Because of the high interrelation between the system test and conversion functions, planning for the two should be a coordinated effort.

1.06 Throughout the Preliminary Design process, decisions will be made concerning the resources required to perform specific system functions or sets of functions. As the functional or logical design is firmed up, the total resource requirements for the system must be determined for both conversion and on-going operation. Requirements should be developed for personnel, equipment, facilities, transportation, hardware, software, and the communications network. As these requirements are prepared, they should be reviewed with each appropriate planning and/or support organization to assure resource availability and conformance to organizational resource plans.

1.07 By the end of the Preliminary Design, there will be sufficient information to develop a reasonably precise view of the costs and benefits of the new system. Development and conversion costs, operational expenses, anticipated maintenance costs, and the magnitude of system benefits should be recalculated. Significant differences (10 to 15 percent) from Feasibility Phase estimates should be examined and the reasons for the increase(s) or decrease(s) identified.

1.08 The composition of the project team for the Preliminary Design Phase is critical to pro-

* Check Divisional Index 007 for availability.

ducing an effective system design. Depending upon the type(s) of system architecture that is to be employed, a variety of expertise may be required — personnel subsystem and human performance, computer subsystem, data base, data communications, software, hardware, etc. For large projects or for projects with heavy technical involvement in any of these areas, it is usually advisable to have technical experts actually assigned as project personnel. Where technical demands are not so great, it may be possible to obtain part-time assistance from technical support groups.

1.09 It is important that all project personnel work as a team throughout the Preliminary Design Phase. The selection of a system architecture and the development of an optimum system design will require a great number of technical decisions and trade-offs utilizing inputs from each of the specialty areas represented on the team, eg, PSS, CSS, data base, and data communications. This interdisciplinary approach to design is beneficial throughout the system process. Additionally, every effort should be made to colocate all project personnel during Preliminary Design in order to foster the decision-making process and the effective flow of information.

1.10 There should be a high degree of interaction between the project team and the technical support and planning groups during Preliminary Design. The various support groups can provide information and ideas concerning design alternatives. In addition, in most companies, the support organization is responsible for the actual selection of equipment, software, hardware, etc, based on the total requirements across projects/applications. Also, the design of the communications network and data bases for the system will typically be a support responsibility based on requirements from the application. Because of these shared responsibilities, the project manager should assure a close day-to-day working relationship with all affected planning and support organizations.

1.11 It is important that a design review be held at the completion of the Preliminary Design Phase. The review should focus on the operational, technical, and economical characteristics of the system and should typically involve the following organizations as required:

- Client/user
- Departmental methods personnel
- Computer operations
- Hardware and software
- Data base administration support
- Data communications support
- Planning
- Internal auditing
- Facility planning
- Standards
- Other groups as necessary.

1.12 The purpose of this design review is to assure that all facets of the design have been properly addressed and satisfy the system requirements and to gain the acceptance, concurrence, and/or approval of the various organizations that are or will be involved in the development, installation, or operation of the new system. Thus, this review point is a major milestone in the system development process.

2. SYSTEM STRUCTURE

2.01 The first step in addressing the design of the system structure is the review and validation of the proposed system model. The system requirements are then reviewed to determine if they adequately represent the system model. If changes to the model or requirements are required, they should be documented.

2.02 Following these reviews, design activities can proceed. The emphasis at this point is twofold:

(a) To finalize the logical data views into the logical record, segment, and data base specifications

(b) To structure the system down to a level of module and program descriptions for machine processing; task and work module (position) descriptions for human processing.

2.03 The logical data structure, usually developed in the Definition Phase, may be presented in products such as linkage diagrams, entity dependency diagrams, and usage views. Based on this data

information and system functions information from a high-level flow diagram, the logical record specifications and segment and data base specifications can be developed.

2.04 The detailed functional architecture of the system can be developed in parallel with the work on the data structure and specifications. Although the architecture is heavily related to the data structure, there is sufficient information on the views of the logical data from the Definition Phase to start identifying the functional architecture for the system. During this activity, several architecture options may be identified. In developing these options, the following influences in addition to the data structure must be considered:

- Standard operating environment
- Design constraints
- Environmental factors
- Data center deployment/operation.

