Pre-Project Planning Handbook

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Prepared by
The Construction Industry Institute
Pre-Project Planning Research Team

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Research conducted by the CII Pre-Project Planning Research Team indicates that well-performed pre-project planning can:

- *reduce project costs by as much as 20 percent.*
- *Lead to less project variability in terms of cost, schedule, and operating characteristics.*
- *increase the chance of meeting a project? environmental and social goals.*

The research also indicates a direct relationship between project success and the level of pre-project planning effort. It is therefore imperative that the underlying pre-project planning process be understood and embraced by industry participants, particularly owners.

The purpose of this handbook is to define the functions involved in pre-project planning and to provide an outline that can be used to develop specific steps and tools for the pre-project planning of capital projects. The research team believes that proper performance of pre-project planning is an owner responsibility and cannot be completely delegated. Although consultants and other experts may be significantly involved in this process, the owner must assure that it is being performed properly. To that end, the research team offers the following conclusions:

- *Pre-project planning is an owner-driven process that must be tied closely to business goals.*
- *Pre-project planning is a complex process that must be adapted to the business needs of the company. Operations, business, and project management must be closely tied to pre-project planning early in the process.*
- *Corporate goals andguidelines for both pre-project planning and the project must be well-defined. There must also be key individuals empowered by management to act on those goals, as well as be accountable for their actions.*

The research team has developed this handbook to be as generic as possible and, as such, companies must adapt to meet their individual business needs. The handbook contains an outline of the important steps in the pre-project planning effort. Owners can use this outline to develop specific steps and tools to insure that the project team performs all the important planning functions prior to beginning detailed design and construction.

CHAPTER I

User's Guide To The Handbook

The purpose of this handbook is to define the functions involved in pre-project planning and to provide an outline that can be used in pre-project planning of capital projects. The process is, by necessity, generic. Every company's business environment is different, and every project differs in terms of size, type, and complexity. The underlying process of performing pre-project planning is the important issue.

Pre-Project Planning Process. Pre-project planning is defined as *the process of developing sufficient strategic information for owners to address risk and decide to commit resources to maximize the chance for a successful project.* Specific steps and details will vary. However, pre-project planning is a process that should be standardized by all organizations involved in front-end planning for capital projects.

The question, "Is this approach the only way to perform pre-project planning?" is worth addressing at this point. After looking at many different companies performing pre-project planning, the research team concluded that all companies' approaches were somewhat different; however, the underlying **process** is similar. Many dissimilarities exist among companies such as: whether the company has a one-step or a three-step authorization process; whether the company has a formalized written process; and whether the company has a team-based approach. The key issue is that the pre-project planning process is essential.

When the pre-project planning effort is finished, one should have completed the following to ensure a high level of confidence in the success of the project:

- *addressed business requirements for the project*
- *selected critical technologies for the project*

- *chosen a site*
- *defined the scope □↗ work to be accomplished*
- *determined the cost and schedule for the project*
- *assembled a project team with the proper expertise to Lead the execution effort*
- *prepared project documentation so that the project can move smoothly in to execution*
- *allowed key members of the project team to gain an intimate understanding of the development of this project.*
- *addressed the decision maker? needs and concerns in order to facilitate the decision*
- *presented intermediate and final recommendations in a "user friendly" manner, permitting the decision maker to evaluate risks and make the proper decisions*
- *gained commitment from all interestedparties in terms ofproject scope, cost, schedule, and plan of execution*
- *investigatedpermit requirements.*

The Project Life Cycle Diagram, Figure 1.1, divides the project cycle into four distinct stages: *perform business planning, perform pre-project planning, execute project,* and *operate facility.* Owners and engineers traditionally think of project planning as including both the business planning and pre-project planning functions. This handbook will focus on the "how to" of pre-project planning and its four primary sub-processes:

- *Organize for pre-project planning*
- *Select project alternatives*
- *Develop a project definition package*
- *Decide whether to proceed with project*

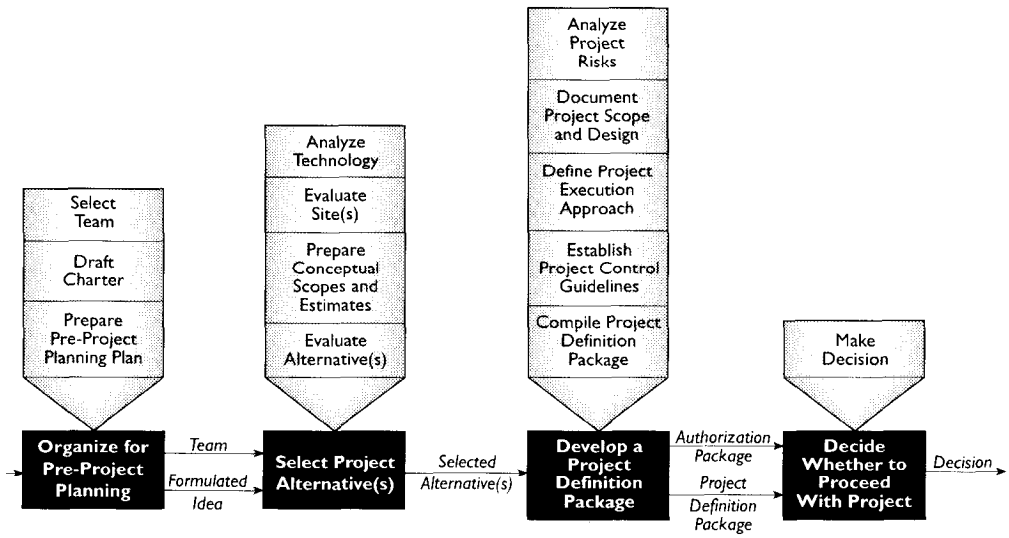


Figure I. I: ***Project Life Cycle Diagram***

Early stages have great influence on project outcome.

Pre-project planning has a significant impact on the outcome of the construction of a capital facility. Figure 1.2 graphically illustrates this concept. The curve labeled "influence" in the figure reflects a company's ability to affect the outcome of a project during the various stages of a project. As the diagram indicates, it is much easier to influence a project's outcome during the early project stages, when expenditures are relatively minimal, than it is to affect the outcome during the later stages of the project (project execution and operation of the facility)

Research conducted by the CII Pre-Project Planning Research Team indicates that well performed pre-project planning can reduce project costs by as much as 20 percent on average versus poorly planned projects. The research shows that risk management is the driving force for pre-project planning and that poor performance is often due to failing to mitigate risks. Pre-project planning can lead to less variability in terms of cost, schedule, and operating characteristics, as well as other intangibles such as customer satisfaction, improved community relations, and feelings of success among project participants.

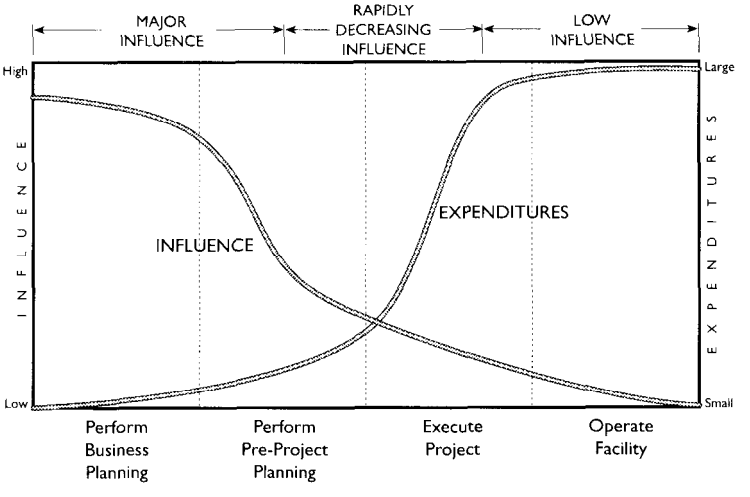


Figure I.2: ***Influence and Expenditures Curve for the Project Life Cycle***

Pre-project planning has many aliases.

Pre-project planning is an important part of the project life cycle as illustrated in Figure 1.3. The diagram conceptually shows the overlap and iteration between phases of the life cycle. The first phase is sometimes called feasibility analysis rather than business planning. The second phase, corresponding to the organizing and select alternatives sub-processes, is sometimes called conceptual planning. The third phase, corresponding to develop project definition package and decision

making sub-processes, is sometimes called detailed scope definition. The fourth phase, corresponding to the detailed design, procurement, construction, and start-up sub-processes, is sometimes called project execution. The increasing size of the arches conceptually shows the increasing effort and expenditure at each phase. Overlap between each phase is typically a place where a "transition" occurs and where decisions are made. These interfaces are critical junctures in maintaining the strength of the process.

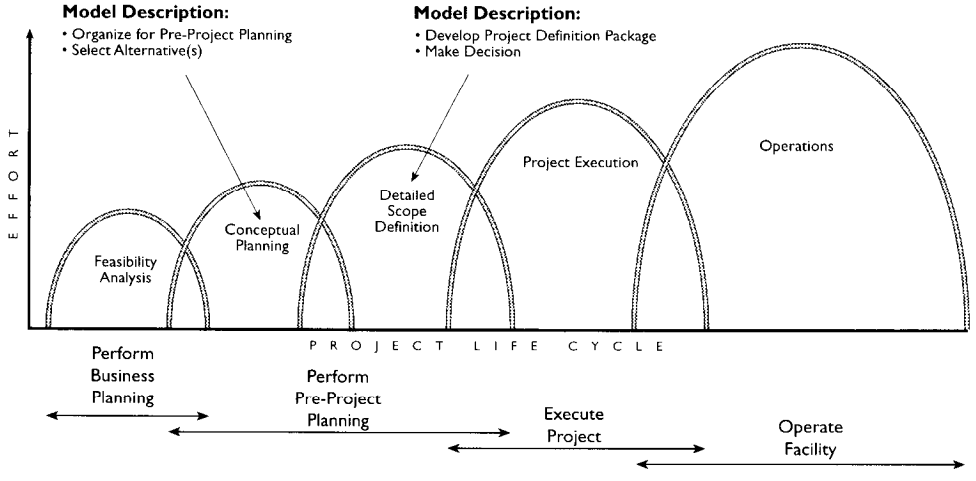


Figure I.3: *Project Life Cycle Diagram - A Different View*

This process is not linear. Functions can be occurring concurrently-interaction, feedback, and iteration are inherent within the process. Several interim funding authorizations or "hold points" may occur, allowing the pre-project planning team to continue with analysis. The final authorization entails funding for detailed design, procurement, construction and start-up of capital facilities.

For projects that proceed to full authorization the cost of pre-project planning will contribute to and reduce bonifide engineering, construction and start-up costs.

For projects that do not proceed to final authorization, pre-project planning costs can be reduced by interim authorizations and thereby prevent financial/political problems.

The IDEFO Model

The research team needed a methodology to organize its efforts and adopted the IDEFO, Structured Analysis and Design Technique"', methodology (Marca and McGowan 1986). The U.S. Air Force developed this methodology to model the functional relationships of manufacturing processes involved in defense weapons procurement contracts. The methodology provided the research team with a structured, graphical tool to organize its thoughts.

Figure 1.4 shows an example of one of the IDEFO diagrams that the research team developed and relates to the major functions involved in pre-project planning. Underlying these diagrams are a structured review process, a detailed glossary of terminology, and a narrative describing the interactions within the diagram. The models facilitated the writing of this handbook. Research team members identified the information flow between the various planning functions, as well as the major players and the controls for each process. It could apply equally to different project types and companies. Appendix A contains the pre-project planning models and Appendix B contains the definitions of terms.

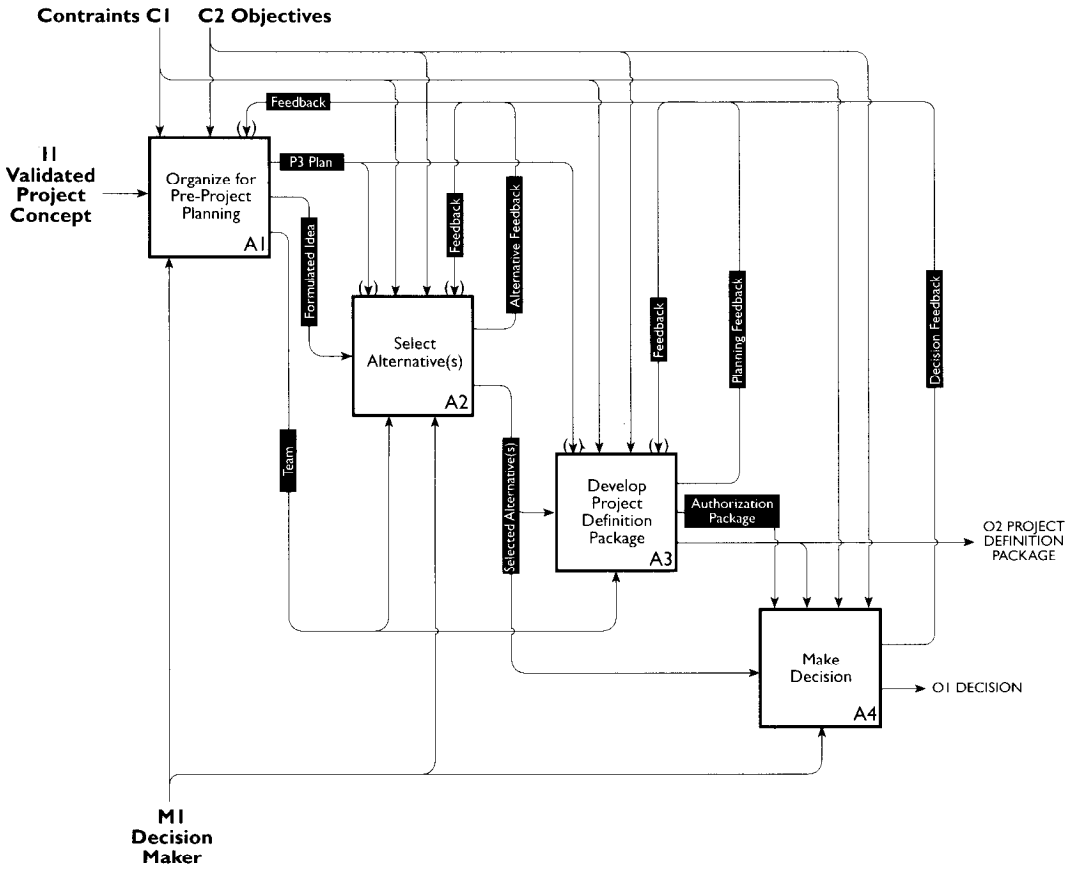


Figure 1.4: ***A0 Diagram - Perform Pre-Project Planning***

As can be seen in Figure 1.4, the major sub-processes of pre-project planning are: *Organize for pre-project planning; Select alternatives; Developproject definitionpackage;* and *Make decision.* Note that: 1) this is not a linear process and functions can be occurring concurrently; and 2) interaction and iteration are inherent within this process.

Details of the Format

This handbook makes every attempt to relate the process, as outlined in the next four chapters, to the model introduced previously. Icons are used to gain perspective of the user's position in terms of the model. For example, the icon shown in Figure 1.5 is a simplified representation of Figure 1.4. When this icon is given, the highlighted function is the center of the discussion in the chapter, in this case, *Organize for Pre-Project Planning.* The handbook will use these icons to reinforce the process discussed in the next four chapters.