Each identified architecture option must be evaluated in terms of its feasibility [ie, technical, operational, and economical feasibility (both developmental and operational)].

2.05 Identifying the functional architecture options basically involves the following three steps:

(a) Partition or allocate the functions to people and machines.

(b) Identify on-line versus batch oriented functions.

(c) Identify the general structure of the on-line and batch functions.

2.06 When allocating the system functions, some analysis of these functions will be required in order to clearly identify to which processor, person or machine the function or subfunction should be allocated. Those functions allocated to people should be reviewed to determine that the results will be meaningful work for them. Also, allocated functions should be continually reviewed throughout the design process to assure the allocation is still appropriate. For example, it may become evident in later design that the volume of work, accuracy required, or processing criticality is such that people cannot perform effectively or efficiently, and the function should be reallocated to the machine. Conversely, a function assigned to the machine may be performed infrequently, require judgmental decisions, and could be performed more effectively by people. In this case, the function should be reallocated to the human processor.

2.07 Once an architectural option has been selected (with the functions appropriately allocated), each function can be further analyzed. The low level processes identified through this analysis can then be synthesized into modules and programs for machine processing or tasks and work modules (positions) for human processing. During this analysis process, the data structures and function considerations must be considered in order to develop an effective design.

2.08 System control and reliability requirements must be examined to determine the processes (machine and human) which need to be interwoven with the transaction oriented functions. The various areas which require system controls and the means for providing such controls will determine the control processes to be designed and integrated into the overall system design. The processes to satisfy reliability requirements also must be designed and integrated into the overall design. The design of these two sets of processes will be influenced by the architectural option selected and must also consider the data and function structures.

3. TEST AND CONVERSION STRATEGIES

3.01 At this point in Preliminary Design, enough is known about the system requirements; system functions; personnel requirements; hardware, software, and equipment requirements; and the system schedule to develop the initial system test and conversion strategies. Both of these strategies are dependent on the nature of the system that has been designed and both can be influenced by the dictates of the other strategies (ie, testing can be influenced by the conversion strategy or vice versa).

3.02 For testing, an overall system test plan for dynamic testing will be developed and reviewed. This plan will include general test objectives, testing environment (verification, validation, and certification) for each level of testing (unit, integration, and system), strategies and techniques to be

used, testing schedule, resource estimates for testing, and test data base requirements. This overall test plan should be reviewed and evaluated. Once the plan is accepted, specific test plans will be developed in the Detail Design Phase for the PSS and CSS units, integration, system, conversion, and acceptance testing.

3.03 Static testing of phase products will be planned and conducted using techniques such as desk top reviews, peer reviews, and walk-throughs. Although each phase of TSD will include these types of product reviews, they are especially important during Preliminary Design because of the development of the overall test plan. During these product reviews, an objective is to ensure the design specifications contain specific and measurable criteria for unambiguous testing because these specifications will be the basis for developing the overall test plan.

3.04 Another factor to consider in developing the overall test plan is the selected conversion strategy. Different strategies may require adjustments to various aspects of the test plan such as the schedule, resources, test cases, and test data base.

3.05 As previously noted, the selection of an appropriate conversion strategy is done at this point as a part of the initial view of conversion requirements. The specifics for the conversion plan will be developed in Detail Design based on these conversion requirements.

3.06 The data conversion considerations developed in the Definition Phase should be reviewed and updated if required. This information plus knowledge of the system architecture and data structures will be used to select a conversion strategy (eg, a phased conversion or flash cutover), and to identify if conversion can be accomplished using the system functions or if special conversion functions must be designed or a conversion subsystem is needed.

3.07 Other factors to consider in developing the conversion strategy and requirements are the impact on the business operations during conversion, such as reorganization in user work units, special training requirements for conversion procedures, and resource requirements (eg, unique or special hardware or software and personnel requirements for conversion).

4. SYSTEM RESOURCE REQUIREMENTS

4.01 With the basic design of the system available, a more definite set of physical resource requirements can now be determined. These resource requirements should address the following as appropriate for the system:

- Personnel
- Equipment
- Facilities
- Transportation
- Hardware
- Software (nonapplication)
- Data communications.