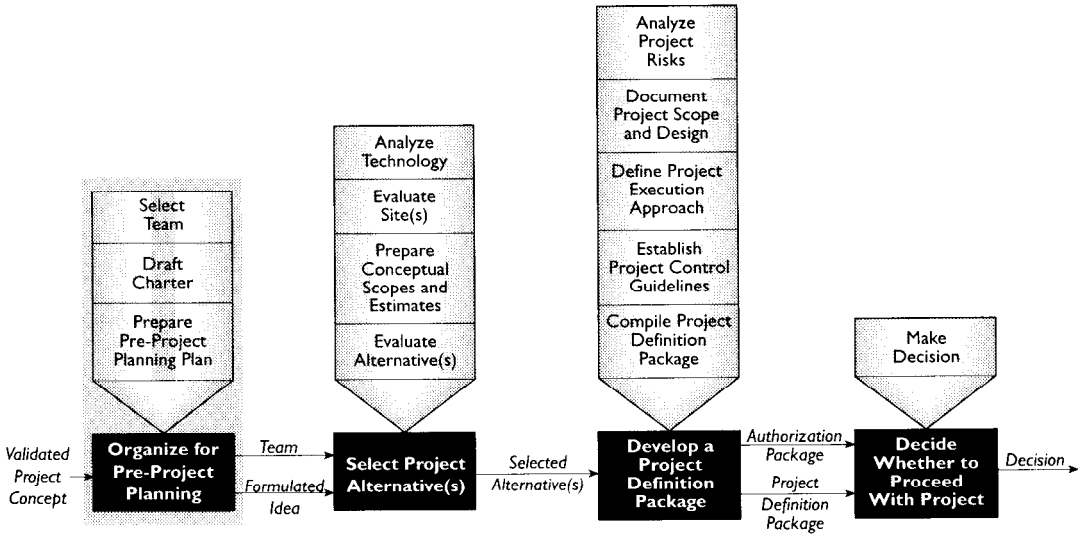
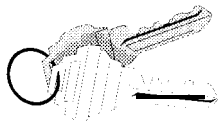


Figure **I.5** *Pre-Project Planning*

In addition, quotations will be given at the beginning of major subtitles. They underscore the importance and applicability of the material. These quotations and other data introduced into the discussion were gathered during a detailed research investigation that evaluated 62 industrial projects.

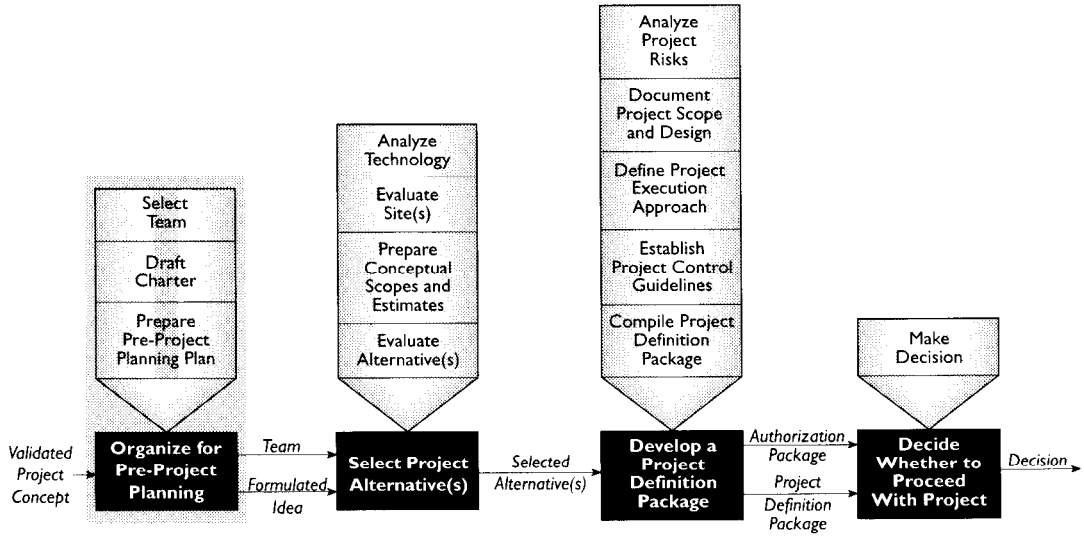
The text and Appendices C and D contain examples of tools used to perform pre-project planning. These examples should give the user ideas of the documentation and effort involved in performing this process-as well as become the basis for similar efforts. Each chapter ends with a short summary detailing the major points made in the chapter. A list of applicable CII publications are given in Appendix E for reference purposes.



Key Points

The research team provides the following key points as guidance:

- *Membership or participation on the pre-project planning team is very dependent on the size and complexity of the project, as well as the expertise resident within the company. In smaller organizations, with Limited staff and/or project skills, consultants may be key to performing the process; however, the owner is still responsible.*
- *Responsibility matrices highlighting the tasks and schedule for accomplishment of major pre-project planning activities help facilitate better control of the process.*
- *Participants should report the true facts concerning the financial viability of the project. "Don't shoot the messenger."*
- *Often owners put projects on hold during pre-project planning due to outside influences. It is very important to document the pre-project planning progress so that the project team can resurrect the project quickly with minimal disruption. In addition, the project team must document all projects and all phases in order to use process improvement from project to project.*
- *Believing that a project is a 'copycat" can be a vicious assumption. ALL projects are different and need some amount of pre-project planning.*
- *Be careful when making assumptions. Bad assumptions can cripple projects very quickly.*



The first series of activities in performing pre-project planning deals with organizing for pre-project planning. The three major functions are selecting the team, drafting the charter, and preparing the pre-project planning plan. Figure 2.1 illustrates these functions.

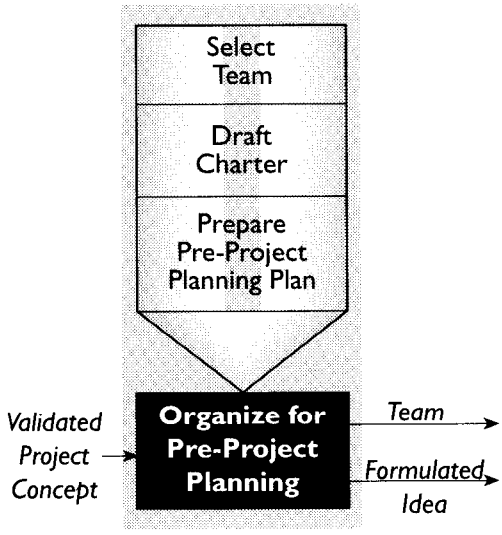
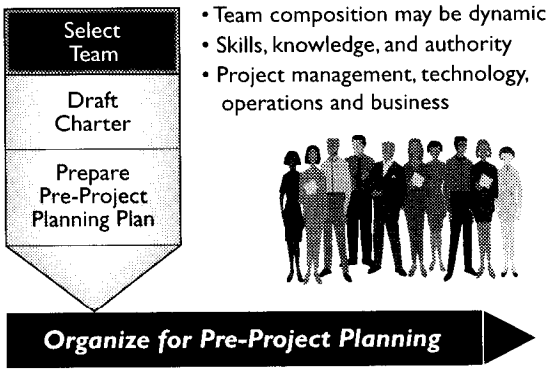


Figure 2.1 : ***Organize for Pre-Project Planning***

Teamwork

The results of performing these activities are a pre-project planning plan, a formulated idea, and a team that becomes an integral part of the planning effort. The first major function in organizing for pre-project planning is to select a team. Members from a variety of different sources from within the owner's organization or from outside parties comprise the team. It is important that the team members all be united and dedicated to making the planning effort a success.

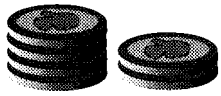


Selecting The Team

Reason for Project Success: "Number of participants from all business areas... Participants were all top qualified... Lots of experience... dedicated full-time to this project." - A project manager

Background. Selecting the proper team is essential to the pre-project planning process. The following discussion outlines this process in more detail.

Starting Point Input. The decision maker will use the validated project concept developed during business planning as an input to determine team composition. The validated project concept is the initial idea for the project that sets the pre-project planning process in motion. It may involve new profit opportunity, regulatory compliance, or reduction of liability exposure for the company. The concept typically includes information relating to the preliminary project objectives and is validated in that senior management has accepted the concept as plausible and authorized funding for the pre-project planning effort.



Resources for team should support the desired outcomes.

Team Composition. Membership on the team is fundamentally a function of organizational participation, and required attributes of individuals so that the team may accomplish its charter.

The first consideration is that all "stakeholders" should have representation on the team, or the opportunity to provide input to the planning process. Stakeholders are key individuals from functional parts of the organization who will be affected by, or have to live with, the project. These functional parts of the organization may include project management, technology, operations, business management, and others. The next consideration, which is critical, is that team members must have the right attributes so that the team is able to effectively accomplish its objectives. The team must possess three fundamental attributes:

- *Expertise - Bonafide knowledge of key elements of the project.*
- *Capability - The ability to physically execute tasks necessary to accomplish the planning efforts.*
- *Authority - The right to make decisions.*

These attributes must be present or the team will have great difficulty in accomplishing its objectives. If the expertise is not present when needed, mistakes are inevitable. If the capability to execute a task is not present, the work will not be done or it will be done poorly. If authority is not present on the team, choices and options will be difficult or impossible to resolve. Different individuals or combinations of individuals may provide these attributes at different stages in the process.

On larger projects, any number of full or part-time representatives

from various disciplines within the organization may actively participate on the pre-project planning team. The number of participants engaged in pre-project planning is not the issue, but rather the expertise that is needed to complete the process. Large scale, pre-project planning undertakings will necessarily involve several individuals; smaller scale undertakings will involve perhaps as few as one individual drawing on the resources available within the organization. Smaller organizations that may have limited staff and/or project skills should not allow a perceived lack of resources to discourage efforts towards pre-project planning. Consultants, contractors and other experts can provide specialized expertise to the pre-project planning process.

On projects involving joint ventures or alliances, the respective owners must bring their individual corporate strategies into focus very early in the pre-project planning process. This may or may not result in direct participation in the planning team; however, the various owners must contribute to the process and reach consensus on both the initial direction given to the team and on the acceptance of the team's final recommendation.

Focus

The Team Leader. The decision maker will select a team leader. The team leader will determine team composition depending upon the concept the owner has chosen and the required attributes of the team. Ideally the qualities of a team leader should include:

- *Comprehensive understanding of the pre-project planning process*
- *Expertise on similar projects*
- *Experience in team facilitation*
- *Competence as viewed by peers*

- *A willingness to Listen and the ability to express oneself*
- *An ability to help individuals or organizations to surpass themselves*
- *Organizational effectiveness (finds the balance between tasks and people)*
- *Ability and willingness to confront problems*

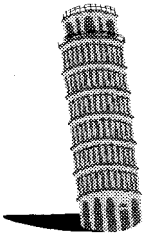
Sub-Teams. Team members may also form sub-teams that will focus on specifically defined tasks. Sub-teams may consist of people (one or more) from within the organization, or from outside sources such as consultants or contractors, that bring a specific expertise considered necessary to support the team's goals and objectives. These sub-teams may review issues such as:

Sub-teams used as an extension.

- *Risk assessment (environmental Legal political, technological, etc.)*
- *Technology assessment*
- *Site assessment*
- *Estimated market assessment*

Sub-teams are merely an extension of the primary or core team and must have the same agenda, support, goals and objectives. They must buy into the team's purpose to ensure that the greater effort and mission are successful. Sub-teams may become self-directed and develop their own mission statement and objectives to support the overall objectives and goals of the pre-project planning team.

The Right Balance. CII research demonstrates that project success is more than having the right human factors in place. A balance of technical, management, and human factors is required for project success. These elements are interdependent, synergistic and congruent. To optimize success, all of the elements must be actively present.



Balance is important.

Successful project teams have strong feelings of teamwork and congruency among key project team members.

Other factors that will bear on team composition are the resources available for pre-project planning, the degree of participation desired of the membership, the degree of pre-project planning detail desired, and the project specific objectives.

Anticipated Project Requirements/Skills and Staffing.

In developing the team, the team leader must evaluate project requirements and determine skill and staffing requirements for the following areas:

Team makeup is critical.

- *Business and Market Evaluation*
- *Construction*
- *Cost and Schedule*
- *Environmental*
- *Financial Analyst*
- *General Engineering*
- *Human* Resources
- *Image*
- *Labor Relations*
- *Legal*
- *Operations*
- *Process Engineering*
- *Procurement*
- *Project Controls*
- *Project Management*
- *Project Sponsor*
- *Public Relations*

- *Quality*
- *Safety*
- *Specialist Engineering*

Long-Term Continuity. When selecting key team members, it is desirable to provide for continuity of project leadership throughout the life of the project. This continuity helps assure the original objectives and intents are met by providing people with full project background knowledge; how things were determined; why decisions were made; who did particular tasks; where information is stored, etc. This adds strength, stability, confidence, consistency, and competency to the efforts of not only the technology evaluation team, but to the many sub-teams that will be required to perform during the course of the project. If continuity is not possible, then a well-defined and documented plan becomes even more critical.

Continuity is important.

Team Commitment. The team leader helps the team members focus on accomplishing the team's goals. Team members support each other, collaborate freely and communicate openly and clearly with each other. The goal of the team must be a very high priority for the team members. If other organizational responsibilities have a higher priority, the team will suffer. This must be taken into account when team members are assigned, and they must understand their priorities. Research conducted by the Pre-Project Planning Research Team has established a clear link between teamwork and positive project performance. Most non-team groups tend to be collections of individuals with personal agendas that may be more important than the agenda set by the team. Shifting agendas, power plays and even a win-lose ori-

Teams must work together.
(or Teamwork)

entation often characterize discussions, interactions, and relationships in such groups. The result is that one individual or subgroup gains at the other's expense.

Open exchange of information.

An extended benefit of collaboration is open, honest, free-flowing communication among team members. Team members understand and embrace synergistic power of teams and the open communication that flows therein. Communication is constructive in teams. This does not mean that conflict does not exist, but team members openly deal with it within an environment of honest and constructive communication.

Consensus Decisions. Teams make decisions by consensus. Consensus does not mean that everyone necessarily agrees with a decision. Once the group supports that decision, however, all should strive to effect a positive outcome from the decision. This does not mean that one person does not have ultimate authority to make a decision. It does mean that all inputs are considered, and the team can support the decision.

People who participate in decisions and solutions own them and consequently feel committed to carrying them out successfully. Team members also feel a strong commitment to not let the team down.

Effective Teams. Ideally, members of effective teams:

- *are flexible*
- *are trusting*
- *are wholeheartedly supportive of every member of the group*
- *have shared objectives*
- *are technically qualified individuals*
- *are open and honest*
- *are respectful of others*
- *are non-threatening towards other members in the group*
- *are self motivated*
- *are solution oriented*
- *are totally committed to the group*
- *are willing to share power*
- *are willing to participate in group discussion*
- *are willing to collaborate*
- *have effective working relationships*
- *have appropriate roles and responsibilities*
- *have information systems to promote communications*
- *employ work planning techniques andpractices*
- *maintain continuity ofparticipation (by key members)*
- *support decision by consensus*
- *demonstrate a sense of urgency*

Effective teams remain effective by continuously reinforcing the above entities, by focusing on team objectives, and by removing individuals from the team who do not embrace the concepts of teamwork and team building. Owners or team leaders must remove those team members who are unable or unwilling to embrace a systemic attitude

regarding the team and its mission and who harbor personal agendas with a narrow focus to the detriment of the team and its goals.

Project objectives must be clearly defined.

Clearly Defined Objectives. Previous CII research has determined that a significant cause of project difficulty lies in a lack of clear owner-objective definition, internal inconsistency of objectives, and a lack of clearly communicated project objectives. This research team concluded that the first step in planning and organizing for project success must be a clear, detailed definition of the owner's objectives. The owner must communicate these objectives to the project participants. Further, the methods by which the entities engaged in pre-project planning combine their own objectives with the owner's objectives become critical if the project team is to truly have shared objectives that will permit it to function effectively. The Pre-Project Planning Research Team has shown the disparity in objectives between project management, business unit management, and operations management.

Individual objectives must be aligned with business objectives.

Project objectives should be: precise, defined in terms of measurable results, specific in terms of time periods for objective accomplishment, flexible, accommodate change as feedback warrants, and assign relative priorities to multiple objectives. In the development of objectives, the owner must consider the people who will be working toward achieving the objectives. Developing objectives that are clear is essential in order to accomplish a particular purpose. Source CII Document 31, *Project Objective Setting by Owners and Contractors*, provides a complete outline for objective setting.

Upon completion of the formulated, project-specific objectives, the planning process can continue. A business may have many different goals for a particular project, but the project objectives can be distinguished by the fact that they deal with time, cost, and quality. These

"Good, fast, cheap. Pick two."

characteristics of project objectives are dependent variables since each one has an effect on the others. The right balance must be established among them, and the team must have a clear understanding of the correct balance that fits within the business objectives. The project objectives as molded by this balance between time, cost, and quality will determine the project acceptance criteria against which the owner will ultimately judge the success of the project.

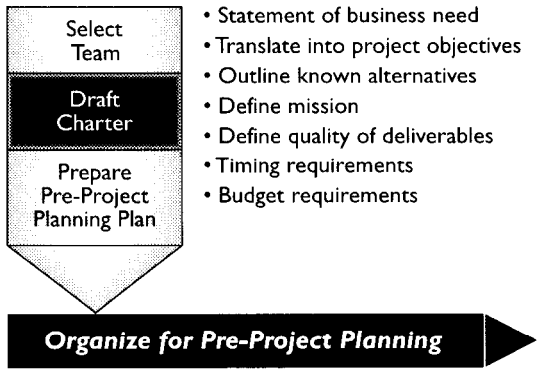
Feedback. Because this effort is iterative in nature, feedback from the other steps in the organization process may also control team selection. The team selection function generates a dynamic team which becomes key to the rest of the pre-project planning effort. Fundamentally, feedback is to support and reinforce the meeting of the project objectives, and feedback provides the control vehicle to ensure that the pre-project planning effort does not lose its way.

Alliances. Global alliances are being formed, in many cases, to allow businesses to compete more effectively for market share. An alliance is a long-term association with a non-affiliated organization to further the common interests for the members. The CII International Construction Research Team cites the following benefits of alliances:

- *enhance competitive position*
- *increase market share*
- *obtain new work*
- *broaden client base*
- *increase cultural maturity*
- *share risk*
- *increase profits*
- *increase Labor productivity*

A pre-project planning team could consist of members of the alliance. Because of potential differences in corporate objectives and values and even cultural differences among team (alliance) members, it becomes even more important that team members have *shared objectives* and feel a *strong commitment* to the team.

Conclusions-Selecting the Team. An extremely important factor in performing pre-project planning well is selecting the proper team for the job. The correct functional and technical expertise, team training, team objectives and leadership are essential for this process.



Drafting The Charter

Reason for project problems: Need to have "Better communications and understanding to and from upper management so they understand the implications of what's developed." - A project manager

Background. The second step to organize for pre-project planning is for the team to draft a charter. The charter defines the pre-project planning team and its mission, responsibilities, accountability, and authority in order to transform the project concept into a valid approach to completing the project. Allotted time, corporate guidelines for capital projects, corporate objectives concerning level of planning detail, and success criteria for pre-project planning control the drafting process. The following discussion outlines this process in more detail.

A charter defines mission, responsibility, accountability, and authority.

Corporate Objectives. The corporate objectives, while typically more conceptual or esoteric than project specific objectives, nonetheless need to be conveyed in terms that will be understood completely by those engaged in pre-project planning activities. The project specific objectives that were a significant "control" in the team selection process must be compatible with the corporate objectives. To ensure that project and corporate objectives are consistent, the corporate

leadership must explain corporate objectives in enough detail to allow the pre-project planning participants to gauge compatibility among objectives. Applied corporate objectives must reflect consensus of all participating entities such as partners or joint venture companies or government agencies.

Definition of objectives should not prematurely focus the project.

The corporate objectives should clearly define the *business need or opportunity* in terms that are broad enough so that they do not prematurely focus the project in a specific area that may not be the best alternative to addressing the need or opportunity. For example, if management defines a business need as "install a new boiler" rather than "provide more steam," one may miss the fact that one could upgrade systems or reorganize it to satisfy the need. Another example would be "build a new school," which is a narrower definition than "provide more classroom space." One could satisfy the former by refurbishing old buildings or using temporary buildings.

Judging Project Success. The perspective of who is gauging success can influence the criteria. The owner's reason for the completed project is its performance. The design and construction of the project are the designer's or constructor's focus. In essence, the *product* is the owner's concern, and the *design and construction processes* are the designer's and constructor's concern. Until the constructors complete the project and it is operational, one cannot adequately judge the project's success. Nevertheless, the owner will ultimately judge the success of the project on the basis of its having satisfied the acceptance criteria, which have been based upon the project objectives, which in turn will have been influenced by the elements of time, cost and quality. Some of the success factors necessary to support a successful pre-project planning effort would include:

- *well-defined project objectives*
- *congruency of objectives among key participants (especially those representing the business, technology, and operations' interests of the company)*
- *early and extensive planning*
- *technically competent and experienced participants from sectors affected by the project*
- *time commitments by key participants*
- *Leadership through major participants*
- *proper team chemistry*
- *a sense of urgency and responsiveness in team members*
- *open supportive communications*
- *teamwork/team building attitudes*

Pre-project planning requires a plan.

Fundamentally, the pre-project planning effort must develop a plan that adequately addresses any and all project variables that could impact the outcome of the project. The development of the charter, which itself is an input to the preparation of the pre-project planning plan, embodies the success criteria. The criteria for success are a measure of how the pre-project planning effort will have performed relative to the team's set goals. The overall success of the completed project will ultimately reflect the true success of the pre-project planning effort.

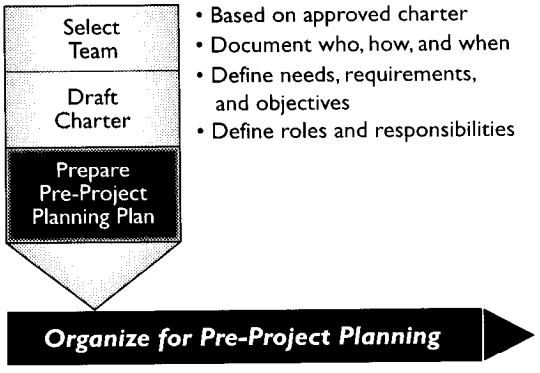
Corporate/Company Guidelines. Most organizations will have established formal or informal guidelines for pre-project planning. The team leader should review these guidelines for applicability to the specific project and then summarize and communicate them to all team members.

Charter Contents. On large projects, a formal charter may consist of a memorandum to the team members. In any case, it should address the following key elements:

- *Mission Statement*
- *Definition of Quality of Deliverables*
- *Organization Chart with Roles and Responsibilities*
- *Set of Major Milestones for Pre-Project Planning*
- *Team Building Procedures*
- *Defined Reporting Requirements*
- *Coordination Procedures*
- *Defined Limits of Authority*
- *Funding Parameters*

Conclusions-the Charter. The charter focuses the team on the task at hand and is the basis for communication throughout the pre-project planning process. It forces the team to address key issues regarding the project early in the planning process. Most organizations will have established formal or informal guidelines for pre-project planning such as budget and accounting requirements. The charter should be prepared, taking these guidelines into account, and then reviewed with the decision maker(s) before proceeding with the pre-project planning effort. This review will help insure alignment of corporate objectives, the decision maker's viewpoint, and the pre-project planning team's mission and goals.

Obtain commitment from sponsors to the charter.



Prepare Pre-Project Planning Plan

Reason for project problems: "We need to have documentedguidelines for pre-project planning; need a road map to adhere to. "-A project manager

Background. The third and final function in the organization of the pre-project planning effort is to prepare a pre-project planning plan. The team prepares the pre-project planning plan using the validated project concept (the idea for which the pre-project planning effort is being expended) and the charter (defining the team, its mission, responsibilities, authority) as inputs. Time, team skills, and other management criteria serve as controls for the development of the plan. These criteria may include information, standards, rules, and guidelines that management must consider before it makes a decision to appropriate funds. Preparation of the pre-project planning plan results in two outputs. First, the team generates a formulated idea, which is a more clearly focused, validated project concept-that is to say, "We have figured out what we need to do and we have the concept in-hand and clear project objectives with which to move forward." Second, the team generates a pre-project planning plan.

The Pre-Project Planning Plan. The pre-project planning plan is a formulation and documentation of the methods and resources an owner company can use to perform the pre-project planning process. It is composed of the following:

Composition of pre-project planning plan.

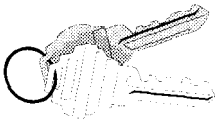
- *Statement of Business Need*
- *Outline of Known Alternatives*
- *Defined Schedule for Pre-Project Planning*
- *Defined Pre-Project Planning Resources in Detail*
- *Defined Budget For Pre-Project Planning*
- *Defined Information Availability and Needs*
- *Locations of Pre-Project Planning Work*
- *Contract Strategy*
- *Permit Analysis*
- *Defined Deliverables*
- *Status Reporting Requirements*
- *Defined Tasks of Minimizing Risks for:*
  - *A. Research*
  - *B. Technology*
  - *C. Site*
  - *D. Market*
  - *E. Competition*
  - *F. Health and Safety*
- *Project Outline*
  - *A. General Capability*
  - *B. Location*
  - *C. Feed and Product Quality*
  - *D. Technology Review*
- *Pre-Project Planning Priorities*
- *Define Responsibilities for All Pre-Project Planning Team Members*

Addressing the elements of the pre-project planning plan will support effective development of the project definition package, which encompasses the project execution plan. Chapter 6 of this handbook addresses the project definition and execution packages.

In the process of preparing the plan, two factors will influence the success of the undertaking: one, the team's composition and attendant skills, and two, the quality of the charter in terms of clearly expressed objectives.

Team skills are important.

Key Points. Elements for consideration in the pre-project planning process at this juncture include:



- *The earlier you plan before project execution, the more you will influence project execution.*
- *The earlier you are able to divide tasks into smaller, self-contained, independently executable sub-tasks, the easier it is to shorten the planning duration by attending to several sub-tasks simultaneously.*
- *Clearly defined roles and responsibilities for team members (core team as well as sub-teams) are vital for successful pre-project planning.*
- *The more time and resources allocated for planning at each stage, the greater the opportunity to pursue optimal solutions. The pre-project planning plan must be controlled in terms of schedule and cost.*
- *In situations of high uncertainty, planning with a flexible and responsive approach is appropriate; selection of qualified team members becomes more important as the degree of uncertainty increases.*
- *Planning requires two strong beliefs-that unless something is done, a desired future state is Less Likely to occur, and that something can be done to increase the chance that* a *desired state will occur.*
- *Lastly, planning can be time-consuming and technically/administra-*

tively challenging; time must be made available to team members to carry out their pre-project planning responsibilities.

Conclusions-Developing the Pre-Project Planning Plan.

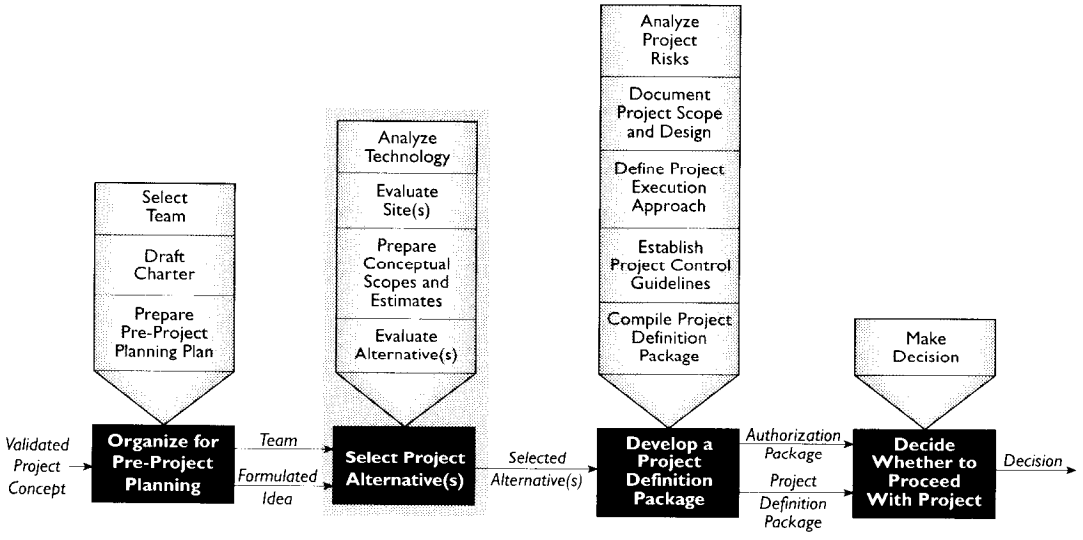
Planning of the pre-project planning activities sets the stage for successful project performance. The plan as outlined previously ensures that the process is well coordinated and comprehensive.

Key Points-Organizing for Pre-Project Planning

In pre-project planning, there is no magic wand.

Organizing for pre-project planning fundamentally comes down to picking the right people for the task at hand, empowering those people to perform, and clearly communicating the business objectives of the enterprise and the project objectives. Everything else relates to the mechanics of getting it done. With the fundamental requirements in place, the process should be clear as long as the team members pay proper attention to the functional steps and details of organizing for pre-project planning.

Select Alternatives



The second series of activities in performing pre-project planning deals with *selecting alternative(s).* The four major functions are: *Analyze Technology Evaluate Site(s), Prepare Conceptual* Scopes and *Estimates,* and *Evaluate Alternatives.* These functions are shown graphically in Figure 3.1.

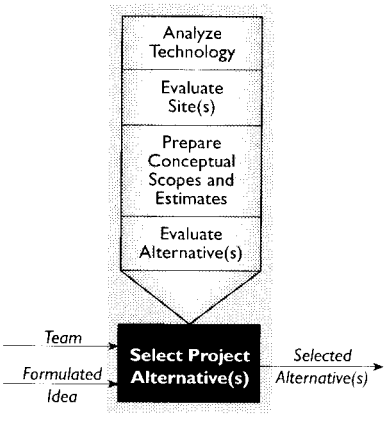
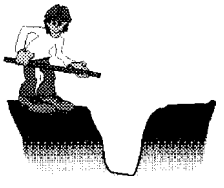


Figure 3.1: **Select Project Alternative(s)**

The result of performing these activities is *selected alternative(s).* The evaluation process must include all of the steps in this chapter (even if some may be based on preliminary information necessary to assess technical feasibility, cost, timing and strategic value). The assessment results must be reviewed by a decision maker, who may produce a go/no go decision or provide guidelines to recycle and evaluate alternatives.

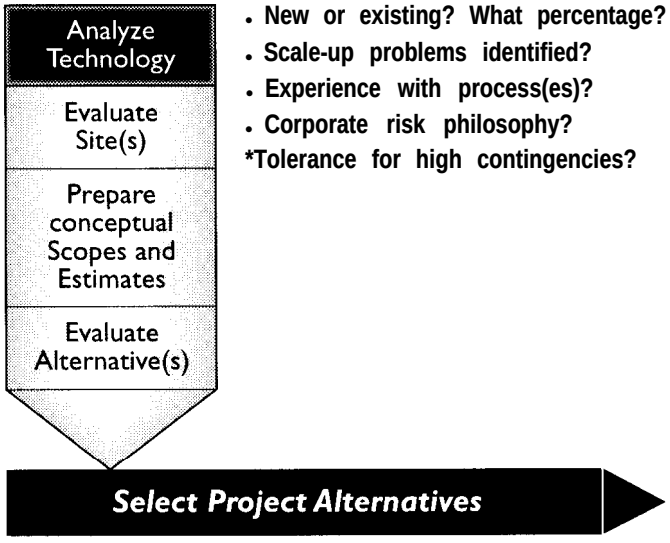
Knowledge gap= Pitfall



As the team is formed, the core team leader or a representative must ensure that sufficient expertise is available to complete these activities. Special consideration should be given to the following:

Cover your knowledge gaps.

- *Archeological/Historic Preservation*
- *Available Technology*
- *Business*
- *Community Relations*
- *Competitive Position*
- *Engineering/Construction*
- *Environmental*
- *Financial*
- *Health/Safety/Toxicological*
- *Human Resources*
- *Knowledge Gap Identification & Solution*
- *Labor Relations*
- *Legal*
- *Market Expectations*
- *Marketing/Purchasing*
- *Operations*
- *Project Estimating*
- *Risk Analysis*
- *Supply and Distribution*
- *Technology Gap Identification &Solution*



Analyze Technology

Reason for project success: "New type technology used that was risky but paid off...did Lots of field testing and convinced ourselves this was feasible technology."- A business manager

Do your homework.

Alternatives must be carefully analyzed to be sure your project starts from a solid foundation.

Background. The function, *analyze technology*, assesses available technologies in relation to company needs and constraints. This sub-process also identifies and addresses knowledge and technology gaps that team members must overcome to permit the decision maker to reach a quality decision.

Analysis of Available Technologies. Normally, several competing technologies, and possibly a company-developed technology, must be considered. In addition, all questions necessary to produce a high quality financial analysis must be answered. Each alternative must be

analyzed to ensure that it meets stated objectives and is within applicable constraints, such as legal, patent, regulatory, toxicological, environmental, and safety considerations.