These resource requirements must include both conversion and operational needs. In many cases, the same resources will be used for both conversion and daily operations. However, when special or additional resources are required for conversion, they must be clearly highlighted, and the length of time they will be required should be identified.

4.02 The cost analysis of these resource requirements are discussed in Part 5, Refined Economic Analysis. However, when special or additional conversion resources are required, their potential costs should be reviewed in conjunction with the length of time they will be required based on the conversion strategy selected. If potential costs are high for these resources, it would be appropriate to examine the entire proposed conversion process to determine if adjustments can be made to reduce these costs. Although conversion costs are not on-going, they can be a major expenditure when bringing in a new system.

4.03 Each of the seven potential resource requirements must be defined based on the design of the system at this point in the development cycle and the system requirements with any updates incorporated during this phase. As the various resource requirements are defined, the current set of assumptions and constraints must be reviewed to determine if there are any conflicts. If conflicts are found, they must be resolved by clearing or rewriting assumptions, negotiating changes to constraints, or making adjustments to the design. This may require obtaining agreement to changes in the system requirements.

4.04 Various modeling, simulation, and quantitive analysis techniques are available to assist in

determining each type of resource requirement. The selection of techniques to use is influenced by a number of factors:

(a) Type of resource

(b) Type of system (eg, on-line, transaction oriented, decision support)

(c) The size of the system

(d) Time available to do modeling or simulation

(e) Skill and knowledge of project members in using a specific technique or availability of support staff with needed expertise.

4.05 As the various resource requirements are prepared, they should be reviewed with each appropriate planning and/or support organization to assure resource availability and conformance to organizational resource plans. If the required resources are not available or are not in comformance with resource plans, then adjustments must be negotiated either to the plans to provide for the resources or to the system under development.

5. REFINED ENONOMIC ALALYSIS

5.01 At this point in the development cycle, the economic analyses prepared in the Feasibility Phase are reviewed and refined but only for the system alternative being developed. The same economic analyses and method of calculation used during feasibility should be used again at this point to assure a common basis for comparing any variances in the results. If additional analyses are deemed useful, they should be prepared. However, if additional analyses are prepared, those results which are recalculations of the Feasibility analyses should be clearly indicated.

5.02 The cost and benefit calculations may still be presented in ranges; however, the difference between the low and high ends of a range calculated during Preliminary Design should be less than calculated during Feasibility. With more specifics known about the system during this phase, the refined economic analyses results should be more precise.

5.03 The refined economic analyses results should be compared with the same calculations prepared during Feasibility. Any results which differs significantly (10 to 15 percent) from the Feasibility estimates should be examined, and the reasons identified for the increase(s) or decrease(s).

6. END-OF-PHASE ACTIVITIES

6.01 During this phase, various types of product reviews should have been conducted. However, a final review of the overall system preliminary design should be conducted at this point to assure logical continuity and completeness of design based on a comparison with the system requirements produced in the Definition Phase and any updates to it. Testing and conversion information, resource requirements, and refined ecomonic analyses results should also be included in this end-of-phase review. This review will typically involve such groups as users, support approval, operation, or any other group that will be impacted by the system or that can contribute technical or subject matter expertise to the review.

6.02 The project status and recommendations should be prepared.

6.03 The status and recommendations plus other supporting information required by the appropriate project approval entity are submitted to that group to obtain authorization to proceed. The project approval entity should evaluate the project in the following ways:

(a) Compare the refined economic analysis with the economic results from the Feasibility Phase to determine if the project continues to be economically viable.

(b) Determine if the business goals and objectives addressed by the system are still viable and that the system will adaquately support the user needs.

7. REFERENCES

7.01 The following sections will provide additional information relevant to the Preliminary Design Phase:

SECTION	TITLE
007-180-301	Computer Capacity Planning — Methodology
007-200-310	Functional Roles in a Systems Environment

SECTION	TITLE
007-208-310	Project Management
007-220-300	Total System Delvelopment-Milestones
007-227-310	Developmental Documentation Specifications
007-233-300*	Testing Recommendations for Information Systems.

*Check Divisional Index 700 for availability.