One of the first tasks is to determine what technologies exist, how competitive they are, and if they are available. This will include any new technology being considered that might be forthcoming from the firm's own research and development efforts. Key elements of this part of the analysis involve reviewing things such as: open literature; technology monitoring services; patents; and business and marketing intelligence reports. Normally at this point, several technologies can be eliminated to reduce the alternatives to a manageable list.

Obtain all relevant technology information.

More detailed information must be gathered concerning the remaining technological alternatives. The next step is to approach owners of the technologies of interest and request a limited secrecy agreement (if required). This will allow the team to exchange sufficient information for financial analysis, product evaluation, and process evaluation, as well as assessments of legal, patent, health, safety, toxicological, regulatory and environmental concerns. This evaluation also helps determine additional requirements such as feedstocks, packaging requirements, operating labor, maintenance requirements, storage requirements, utilities, services and other requirements necessary to produce rough capital cost estimates. The same effort should be expended to develop similar information on newly developed company technology to ensure that the new process will be competitive.

After all alternatives have been evaluated and knowledge gaps filled, the team should develop recommendations based on selection criteria that takes all mission objectives, constraints and guidelines into account. This is a critical step that must be very carefully considered.

Review selection criteria with management.

An excellent time to review the criteria with management (i.e., the decision maker) and get feedback before proceeding with selection is after the selection criteria have been developed. Many times the selection criteria will be a weighted blend of the following:

- *Long-term competitive position*
- *Product qualities*
- *Process flexibility*
- *Financial analysis results*
- *Operating considerations*
- *Environmental considerations*
- *Compatibility with potential sites*

Document the technology analysis.

Preparation of Technology Documentation. As the technology analysis proceeds, the process should be documented and contain the following information:

- *Objectives of the Analysis. A statement of the technology objectives and a List of the technologies to be analyzed by the team.*
- *Description of Products and Process. A general description of each process and the resulting products is documented. Also, a Listing of identified knowledge gaps or process/product shortcomings is prepared.*
- *Applications/Market Factors. Potential and target applications of process/products are discussed and could include: competitive positioning, target market share, degree of competition anticipated, types of market, expectedgrowth of market, threat from other sources, and long-range sales projections.*
- *Financial Analysis. Plans for financial analysis of each technology should be made. These should include a risk assessment study and sensitivity analysis. Standard company measures such as return on investment (ROI), cash flow rate of return (CFRR), net present value (NPV), etc., should be compared.*

- *Assessment of Regulatory Status and Need for Environmental/ Toxicological Testing. A plan to address these issues is included.*
- *Legal and Patent Status. Plans are made to address Legal and patent questions.*
- *Knowledge and Technology Status. Plans are made to address identified knowledge and technology gaps.*

Use milestones and key dates to keep the analysis moving at the proper pace.

Technology Analysis Milestone Schedule. The technology documentation should also include a milestone schedule to help define the time line required to complete the study. Key milestones in the schedule may include:

- *Team formation date*
- *Identification of all technologies to be considered*
- *Secrecy agreements for all technologies executed*
- *Product samples obtained and tested*
- *All site visits and meetings*
- *All inputs to financial analysis. These include sales forecasts, price/volume for each product (short- and Long-term), and all cost elements, (labor, cost of goods, capital, etc.) for each technology*
- *Assessment of regulatory status for each technology*
- *Assessment of Legal andpatent status for each technology*
- *Risk assessment*
- *Selection criteria management review date*
- *Final report and recommendation date*
- *Anticipated date of completion of installation*
- *Anticipated date of first sale ofproduct or date of occupancy*

Once the general plan and milestone schedule are produced, the team should develop, expand, and refine the information into detailed plans, schedules and individual responsibility assignments.

Selection criteria provide a way for others to understand how the decision is to be made.

Technology Selection Criteria. The team develops selection criteria based on project objectives. These criteria can generally be placed into three categories:

- *Go-No Go. This category typically contains items that must be complied with or the evaluation is terminated because the technology has no chance of being successful Examples include: (a) Company must maintain a favorable Legal position; (b) Technology must have patent clearance; (c) Technology must comply with regulatory requirements.*
- *Critical Needs. This category typically deals with those items contained in the stated objectives, constraints, and success criteria such as capacity product form, feedstock requirements, square footage of floor space, etc.*
- *Wants or Likes. This category typically deals with the customer: satisfaction of the key stakeholders such as business, operations, maintenance, engineering, etc. A selection criteria matrix or table should be prepared that shows the weighting for each criterion and the rating or score for each technology alternate. Suggested weights should total 100 percent and ratings should be on a 0 to 100 scale. Separate sheets showing explanations for selected ratings may be helpful and appropriate. For an example of the objective matrix methodology see CII Publication 8-1,* Evaluation of Design Effectiveness.

Get everyone on the same page.

Final Report. The final technology evaluation report requirements should contain a management presentation and formal report.

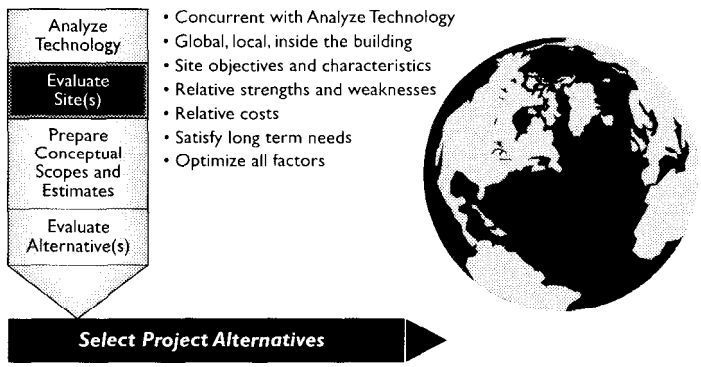
- *The Management Presentation. The objective of this presentation should be to give management sufficient understanding of and confidence in the recommendation so that they are convinced that.*

Give management confidence that the right things have been done and the correct recommendation has been made.

- *All relevant technologies have been explored or analyzed*
- *The method of analysis has been thorough*
- *The results are complete and accurate*
- *The recommendation is well-based, sound, and responsible*
- *The recommendation will meet company objectives and can be accomplished within requirements and constraints outlined*
- *The selected technology is correct*

- *Formal Report. This written report should document details of the technology study and include the final cost of the team effort.*

Conclusion-Technology Selection. The technology selection function is a critical element in the long-term success of the company or organization. Careful consideration of all needs and situations is essential to making the best decision. The stated approach, which draws from resources and expertise of the organization to ensure that all aspects are thoroughly evaluated or considered, provides a means of logically and systematically arriving at a technology selection recommendation.



Evaluate Site(s)

Reason for project problems: "...in this case the building was in a seismic zone and not seismically constructed. We found this out Late...." - A business manager

Site alternatives may be global, local, or inside the building.

Background. In many cases, site characteristics influence the technology selection. The site selection team must develop sufficient information to permit the optimization effort to occur during the evaluation of the alternative(s) function.

The function, *evaluate site(s),* is the assessment of relative strengths and weaknesses of alternate locations to meet owner requirements. The theory of site selection is fairly simple - to find a location that maximizes benefits for the owner company. Practical application of the theory is less straightforward. Evaluation of site(s) may address issues relative to different types of sites, i.e., global region, country, local, "inside the fence," or "inside the building."

Consider long-term needs.

Major Steps of "Evaluate Sites." Business objectives are of pri-

mary importance to this evaluation. The first decision is to determine the general geographic location of the facility, i.e., near the targeted market area, the source of raw materials, low cost labor, available utilities, existing facility, or a combination thereof. Developing cost impact tables can help determine priorities, but the business decision should be pointed to long-term needs. Examples of different types of sites and specific evaluation criteria include: Gulf Coast of Texas (site 1) - Raw material supply location; Tennessee (site 2) - Low cost of labor; Oklahoma (site 3) - Low cost of power; and Los Angeles (site 4). - Intended market area. Table 3.1 illustrates a method to compare the major differences in sites. Note that capital cost is expressed as a

Set site correctly by evaluating pertinent criteria.

Table 3.1 : ***Annual Cost Impact Table***

	Best Raw Material Site 1			**Best Labor Site 2**			**Best Power Site 3**			**Best Market Site 4**		
	Estimate			**Estimate**			**Estimate**			**Estimate**		
ANNUAL COST FOR:	Low	Best	High	Low	Best	High	Low	Best	High	Low	Best	High
Raw Materials Cost												
Labor												
Capital (Straight Line Method) Amortization and/or Depreciation Expense												
Utilities												
Supply & Distribution Cost												
Administrative & Marketing Cost												
Total Cost												
Site Advantage-between Site and low cost												

depreciation expense. This evaluation helps focus on the business objectives and how important each major element is to the selection.

If site selection is unconstrained by politics, legal, regulatory, financing requirements or social issues (which is highly unusual), then the selection will normally become an optimization based on best available choices. These generalized considerations are as follows:

Don't expect a perfect site.

- *Best overall economic choice (present plus future considerations)*
- *Best choice from a benefits standpoint (market)*
- *Best choice from a cost standpoint (raw materials, Labor, utilities, supply and distribution cost)*
- *Best choice from an initial investment standpoint*

If politics, legal, regulatory, financing requirements or social issues constrain the site selection, then the selection becomes a sub-optimization based on the best available choices given the set of constraints that apply. For example, international financing and/or government-sponsored loans can require extensive time to obtain and administer. Planners must consider these complications and allow for both in the project timetable and funding cost. Once the general study is complete, specific available sites are located that meet the general criteria from the results of the annual cost impact table. This step can employ the services of local governments, real estate agents, or Chamber of Commerce assistance. Ultimately, the team prepares a list of specific sites and from this list they select the final site.

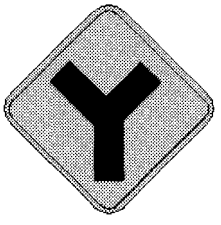
Each project has a different set of site requirements.

To make this selection in a logical manner, extensive information for each site must be developed. Possible site objectives and site characteristics are listed in Table 3.2.

Table 3.2: ***Site Objectives and Site Characteristics***

SITE OBJECTIVES	SITE CHARACTERISTICS
Ability to Expand for Future Capacity	Hydrological Considerations
Level of Tax and Legal Considerations	Soil Capabilities • Roads • Equipment Foundations • Building Foundations
Long Range Goals	Other Geotechnical Considerations
Access to Markets (New and Existing)	Surface Run-off Considerations
Access to Low Cost Feed Stocks	Historical Implications
Access to Low Cost Construction Labor	Environmental Evaluations • Area Environmental Attainment Status • Availability of Ambient Air Quality Data • Feasibility of Providing NO offset • Surrounding Area Land Use • Water Quality Permitting
Access to Low Cost Operation Labor	Hazardous Waste Clean Up Considerations
Access to Low Term Growth Opportunities	Location
Land Availability and Costs	Configuration
Transportation	Topography
Competitor Considerations	Zoning
Energy Cost	Neighboring Land Use
Labor Analysis • Availability • Work Ethics • Labor Posture • Labor Cost • Skill Level • Attitudes	Access (Road, Rail, Marine, Air)
Regional Analysis • Ability to Attract and Retain Professional Employees • Services • Infrastructure • Quality of Life • Utility Service and Cost • Local Area Industry Size • Local Area Industry Cost • Local Area Financial Incentives • Growth Incentives • Taxes • Environmental Restrictions • Cost Analysis for Each Site • Recurring Cost • Non-recurring Cost • Ability to Attract and Retain Professional Employees	Construction Access Construction Feasibility Utilities Ownership Cost of Property Total Site Development Cost Weather Climate

More than one alternative may be *viable.*



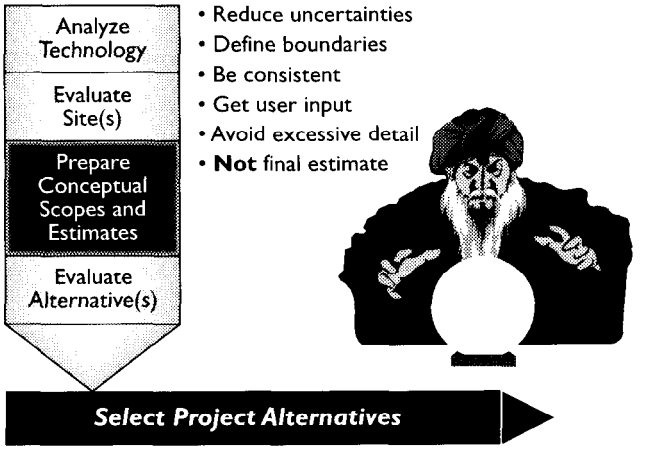
But you have not eliminated site uncertainty until one site is agreed upon.

Site Selection. Once the site information has been developed, the team must organize the information for decision purposes. The decision will reduce the potential sites to a manageable few, if not to a single site. If the team cannot finalize the site selection based on available preliminary data, then the team should include one or more alternative site selection options. The team can make final selection either during the project definition package activities or further defer for consideration as part of the ultimate decision step.

Site Recommendation. At this point, the alternatives evaluation effort has not formally considered all combinations of sites and technologies which could alter the final recommendation; therefore, the preliminary site recommendation should be fairly informal. The team leader should review preliminary conclusions with the decision maker(s) prior to formally evaluating alternatives so that the financial analysis is based on "solid ground." The team should compose alternative combinations that allow comparison of economic and non-economic differences for all sites.

Reporting Requirements. The team should document the site evaluation effort in a written report containing site recommendations as well as tabular comparisons that will allow easy reference during evaluation. Any detailed site characteristics information should be preserved for future use by the pre-project planning team, probably in the form of a technical report. Oral presentations should be made to help supplement the written report and to add to the decision maker's confidence that the recommendation is the proper choice.

Conclusions-Site Selection. Site selection is more than locating available sites near raw materials or near the product market. It involves many considerations that impact the potential profitability of the venture. The process of optimizing both economic and non-economic considerations will produce the best site for a particular situation.

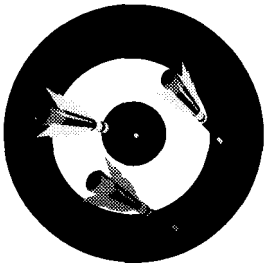


Prepare Conceptual Scopes and Estimates

Reason for project success: "Great deal of effort or evaluating alternatives, developing estimates and schedules." - A project manager

Background. The function, *prepare conceptual scopes and estimates,* pertains to both capital requirements and usage requirements for the alternatives. The purpose of this function is to provide input data for financial analysis during the evaluation of alternative(s) effort. The conceptual scope definition effort attempts to resolve the following four issues:

- *Provide a means to reach agreement on provisions to be included*
- *Provide data for generation of usage requirements*
- *Reduce uncertainties to an "acceptable risk" level*
- *Balance the need for more detail and accuracy with the reality of available time and available study budget.*



You are not trying to be precise at this stage.

The conceptual estimate effort attempts to provide a reasonable order-of-magnitude estimate of capital costs, using preliminary scope information and fairly inaccurate early estimating methods. To better understand the situation, realize that the conceptual scope and estimat-

ing effort will probably work with as few as one or as many as 30 alternatives. It is obvious that detailed, highly accurate information will be too costly and untimely to produce. Because the remaining number of alternatives can still be large, the level of detail of the scope development and the accuracy of estimates must be controlled to avoid excessive front-end costs.

Scope/Estimating Effort. The scope/estimating plan and schedule should account for dynamic situations requiring feedback and adjustment. This effort will be most effective if all alternatives are prepared in a similar fashion, to the same level of detail, using the same team members to perform the same function for each alternative. Consistency is an important ingredient maintained by producing data on all alternatives that meet a pre-determined set of deliverables as prescribed by the team.

How good is the crystal ball?

Using sufficient expertise to reduce uncertainties to "acceptable risk" levels without spending excessive time or money is a challenge. The most common pitfall of work is to expect that it will produce accurate results, yet at this point it is very difficult to get firm commitment for the scope and estimate. Without this commitment, both are likely to change. How can we make good estimates when we estimate on the wrong basis? The core team leader needs to ensure that the scope/estimate activity has a high probability that the scope really will reflect the actual project. The best prospect is to get agreement on project scope of all users of the facilities. Detailed discussion of scope and estimates follows.

Get everyone to commit to the scope.

Conceptual or Feasibility Scopes. Conceptual scopes may include preliminary information on some or all areas listed in Table 3.3.

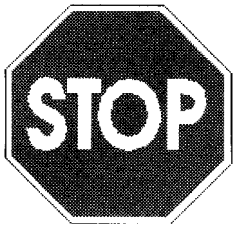
Table 3.3: ***Preliminary Information for Conceptual Scopes***

Process Facilities	Buildings	Utility Projects
Design basis	Zoning	Control philosophy
Heat and material balances	Use	Distributed control systems
Equipment list	Location	Environmental
Flow diagram	Land requirements	Noise limits/requirements
Plot plan	New/renovate	Metering
Special provisions	Building population	Safety concerns
Cash flow	Environmental concerns	Basic layout
Approval document	Parking/landscaping	Laws/standards/codes
Service and utility requirements and usage	Security concerns	Cable trench interconnections
	Design potential cost impact	Station ground interconnections
	Roads and access	Transformers/switch gear/disconnect switches
	Utilities	Limits to high/low voltage connections
	Cafeteria/auditorium/laboratory requirements	
	Telecommunications/sophistication of electronics	
	Building type/finish/size/number of floors	

Consistent, but rough -Don't expect Less than 25% to 35% and sometimes no better than 50% *accuracy.*

Conceptual or Feasibility Estimates. Normally at this stage, an estimate will be made using a parametric or factor technique to produce an expected cost. In addition, a milestone schedule should be developed for each alternative. To produce a total cost for the alternative, the estimators will add special provisions, escalation, contingency, and risk provisions. Costs will normally be provided from historical estimating database information. The estimate should be shown in summary form with appropriate approvals from the team. Qualifications for the estimate and expected accuracy range should be included.

In addition to cost estimating, the financial analysis document should provide resource requirements. Typical requirements include:



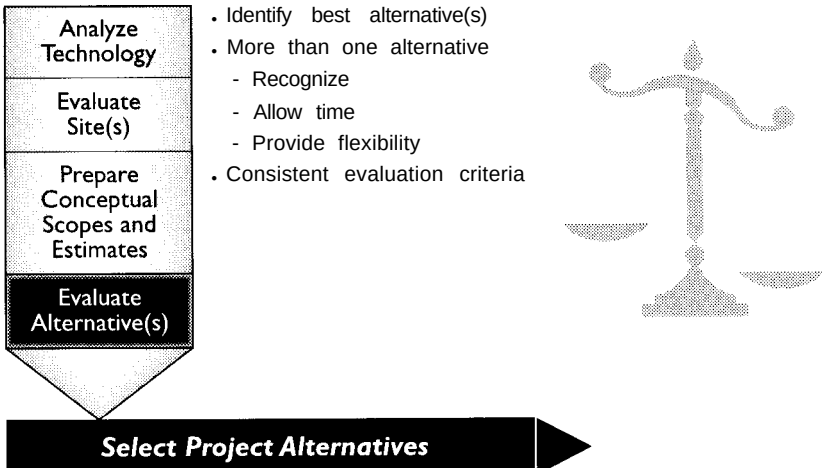
Do not base the final decision on a conceptual scope and estimate.

raw materials and supply usage, labor requirements (quantity and type), and services and utility requirements.

During conceptual estimating, very little actual design has been performed. The project participants provide estimates based on historical data, experience and insight. Estimates during this phase must necessarily carry a large contingency factor, and are useful only to decide whether to proceed with further definition. *It is worth noting here that many project owners base their final decision on estimates generated during this phase, and then skip the definition phase entirely. In most cases, this leads to failure to meet expectations from the owner? standpoint.*

Reporting Requirements. The final product of this effort is a conceptual scope, estimate, milestone schedule, and resource requirement document for each alternative. The project team will use this product for financial analysis.

Conclusions-Preparing Conceptual Scopes and Estimates. Key elements of the conceptual scopes and estimates effort are: eliminate uncertainty to an acceptable risk level; balance level of detail and accuracy with study cost and available time; use as much common effort between alternatives as possible to improve consistency and degree of accuracy among them; maintain continuity of membership throughout scope/estimate effort; and evaluate usage requirements as a vital part of this effort. Once conceptual scopes and estimates are developed, the surviving alternatives should be evaluated as discussed in the next section.

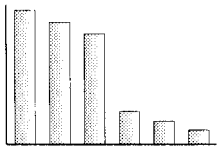


Evaluate Alternatives

Reason for project problems: "... went for cheaper technology over quality...cost dictated quality"- An operations manager

Background. The function, *evaluate alternatives*, draws information from prior efforts of technology selection, site evaluation, and conceptual scopes and estimates to develop a complete picture of each alternative so that valid comparisons can be made. These evaluation criteria include: cost, benefits, economics, and other required decision-making considerations. The conclusion of this function will produce all remaining information necessary for the preparation of the recommendations to be presented to the decision maker(s) concerning the selected alternative(s).

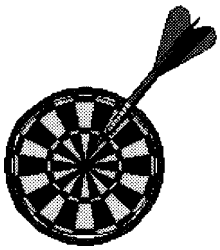
Evaluation Criteria. The evaluation of alternatives can be accomplished only after establishing a consistent basis for selection objectives and selection criteria; otherwise, one does not know the look of the desired target. In most cases, economics will be the primary determinant for the alternative selected. This works well if one alternative is a clear economic choice. Many times, several alternatives



Vital few

will have similarly economic projections, so that this single criterion is inadequate to make the final choice. When additional criteria must be considered, each should be evaluated using tools such as decision tree analysis and/or Pareto analysis. Decision tree analysis can be used to help put risk into proper perspective and to determine sensitivities and ranges of outcomes. Pareto analysis can be used to determine the "vital few" criteria and set weightings.

The participants in this activity should be certain that they understand the needs of the decision maker and work to provide all information necessary to meet success criteria and required information for final decision making as specified in the original team charter.



Economic analysis is the focalpoint of the whole effort.

Economic Analysis. A variety of methods are available and commonly used in evaluating alternatives. Most companies will have their own prescribed method of evaluation and go/no-go criteria. These methods typically require input information that can be grouped into the following general categories:

Benefits

- *Sales volumes and pricing forecast for each product/by-product for the economic life of the asset*
- *Length of the economic life*

Project Investment and Timing

- *Capital cost*
- *Capital project timing with yearly expected cash flows*
- *Cost of financing the project with timing of cost*
- *Date that the facility needs to be in production*

Working Capital

- *Inventory quantities and values*
- *Accounts receivables expected Levels and values*

Non-Operating Requirements

- *R&D expense*
- *Sales, Advertisement, Distribution, and Administration (SADA) expense*
- *General plant supporting investment, including utility capital and investment in raw material manufacturing facilities*
- *Taxes*
- *Incentives*

Operating Requirements

- *Purchased and/or manufactured raw material usage and cost*
- *Utilities usage and cost*
- *Various Labor types, usage, and costs*
- *Operating rates, percent on-stream and percent on-specification production*
- *Maintenance and repair cost (non-Labor)*
- *Other requirements, such as, Laboratory space, transportation, storage, materials handling, etc.*
- *Special costs/savings not identified previously*

Other criteria have to be considered depending on political, social, and other economic factors. These factors may include the following:

- *Future access to market*
- *Future access to raw materials*
- *Long-term access to Labor skills needed*
- *Fit with company Long-range strategy*
- *Political considerations*
- *Transportation/communications/convenience*
- *Company image/quality of life/safety*
- *Environmental considerations*

- *Site availability*
- *Location at an existing site*
- *Long-term competitive positioning-product and cost*
- *Flexibility--ability to meet new requirements of quality, volume, or type of products/tenants/usage*
- *Availability of selected technology in terms of price and timing*
- *Adaptability of the facility to meet other needs fall back position)*

Once criteria have been established that will lead to the selection of both technology and site, then the relative importance of each topic should be determined and placed into a decision matrix as shown in Tables 3.4a and 3.4b.

In this example, Technology Alternative I is a low-density polyethylene facility and Alternative II is a high-density polyethylene facility. Sites 1 through 4 are Massachusetts, Texas, Malaysia and Russia, respectively. Based on the analysis, Site 3, Malaysia, is the best alternative site using Technology I. Site 3, Malaysia, is also the best alternative site using Technology II. The best choice based on the score, therefore, is using Technology II in Malaysia.

Table 3.4a: *Decision Matrix for Technology Alternative I*

	Weight	Tech. Alt I	Site 1	Alt 1	Site 2	Alt 1	Site 3	Alt 1	Site 4	Comment or Explanation
Category	Weight	Score	Wt × Score	Score	Wt × Score	Score	Wt × Score	Score	Wt × Score	
Economics (most probable)	25	5	125	2	50	5	125	4	100	
Flexibility	2	1	2	1	2	1	2	1	2	
Availability	5	5	25	5	25	4	20	1	5	
Competitive positioning	13	5	65	4	52	4	52	1	13	
Access to market	10	4	40	5	50	3	30	1	10	
Access to raw materials	10	5	50	1	10	4	40	4	40	
Access to labor skills	5	2	10	1	5	5	25	4	20	
Incentives	3	1	3	1	3	5	15	3	9	
Tax situation	2	2	4	1	2	5	10	2	4	
Strategy compatibility	10	2	20	1	10	5	50	4	40	
Political considerations	5	1	5	1	5	5	25	2	10	
Traffic/communications/convenience	1	5	5	1	1	1	1	3	3	
Image/life quality/safety	1	3	3	5	5	2	2	1	1	
Environmental situation	5	2	10	1	5	4	20	5	25	
Site availability	3	5	15	1	3	4	12	5	15	
Locate at existing site	0	5	0	1	0	1	0	1	0	
Total	100	53	382	32	228	58	429	42	297	

NOTES:

SITE:

1. Massachusetts: advantage market proximity
2. Texas: advantage raw material availability
3. Malaysia: advantage low cost labor
4. Russia: advantage potential opportunity

Table 3.4b: *Decision Matrix For Technology Alternative II*

	Weight	Tech. Alt II	Site I	Alt II	Site 2	Alt II	Site 3	Alt II	Site 4	Comment or Explanation
Category		Score	Wt X Score	Score	Wt X Score	Score	Wt X Score	Score	Wt X Score	
Economics (most probable)	25	4	100	3	75	5	125	4	25	
Flexibility	2	3	6	1	2	3	6	5	10	
Availability	5	4	20	4	20	3	15	1	5	
Competitive positioning	13	4	52	4	52	5	65	1	13	
Access to market	10	4	40	5	50	3	30	1	10	
Access to raw materials	10	5	50	1	10	4	40	4	40	
Access to labor skills	5	2	10	1	5	5	25	4	20	
Incentives	3	1	3	1	3	5	15	3	9	
Tax situation	2	2	4	1	2	5	10	2	4	
Strategy compatibility	10	2	20	1	10	5	50	4	40	
Political considerations	5	1	5	1	5	5	25	2	10	
Traffic/communications/convenience	1	5	5	1	1	1	1	3	3	
Image/life quality/safety	1	3	3	5	5	2	2	1	1	
Environmental situation	5	2	10	1	5	4	20	5	25	
Site availability	3	5	15	1	3	4	12	5	15	
Locate at existing site	0	5	0	1	0	1	0	1	0	
Total	100	52	343	32	248	60	441	43	230	

NOTES:
Score should be on the same scale for all items- say l-5 where 1 equals bottom 20 percent of each topic and 5 equals top 20 percent of each topic so that the weighting can be applied to all scores and summed to show which is the best alternate. Comments or explanation for each topic should be provided to help identify options, major uncertainties, and potential outcomes for each alternate. The reasoning should be clearly stated to aid the decision makers in understanding the recommendation. The weighting is based on the importance of each factor.

Major Business Risk or Profitability Analysis. At this point, it is probably useful to develop a computerized financial model for each alternative. A financial picture can be developed to show the expected performance, and the major business economic risk can be assessed by checking the various economic scenarios (range of variables).

Unfortunately, not all information on all alternatives has the same level of confidence or reliability. To address this disparity, it would be desirable for each set of financial figures developed on each alternative to be accompanied by an expected probability. Even better would be a probability data set which would include the expected outcome, then include another figure, say with a 95% probability of attainment and another at a 5% probability level. Graphical sensitivity diagrams or computer-based sensitivity models can help illustrate the risk sensitivity for the decision maker(s).

When several alternatives are being considered, it becomes impractical to develop highly detailed cost estimates for each alternative. Each estimate should be as accurate as time and preparation budgets allow. Estimating consistency is also important. Differences *in the final figures should be the result of the differences in each alternative and not the difference in estimating techniques or accuracies.*

Use consistent estimating methods.

Recommendation of Alternatives. Once the process of evaluating alternative(s) has been completed and a conclusion can be reached, the team should prepare a two-part recommendation as follows:

1) A written report stating the recommendation, followed by the supporting documentation, and a description of the process used to arrive at the recommendation. This document should also include a listing

of individuals involved in estimating and the organizations they represent to help add credibility to the study. Cost and time requirements for developing the information to date should be stated. If the "Charter" memo states the basis for decision making, then each of these points should be discussed in detail.

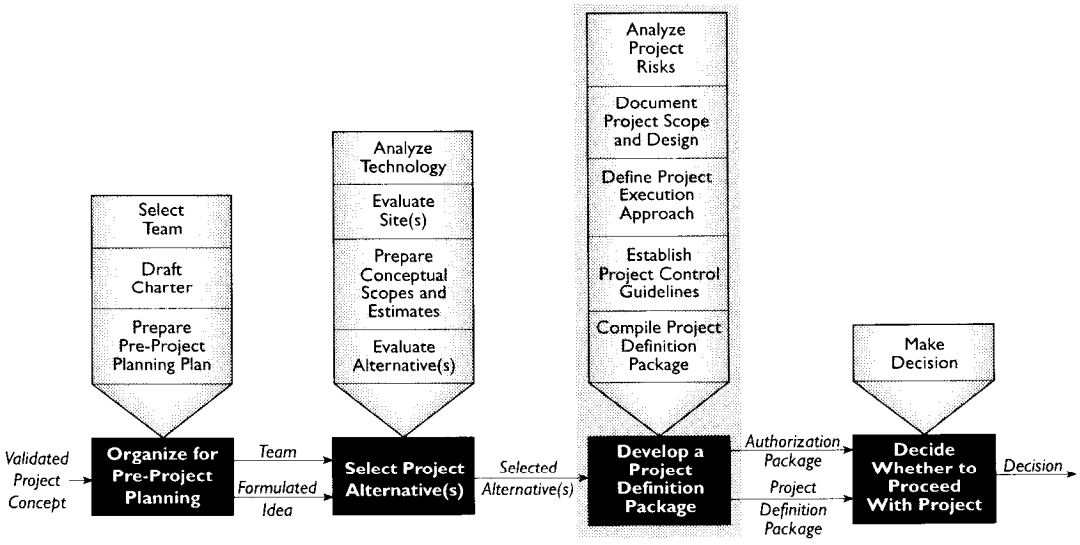
2) An oralpresentation should be developed andpresented to the decision maker(s) to help insure that the recommendation is discussed and properly understood before the final decision is reached.

Conclusions-Evaluate Alternatives. Only through systematic analysis of sites and technologies can the decision maker be comfortable with project choices. Consistency and risk assessments are key to this process.

Key Points-Select Alternative(s)

Research has shown that technology and site selections are critical to the success of the project. The four key functions leading to Selecting Alternative(s) described in this section are accomplished by an empowered team. The output of these functions becomes the input to the next sub-process, *develop project definition package.*

Develop Project Definition Package



After the decision maker has established the pre-project planning team, evaluated the original formulated ideas, and selected a final alternative (or series of alternatives), these decisions become input to the *develop project definition package* sub-process. There are five (5) major functions in this phase: *analyze project risks, document project definition scope and design, define project execution approach, establish project control guidelines* and *compile the project definition package.* These functions are shown graphically in Figure 4.1.

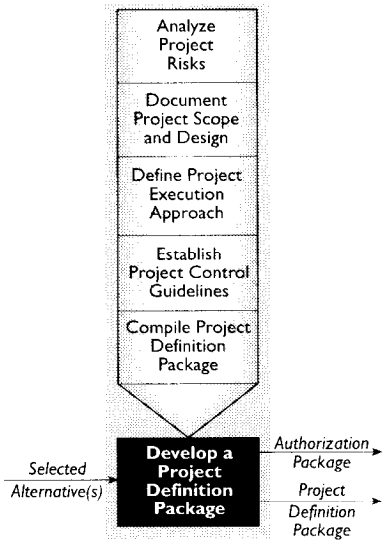
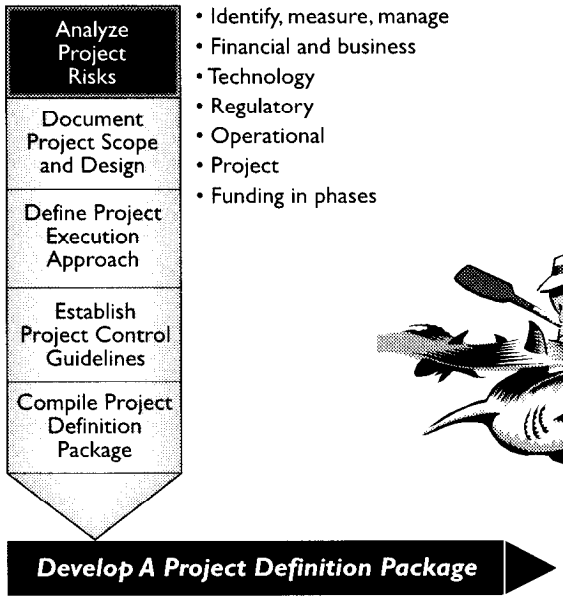


Figure 4.I: **Develop a Project Definition Package**

Make sure sufficient expertise is available to do the job.

As with all other pre-project planning functions, the first step in developing a project definition package is for the core team leader to ensure sufficient expertise is available to perform the task adequately. Expertise in addition to those already discussed will include specialists to prepare calculations, drawings, specifications, requisitions, and the myriad of other technical documents required for the development of a complete project definition package. Many times consultants are used in this sub-process. The first function in completing this process is to *analyze project risks.*



Analyze Project Risks

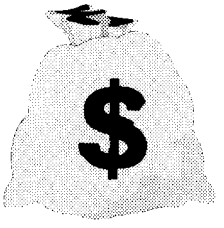
Reason for project problems: "Took a huge risk committing to project with far too Little front-end engineering. Very poor estimate of cost; ... We have pledged to doing a Lot more pre-project planning... " - A business manager

Background. Risk assessment is a management tool that presents alternatives to decision makers in such a way that the risks of exceeding established thresholds of cost, schedule, and technical performance is eliminated. Risk assessment is both qualitative and quantitative.

Total risk includes many variables.

Many owners and projects utilize a traditional method of risk analysis that breaks the project down into small parts, sets up a minimum/maximum confidence range in terms of the cost growth that each activity might experience, and then calculates a contingency need for that item. In this manner, an overall project contingency can be recommended. One must recognize that this method is directed primarily at the direct cost of various components of the project. It does not take

into account "total" risk, including business and market variables, that could have a profound effect on the project.



Many owners use a multi-step funding process.

Project Funding. Depending on the degree of risk relative to business needs, it is often advisable for an owner to approve funding in stages. For example, on a project where the risk is high and the return on investment is relatively low, it would be wise to approve funding for preliminary design in order to eliminate as many unknowns as necessary to insure that risks are within tolerable limits. Many owners now utilize a two- or three- step funding process that allows for adequate scope definition and risk assessment. This process is shown graphically in Figure 4.2.

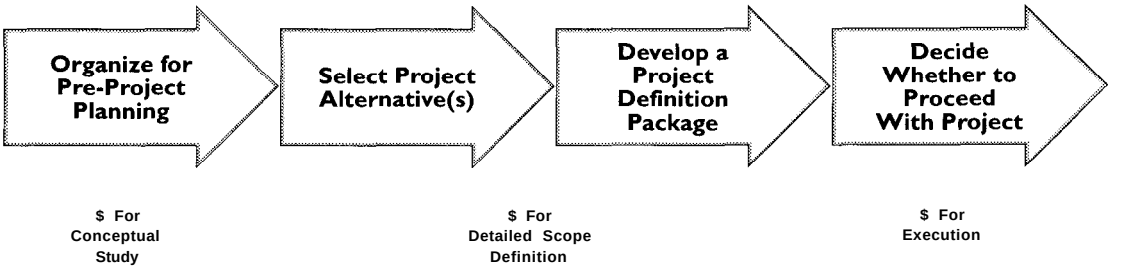


Figure 4.2: **Funding Process**

Conversely, if the risks are low and/or the return on investment is high, it may be reasonable to proceed with the project in spite of the necessity to include high contingencies. Regardless of the scenario, proper evaluation and inclusion of contingency are absolute requirements of good project planning. A risk assessment essentially consists of three phases-risk identification, measurement, and management.

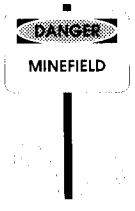
Risk Identification. The most important part of a risk assessment program may be the risk identification phase. Risk identification is a difficult task because there are no unerring procedures that may be

used to identify project risks. Risk identification relies heavily on the experience and insight of the key project personnel. The entire pre-project planning process involves continuous feedback among members and activities. Nowhere is this more important than during the development of the project definition package. As detailed calculations progress, the planners must integrate these calculations into the feedback cycle so that earlier assumptions or preliminary calculations can be confirmed. This continuous design feedback process plays an important role in reducing risk as well as identifying concerns that planners must consider in the formal risk assessment role.

The owner establishes the project conditions and it is in the owner's best interest to consider all potential areas of risk in the early stages of the concept and design phases. The business risk elements that deserve owner consideration include:

Feedback is critical in order to verify earlier assumptions.

- *First costs (capital costs) - What is the worse case?*
- *Operating and maintenance costs*
- *Start-up and commissioning costs*
- *Market considerations, such as product marketability, market size, market share and life span*
- *Uncertainty in process and technology capabilities*
- *Public concerns*
- *Regulations*
- *Qualification or availability of contractors and designers*
- *Impact of financing restrictions*
- *Availability and cost of financing and the stability of the financial markets*
- *Cost and availability of raw material and feedstocks*
- *Impact building codes have on cost/schedule/renovation*



In addition, there are a wide variety of construction related risks including:

- *Labor availability andproductivity*
- *Subcontractor, equipment, and supplier performance*
- *Unusually severe weather*
- *Strikes, work stoppages, and other adverse Labor activity*
- *Unforeseen project conditions*
- *Unforeseen economic factors (inflation, shortages, etc.)*
- *Differing site conditions*
- *Level of constructability*
- *Other global and logistical problems*

Pay attention to both severity and frequency of risk.

Two characteristics of risks are important. First, project participants must give proper regard to those uncertainties that produce severe losses. Second, those uncertainties that produce small losses, but which may occur frequently, must be considered.

Another major source of risk is the effectiveness of the management and administration of the project. Several tasks, which are the responsibility of the project participants, can increase or decrease the overall risk and include:

- *Cost and schedule estimates - Inaccurate estimates or schedules force unrealistic goals and inefficient project planning.*
- *Human errors - The technical risks inherent in the project are not the sole source of concern. Omissions, poor judgment, lack of knowledge, and misunderstandings are some of the mistakes that project personnel are capable of making. Team building techniques can help mitigate these problems.*
- *Timely decisions - The Lack of prompt management action will increase risk to the project.*

Risk Measurement Methods. Clearly, the objectives of the analysis are of prime importance. For our purpose, a risk assessment can have one of three objectives, namely: to determine the business risk or probability of the project being profitable; to determine the variability of the project cost estimate; or to determine the variability of the project schedule.

Business risk analysis covers those situations where the owner is trying to determine the combined effects of uncertainty on product demand, market factors, cash flow needs, and capital and operating costs. Typically, these analyses are probability forms of common profitability analyses.

Cost estimate variability, which is one of the inputs to the business risk analysis, covers those circumstances wherein the objective of the analysis is to determine the variability of the project cost estimate. Most owners utilize either a probability analysis, such as the Monte Carlo method, or a subjective method, such as the contingency evaluation approach.

Monte Carlo analysis uses computer programs to repeatedly sample the probability functions of the estimate variables to determine the total variability of the estimate.

The contingency evaluation approach assigns a value to each of the risk factors, based on the analyst's subjective view. A contingency analysis technique that has been successful in the process industries is the "Definition of Uncertainty Rating" (Hackney). This technique uses six checklists to rate the completeness and sufficiency of the project scope definition. The six general areas measured by this technique are:

- *General Project Basis*
- *Process Design Status*

- *Site Information*
- *Engineering Design Status*
- *Detailed Design*
- *Field Performance*

Based on the degree of project definition in each of these areas, contingency ranges can be suggested as illustrated by Figure 4.3.

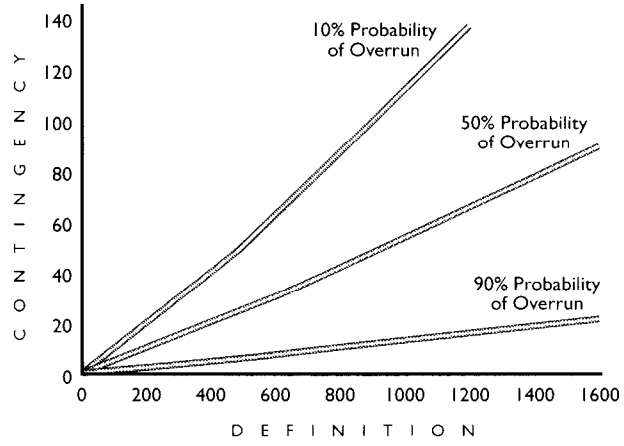


Figure 4.3: **Estimate Definition Ratings vs. Contingency Required**

As another example, Figure 4.4 illustrates estimate accuracy ranges, established by a CII member company, for various classes of estimates made during different phases of a project.

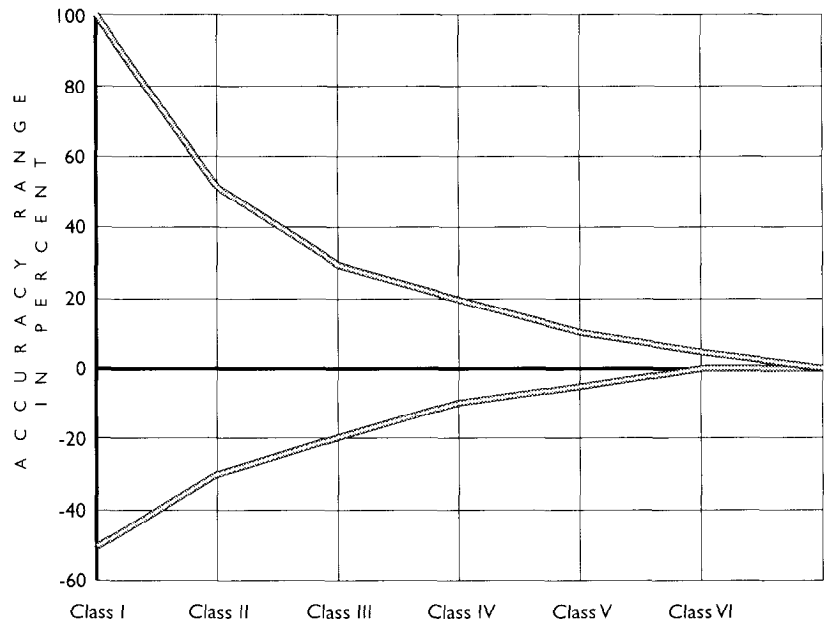


Figure **4.4: Estimate Accuracy By Class For Various Project Phases**

Each type of estimate has a specific purpose, and the methods used to do the estimate, as well as the type and quality of input data, are clearly defined and verified through the use of detailed checklists. A summary level description of the various classes of estimates can be found in Table 4.1.

Table 4.I : **Estimating Classes**

CLASS I. FEASIBILITY	
Purpose:	Initial evaluation of proposed projects.
Engineering Effort:	Minimal
Accuracy:	-50% to +100% before contingency.
Methods:	Ratio from existing units, sales estimates, or published costs. Allowance (% of contract cost) for offsites and owner's costs if required.
Limitations:	Should not be used for revamps. Offsite requirements may not be well-defined.
CLASS II. SCREENING	
Purpose:	Evaluation of proposed projects and alternates for a specific site.
Engineering Effort:	Minimal
Accuracy:	-30% to +50% before contingency.
Methods:	Factored estimate on appropriate equipment sizes. Allowance (% of contract cost) for offsites and owners cost if required.
Limitations:	Should not be used for revamps. Offsite requirements may not be well-defined. Process Flow Diagrams (PFD) may not be available. No schedule or project execution plan.

CLASS III. BUDGET	
Purpose:	Commit funds for licenser design, initial engineering, and purchase critical equipment.
Engineering Effort:	Preliminary process design.
Accuracy:	-15% to +30% before contingency.
Methods:	Factored estimate based on equipment sizes from preliminary construction data. TDC instrumentation estimated basis preliminary loop count and number of analyzers. Major site work, buildings and structures identified. Piping, licenser royalty and engineering, and other owner's costs included.
Limitations:	Process engineering preliminary (<5% complete). No Process and Instrumentation Diagrams (P&IDs) or equipment data.

CLASS IV. AUTHORIZATION	
Purpose:	Provide basis for cost control.
Engineering Effort:	Process design 70-90% complete. Licenser design is complete.
Accuracy:	-10% to +20% before contingency.
Methods:	Factored estimate basis preliminary data sheets and approved PFDs. Vendor quotes for major equipment. Preliminary plot plan and equipment arrangement. Licesener design packages if required. Project milestone schedule and preliminary execution plan.
Limitations:	P&IDs not final. Bids on major equipment may or may not be available.

CLASS V. DETAILED	
Purpose:	Provide breakdown of labor and materials for each cost control category. The detailed estimate is the basis for planning field progress, manpower, and schedule.
Engineering Effort:	Detailed engineering 25-40% complete.
Accuracy:	-5% to + 10% before contingency.
Methods:	Quantity based estimate. Material takeoffs (MTO) by discipline to define quantities plus MTO allowance. Optimized, site specific H&MB, final equipment data sheets and vendor bids, final P&IDs and electrical one-lines, and approved plot plan. Detailed project schedule and final contract arrangements.
Limitations:	Final detailed drawings not complete.

CLASS VI. DEFINITIVE	
Purpose:	Confirm bulk material quantities and “fine tune” planned field progress.
Engineering Effort:	Detailed engineering 90+% complete.
Accuracy:	-2.5% to +5% before contingency.
Methods:	Quantity based estimate basis final material take-offs. The estimate is normally not issued as one document, but is done over a period of time. As detailed engineering for each major cost account nears completion, quantities and forecast costs are updated.
Limitations:	Final field labor productivity is unknown.

Scheduling variability covers those situations where the analyst's interests focus on determining the effect of uncertainty on the project schedule. The same uncertainty factors that affect project costs may also affect project schedule. The most common methods of analyzing schedule risk are Program Evaluation and Review Techniques (PERT) and Critical Path Methods (CPM). Proper application of these techniques and programs will enable comprehensive "what-if" analysis of schedules.

Accuracy depends on quality of information.

The fundamental premise here (which is strongly supported by extensive research by CII and others) is that the accuracy of estimates and project risks are directly related to the quality and accuracy of the information being used as the basis for the estimates. Every owner should develop a consistent method of defining the inputs required to produce a project estimate and then apply the appropriate amount of contingency relative to the quality of the inputs. Historical data are essential for this effort; therefore, a formal means of gathering and maintaining accurate historical data on projects is also a critical owner need.

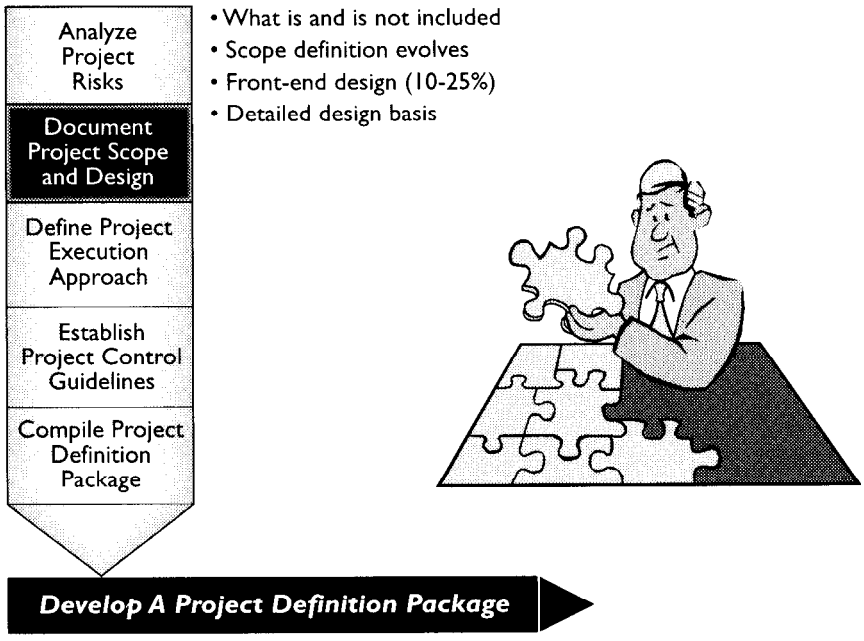
Risk Management. The ultimate goal of the risk assessment process is risk management. Risk management is a process consisting of the control of the risk in the scope, schedule, cost, method of execution, quality, and resources of a project. The process must be continuous to ensure proper execution and provide for changing conditions.

Risk management begins at conception and continues throughout the project life.

Since no two projects are exactly alike, corporate risk management procedures should be flexible and tailored to the specific requirements of the project. However, one characteristic of risk management is certain - *risk management begins at project conception and continues*

throughout the life of the project.

Planners must incorporate detailed risk management strategies into the project control guidelines that they develop during pre-project planning. These strategies are addressed in more detail in the Establish Project Control Guidelines section.



Document Project Scope and Design

Reason for project problems: "Insufficient time was allocated to develop soundpremises and definition. Simply allow more time to do a better job."
- A project manager

Background. Every project presents a differing mix of context, objectives, and resources. The major type and size of the facility, e.g., building, heavy civil, or industrial, is one variable. The type of owner, including classification by public or private, frequent or infrequent buyer of constructed facilities, and large or small staff for project involvement, is another difference. Regardless of the type of project or owner, the basic requirements and objectives of the project must be clearly defined and communicated.

The scope will evolve.

Pre-Authorization Design/Scope Package. As mentioned earlier, scope definition and quality of information will continually evolve and improve as the project progresses. Consequently, the pre-

authorization design/scope package (sometimes known as the project scope package) will also evolve and should be submitted for review and/or approval in stages, depending on the degree of risk involved. Each submittal should clearly define the degree of accuracy or completeness of information, as well as risks and contingencies associated with the quality of the data. With this information in hand, decision makers can make rational decisions as to whether a project should proceed, be canceled, or be further defined through additional design effort. After final approval, this package becomes the basis for the preparation of detailed design for the project.

Contents of the project scope package

The following are typical contents of a design/scope package for an industrial process plant project. Specific sections and details will vary for different types of projects; however, the fundamental concept of clearly defining the entire project, and all of its requirements, is universal. Exhibit D.l, Appendix D, contains an example of a deliverables checklist for the design/scope package.

Project Definition. The project definition describes the key technical and physical attributes of the project, including general quality requirements and budget or commercial issues that would affect design planning and decision making.

Integration Requirements. If the project must be integrated into an existing facility, a high level of effort must be focused on identifying all integration requirements. Integration can be the most difficult part of the project to define and often is the source of poor quality estimates, project delays, and cost overruns. It may also require a significant up-front commitment in time and resource from the existing

facility's operations and maintenance organizations during this phase of the project.

Basic Engineering Design Criteria. This section summarizes basic engineering design data such as the detailed design basis for all disciplines, materials for construction, equipment spares and redundencies, and philosophy. Exhibit D.2, Appendix D, contains a table of contents for Design/Scope Package Contents.

Process Design Basis. The completed process package could include:

- *Integration Studies*
- *Flow Diagrams*
- *Heat and Material Balances*
- *Process Configuration Studies*
- *Licensing Plan*
- *Process Contractor Selection*
- *Process Flow Diagram and Total Process System Diagrams including Tie-ins*
- *Equipment Specifications*
- *Catalyst and Chemicals Sheets Requirements*

Utility Design Basis. Complete utility process package will include:

- *Utility Flow Diagrams and Total Utility System Diagrams including Tie-ins*
- *Utility Balances*
- *Integration Studies*

Control System Design Basis. This section outlines key elements of the process control systems to be used (control hardware, basic control strategy, level of automation, shut-down system requirements) and how they fit with the existing facility control philosophy.

Equipment List and Equipment Data Sheets. The equipment list must be complete and correspond to the basis of the estimate. This list identifies the following: equipment data sheets complete with materials of construction, equipment-standardized seals, and couplings.

Details depend on the type ofproject.

Electrical, Piping, and Instrumentation Schematics. This section includes:

- *Process P&IDs with sized and specified Lines*
- *Utility and other P&IDs with Lines sized and specified*
- *Relief P&IDs with major Lines sized and specified*
- *Electrical Single-Line Diagrams*

This section also includes analysis of start-up, shutdown, and circulation provisions, hazardous operations (HAZOPS) review, and motor listing and voltage level descriptions.

General Site Information. This section includes:

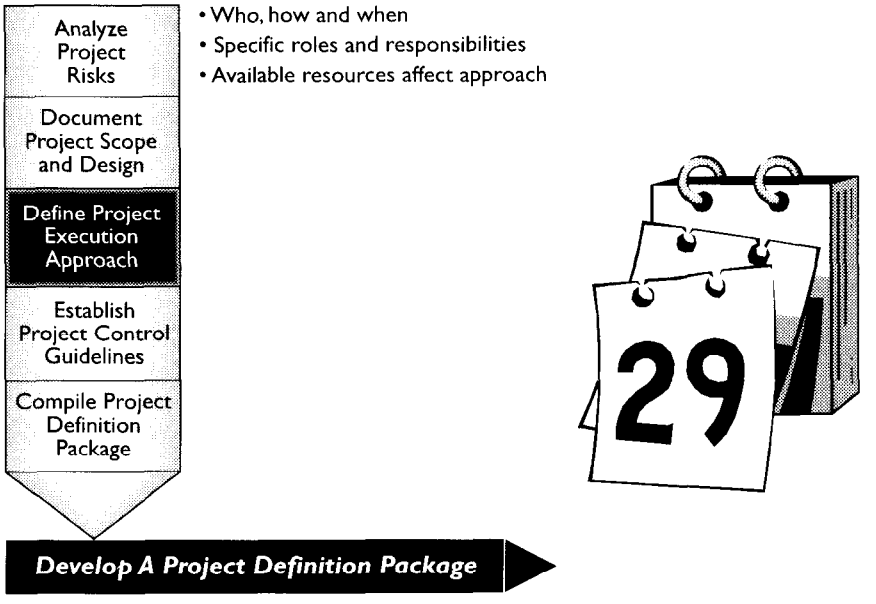
- *On and off-plot plans with equipment arrangements*
- *Interconnecting pipeways plan*
- *Electrical classification plans*

- *Identification of National Fire Protection Association (NFPA) classifications for electrical components*
- *Roads, drainage, and fire protection plans*

Soils Report. A completed soils investigation report, including piling and foundation design criteria requirements should be developed.

Constructability Studies. Refer to *Constructability Implementation Guide,* CII Special Publication 34-l.

Conclusions-Document Project Scope and Design. Different types of owners and projects will necessitate different formats and contents for a project design package. All key elements of the scope should be identified and addressed in as much detail as is necessary to communicate key project requirements to those individuals who are responsible for completing the subsequent stages of design, estimating, and project management. Members from the pre-project planning team must continually review and update the pre-authorization design package to reflect feedback gained during the final definition package development activities.



Define Project Execution Approach

Reason for project problems: "Not enough follow-through by planners into design and construction phase. Planners don't stay with the project and there is not enough communication back and forth." - A project manager

Background. A formal execution approach, often called a project execution plan or project execution strategy, is required to ensure that all tasks are identified and carried out in a timely manner, even in the early stages of project development. The plan provides overall direction for the project team, which must make numerous decisions throughout the course of a project. The strategy serves as a road map for that decision-making process. The plan should be as detailed as possible and include specific roles and responsibilities. The level of detail inherent in the execution approach should be consistent with the accuracy of the estimate and firmness of the project scope. The project execution approach must recognize that plans, assumptions and details of the design basis developed during the pre-project activities will under-

go review and possible change during the execution phase. Therefore, written plan(s) and staff allocations to implement the execution phase must be flexible.

Resources Required. In the early stages of project strategy development, the owner must determine whether to perform certain tasks and duties or to assign them through a contract to other specialists.

The Execution Approach. A typical execution approach would consist of the following:

Contents of the project execution approach

Project Schedule --An integrated engineering, procurement, and construction milestone schedule for the project includes: permitting, training, commissioning, and start-up of the facilities. Key milestones include:

- *Authorization to proceed*
- *Start engineering*
- *Permit application andpermit approval*
- *Long lead time equipment*
- Award *period*
- *Start construction*
- *Construction inspections*
- *Construction complete*
- *Punch out*
- *Start-up*
- *Acceptance*

Design Plan - This section defines the resources and methods to be used to provide cost-effective design execution for the project. It also

includes plans for utilization of both internal and external resources. Items that should be addressed include:

- *Necessity for, and availability of; experts or specialists*
- *Necessary qualifications of outside design firm*
- *The need for comprehensive site investigations*
- *The level of design documentation required*
- *Special requirements for Computer Aided Design and Drafting (CADD) and/or physical models, etc.*

Contracting Plan-This section addresses all aspects of contracting strategies such as fixed price versus reimbursable contracts, union versus open shop labor, and modularization versus field-built components. The contracting plan should provide analysis and recommendations for the most efficient and cost-effective approach to building the project.

Permitting and Regulatory Compliance-This section includes a detailed assessment of all permits required for the project and preparation, submittal, and tracking of permit applications. Many of the responsibilities will require coordination with outside agencies to answer all environmental questions. A list of these agencies, their areas of responsibilities, and an example of an environmental schedule are included in Appendix D, Exhibit D.3 and Table D.1.

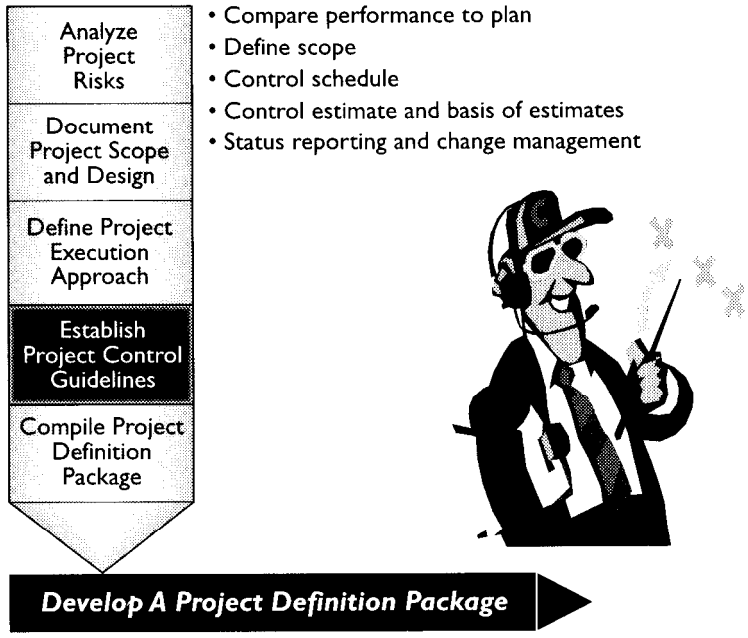
Materials Management/Procurement Plan - This section details the materials management plan and includes: materials selection philosophy, purchasing guidelines and procedures, acceptable supplier list, bid versus single source philosophy, domestic versus foreign supplier guidelines, QA/QC inspection plans, start-up and maintenance spare parts guidelines, and transportation.

Safety Process-This section includes the safety processes to be followed by the project and safety requirements plan for engineering, procurement and construction; process safety information; and process hazards management preparation and review procedures.

Cost/Schedule Controls - This section contains the overall project cost and schedule philosophy including: reporting; frequency and form; level of detail; and scheduling and cost control/reporting procedures. Pages 84-89 of this handbook, Establish Project Control Guidelines, address this issue in more detail.

Owner's Staffing and Team Building Plan -This section summarizes the philosophy for the organization structure, roles and responsibilities, staffing and de-staffing planning, assignment duration, training, and maintenance of continuity into next phase. It summarizes the extent of team building, recognition and awards, incentives, amount of quality training for team members, and use of the quality process in project activities.

Conclusions-Project Execution Plan. As with documenting project scope and design, the project execution approach will vary depending on the type of owner and project. It should address every key element relative to "how" the project will be executed, as well as what procedures, methods, and resources will be required to accomplish the execution. Note also that the execution approach is a formal document and must represent the consensus of the project team and the decision maker(s). It forms the basis for the detailed project execution plan after authorization.



Establish Project Control Guidelines

Reason for project problems: "Financial controls need to be improved; we didn't track well; we were out of control." - A business manager

The fundamental tools of control are estimates and schedules.

Background. Philosophical discussions of defining project control are never-ending. The essence of project control is good planning, good information systems, and good decision-making in a constantly changing environment. *The fundamental tools of control are cost estimates and schedules.* Every owner and project are different, and it is clear that the many variables associated with projects will force deviation and modification of specific procedures. The fundamentals, however, do not change. *Every project must be planned, budgeted, scheduled and controlled.* This section describes how to develop a control plan for the execution phase of the project.

Developing the Control Plan. The purpose of project control is to enable the project participants to evaluate project performance against

We must be able to evaluate performance against a pre-defined plan.

a pre-defined plan and take corrective actions when necessary. In order to accomplish this objective it is necessary to have specific project procedures in place for schedule and cost control for all phases and areas of the project. The degree of sophistication and complexity of the control plan will depend on the size and relative importance of the project. Nevertheless, all projects need to have a method of control and progress reporting. As a minimum, the control plan should provide a means for monitoring, evaluating, and taking action concerning schedule progress and cost trending. Good planning and controls are based on the following philosophies and conditions:

- *To assure effective communication and coordination over the project; life, the team Leader must establish a harmonious team atmosphere and good communication procedures.*
- *The starting point for planning is establishing the owner's need date for the facility.*

The phrase "*Planning proceeds in reverse* order" fashions this key milestone date and is not complete until all phases have been adequately addressed. Effective project control is based on the following fundamental principles:

- *The decision makers must adequately define scope early in the project.*
- *A control base estimate and schedule must be established early in the project.*
- *Work packages must be configured to satisfy the contracting strategy.*
- *Procurement activity must be planned to satisfy both engineering and construction need dates; engineering activity must be planned to satisfy both procurement and construction need dates.*

- *A control system, usually computerized, that effectively interrelates the many project component functions and provides managers with information needed for forecasting and responsive control must be available and used.*

Control Structures. There are two related control systems for the project. One system assists in controlling the work and the other in controlling the cost. The system controlling the work is based on a work breakdown structure (WBS), while the system controlling the cost is based on a cost breakdown structure (CBS). These two systems are interrelated and should be configured so that work elements can have related costs identified and compared to the control estimate. An industry standard, such as the Construction Specification Institute (CSI) 16-division account structure, is a good starting point.

The Project Schedule. The initial schedule for the project is usually a summary bar chart showing dates that mark the completion or start of activities that assure meeting the owner's need date. As definition of the project is refined, the schedule for each phase is described using a logic network that is progressively expanded into critical path method (CPM) format and improved until the desired controlling level is reached. Of course, integration of the detailed phase schedules must be maintained. Key concepts include:

Key Concepts

- *The start-up schedule supports the owner's project need date.*
- *The construction schedule is coordinated with the start-up schedule.*
- *The procurement schedule for materials and equipment takes into consideration the need dates associated with vendor information required for completion of detailed engineering and the need dates for delivery*

of equipment and materials to support construction, particularly long lead time items and major bulk purchases.

- *The procurement schedule for contractors considers the time factors associated with qualification and selection of contractors.*
- *The engineering schedule is coordinated with both the construction and procurement* schedules *so that technical documents required for inquiries and purchase orders are available and required construction drawings and specifications are provided at the correct time.*

Project Cost Estimate. Project estimates will normally evolve through several phases of the project. As a minimum, there are three phases of a project that must be considered:

- *Feasibility Phase - includes development of the basic concept and various options. This phase corresponds to the select alternative(s) effort presented in previous chapters.*
- *Definition Phase - refines the concept and options to the point where a scope, estimate, schedule and plan of execution can be presented to management so that a formal "GO" or "NO GO" decision can be made. This estimate provides the basis for project control.*
- *Execution Phase - includes detailed design, procurement, construction, and turnover of the project to the end user*

The cost estimate is an imperfect forecast of the future.

The cost estimate is often the most critical component of the final authorization package. It is also an imperfect forecast of the future. The estimators must acknowledge this fact, and provide a clear understanding of the accuracy ranges that can be expected. As such, the estimate should include the following information as part of the estimate package:

- *Basis of the Estimate. The basis is an executive summary of the project definition, including any fundamental assumptions made in formulating the scope and estimate.*
- *Estimate Methodology. The methodology should identify specifics such as the estimate being based on historical data, proprietary estimating software, semi-detailed quantity take-oft; and factored information.*
- *Estimate Qualifications and Exclusions. This contains all estimate exceptions.*
- *Estimate Summary. The summary should include estimate summary sheets by discipline and construction contract as well as by site.*
- *Equipment List. The estimated cost of major engineered equipment components is listed.*
- *Escalation Analysis. For large projects of long duration or projects that may not be constructed until some future date, it is necessary to consider the effects of inflation and cost escalation. This analysis should normally break the job down by activity, e.g., home office engineering, procurement, direct field hire, subcontracts and apply an escalation factor to each activity and then calculate the overall project escalation amount.*
- *Contingency Analysis. This analysis details the confidence factors applied to each component of the estimate.*
- *Project Schedule. The schedule addresses the effect, if any, that the project schedule will have on the estimate. This would include items such as overtime, premiums for accelerated deliveries and escalation.*
- *Expenditure Forecast. After optimizing the project schedule, an expenditure forecast showing cash flow needs to be completed.*

Without good data, it is almost a certainty that the project will be either overestimated or underestimated. Underestimates at project authorization frequently lead to financial losses and business failures. Surprisingly, overestimates serve an organization no better. Rather than resulting in greater profits, as one might hope, they often result

in the mentality that, "... since the money's there, it's spent." Unless there is firm management control, the estimate becomes a self-fulfilling prophecy. Realistic estimates result in the most economical cost. They create better morale and keep an organization trim and efficient. They also prevent over-commitment of capital resources.

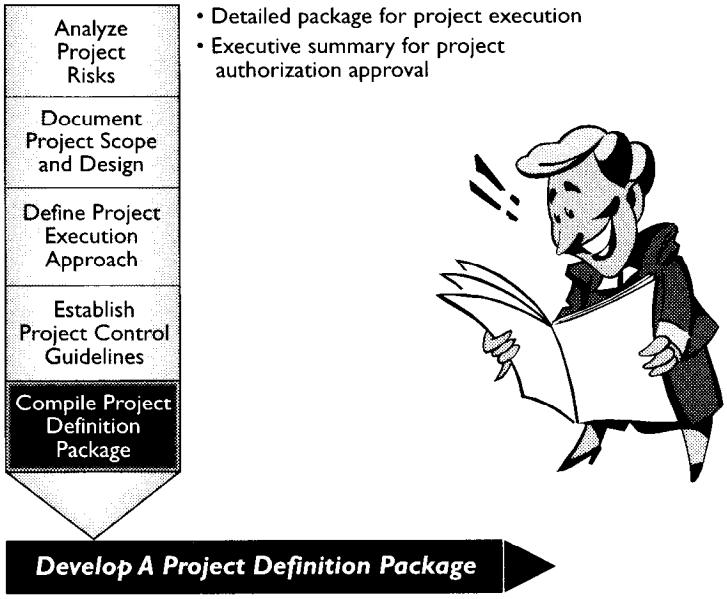
Overestimates can be as bad as underestimates.

Project Status Reporting. The foregoing information provides a baseline to measure cost and schedule progress throughout the life of the project. Without a well-defined baseline, true control is impossible.

With the baseline in place and the control system established, control becomes a matter of monitoring physical progress and costs, comparing expectations (i.e., the baseline) to actual progress, and then taking appropriate corrective actions when necessary. Project status reporting provides feedback to the project team. Good reporting should always compare actual progress to planned progress, and then a forecast of future progress based on current trends can be made. Exhibit D.4, Appendix D, contains a listing of information in a typical large industrial project status report.

Without a baseline, control is impossible.

Progress reporting must include all aspects of the project. The amount of detail and depth of reporting will vary for every project; however, critical elements of design, procurement, and construction must be included.



Compile Project Definition Package

Reason for Project Success: "..we have a formal pre-project planning method that involves all people and produces a project execution plan. This is a vast improvement."- A project manager

Two packages for different purposes

Background. *Compiling the project definition package* includes assembling the information into both a project definition package and a project authorization package. The project definition package is used as a detailed road map for project execution. The project authorization package is an executive summary for the decision maker(s). A discussion of each of these follows.

Project Definition Package. An effective and efficient path for continuation of the project will be met if the organization assembles all detailed information developed to this point. The activities undertaken will be those necessary to compile the project definition package. In addition to providing back-up for the project authorization,

the definition package serves as a road map to be used during the execution phases of engineering, procurement and construction. The amount of detail and information will vary for every organization. However, all critical elements must be addressed, at least at the summary level. The following are essential elements of the project definition package:

- *Project Objectives and Priorities. This section outlines the business needs and project aspects important to the owner. It includes the purpose for the project, cost/schedule trade-offcriteria, operability, technology, project safety, environmental and other regulatory requirements, financial objectives, schedule objectives, quality requirements, community and governmental relations objectives, and operations requirements.*
- *Cost Estimate. This section should describe the information the team used to make its estimate, and the level of confidence associated with all components.*
- *Economic and Risk Analysis. This section updates business and market projections, and assesses risks to the project with regard to volume, price, technology, and cost. It also shows updated economic analysis and takes into account optimistic, expected, and/or pessimistic cases.*
- *Alternatives to Project. This section reviews the evaluation ofproject alternatives and why the current project is the chosen case.*
- *Future Obligations. This section identifies and outlines plans for dealing with future obligations resulting from this project such as land options, leases, abandonment, technology Licenses, and transfers.*

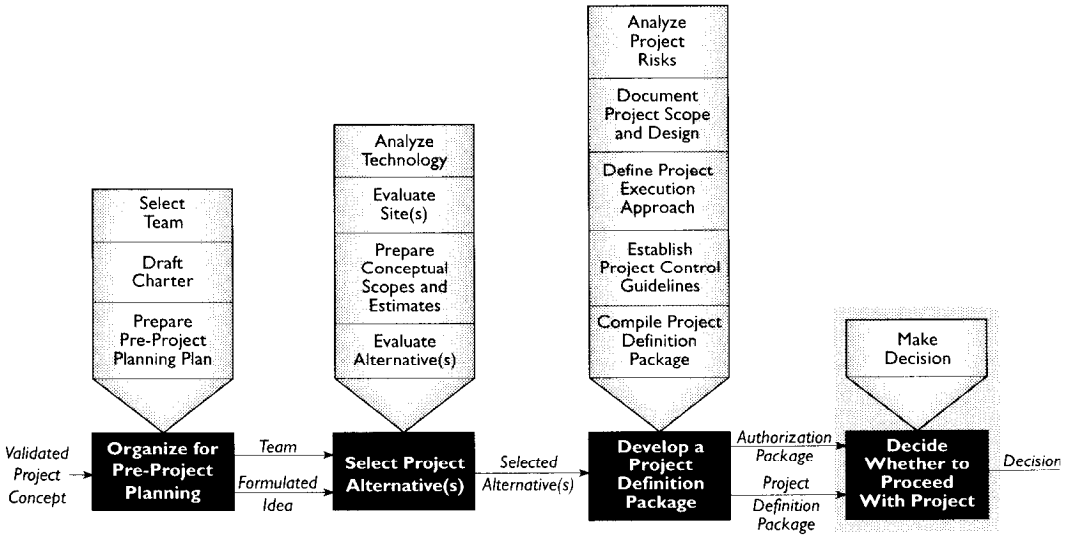
Authorization Package. The final step before making a "Go" or "No Go" decision is to prepare an executive summary. This summary contains all the information necessary for the decision maker to evaluate the viability of the project and decide whether to provide funds

for the venture. This summary is called the authorization package and consists of all elements of the project definition package plus a project justification, expected project benefits, and a summary level evaluation and recommendation. Appendix D, Exhibit D.5, contains an example outline for an authorization package.

Key Points-Develop Project Definition Package

The *develop project definition package* sub-process begins with the selected project site, technological alternatives, and corporate guidance, and transforms these into a project definition package and authorization package that allow the decision maker to make an authorization decision. The functions performed during this sub-process include: analysis of risk; development of scope and design; definition of a project execution approach; establishment of project control guidelines; and the compilation of this information into a useful format. A recommendation of the Pre-Project Planning Research Team, supported by research results, is that 10-25 percent of the total design effort should be completed at this point. The products of this sub-process include a project definition package that is the basis for project execution and an authorization package that is used to make a funding decision.

Make Decision



"We are trying to change the method of authorization so that it is more defined, especially in the area of risk. What investment can we tolerate?"- A business manager

Well-defined needs will enable sound decision-making.

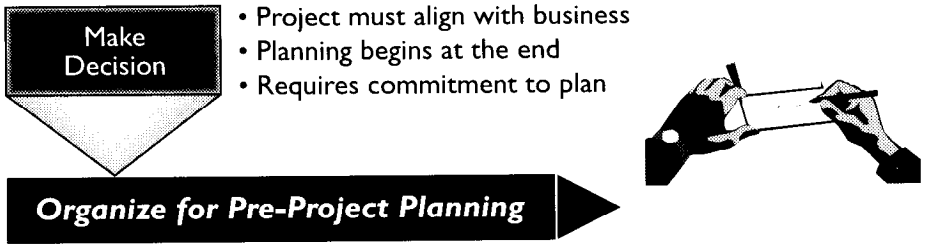
Background. The pre-project planning process ultimately leads to a decision on whether to commit company resources. The dominant theme throughout the pre-project planning effort must be the *business needs* of the enterprise. These needs must be well-defined up-front and communicated to the pre-project planning team throughout the planning process. The objectives and interests of the major entities of the enterprise (especially the business, technology, and operations units) must be an integral part of the pre-project planning process and must be aligned with the *business needs* of the enterprise and the objectives of the project.

Success Criteria. Early in the process, the decision maker must define measurable success criteria and corporate guidance for pre-project planning. Expectations must be defined so that when the authorization package is received, it satisfies those expectations. *he-project planning has to begin at the end, with early input and direction up front from the decision maker regarding expectations.*

Planning begins at the end.

The decision maker will evaluate the authorization package submitted for the selected alternative(s) and may approve or deny funding for the project. The typical authorization package includes justification for the project, cost of the project, benefits expected from the project, schedule, cash flow, people, material and utility resources required, environmental impact, risk analysis with alternatives considered, scope of the project, and method of project execution. The decision maker may also evaluate the project definition package. This package should include sufficient supplemental information to permit effective and efficient detailed engineering to proceed.

Consensus Design



Making The Decision

Validity Test. The process of deciding to commit resources for a project encompasses the assessment by the decision maker as to the likelihood of the project to satisfy the business needs of the enterprise. This process attempts to test the validity of objectives established for the project (especially business, technology, and operations goals) as well as to assess the probability of the project satisfying those objectives.

In assessing the validity of a proposed project, decision makers typically evaluate a number of specific areas. The key points of these areas are summarized below:

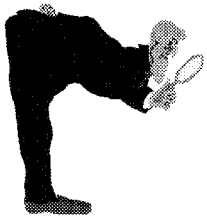
Consider corporate strategy

Business Planning. When evaluating a prospective project from a business management standpoint, the decision maker typically considers the following elements:

- *Capacity/Volume Studies*
- *Location and Market Evaluation*
- *Profit Plan*
- *Long- Term Funding Plans and Strategies*
- *Raw Materials Studies*
- *Product Studies*
- *Process Flexibility and Expandability*

- *World Class Manufacturing Metrics*
- *Delivery Studies*
- *Market Window*
- *Unit Price Objectives*
- *Risk Strategies*
- *Corporate Resource Assessment*
- *Business Alliance Evaluation*
- *Government Regulations*
- *Technology vs. Competition*

Eliminate assumptions.



Consider risks carefully.

Risk Assessment. Risk assessment is the result of identifying and assessing risks related to the project and of proactively seeking to minimize their impact on its success. Decision makers should assess all aspects of risk associated with an undertaking and tie this risk to the business needs of the enterprise. Risk assessment likely will include an analysis of the following:

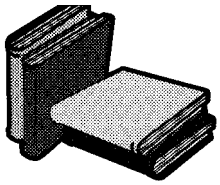
- *Environmental Risks*
- *Social Risks*
- *Political Risks*
- *Processing Technology Risks*
- *Equipment Capability Risks*
- *Operational Risks*
- *Design Engineering Risks*
- *Project Estimate Risks*
- *Business Risks*

Execution plan

Project Execution Approach. The project execution approach ensures that all tasks are identified and accomplished. The approach also provides guidance to the decision-making process. It involves documentation of the methods used to define such items as:

Who does what and when?

- *Basis of Estimate*
- *Basis of Schedule*
- *Work Breakdown Structure*
- *Procurement Approach*
- *Contracting Strategy*
- *Engineering Strategy*
- *Constructability*
- *Owner Objectives*
- *Construction Strategy*
- *Control Estimate*



Project Definition Package/Authorization Package. The team transforms the selected alternative into an authorization package and a project definition package. The authorization package is an executive summary of the project definition package. The project definition package involves the detailed formulation of a continuous and systematic strategy to be used during the execution phase of the project.

No Go!

Decision Not To Commit Resources. The first output of the pre-project planning process is a decision on whether to provide the resources necessary to proceed with the execution of the project. If the decision makers elect not to commit resources, this decision is used to either modify the business planning or the pre-project planning functional steps.

Go!

Decision to Commit Resources. If the decision makers elect to commit resources, the next function is to execute the project.

Key Points-Make Decision

The Decision. The project definition package and the authorization package control the *make decision* function. The decision maker decides whether to provide the resources necessary to proceed with project execution. If no decision is made, the decision maker may require additional feedback and may allocate additional funding to any of the functional steps of pre-project planning or to the business planning function.

Clear statement of risk vs. benefit

Lack of Consistent Views. The decision maker has the responsibility to ensure that the project participants have adequately evaluated the project. *They must understand that these participants will have very different views ofproject* success. Results of a survey undertaken by the research team underscore this. In one case the business manager rated a project a "1" in terms of success (lowest on a scale of 1 to 5) and the operations manager rated the same project a "5". Another project received a score of 5 for overall success by the business manager and project manager, and a score of "1" by the operations manager.

Project participants have very different views of project success.

The decision maker must make sure that the project team is consistent and informed about the needs of the business as well as those of the individual participants. Key areas for continuous improvement include:

- *More attention should be given to team building.*
- *Business objectives must be set early, clearly understood, communicated and fully shared.*
- *More attention and resources (including time) spent up-font on pre-project planning will pay significant dividends.*
- *Lack of adequate scope definition andproject objectives is probably the biggest detriment to successful project execution.*

- *The interests and needs of the business, technology, and operations units of an enterprise must be represented and accounted for in the pre-project planning process.*

CHAPTER 6

Conclusions

Pre-project planning is a corporate best practice that applies to all projects. It is imperative that project participants understand and become more proactive in pre-project planning. Listed below are some of the tenets of pre-project planning:

- *The Level of effort expended on pre-project planning bar a sign&ant impact on project success, with a net savings of 20% or greater possible.*
- *Pre-project planning is a process that a company can standardize and measure.*
- *The four primary sub-processes in pre-project planning are: Organize for pre-project planning; select project alternatives; develop a project definition package; and decide whether to proceed with project.*
- *he-project planning is an owner-driven process that must be tied closely to the business goals early in the process.*
- *This handbook provides details of a pre-project planning process that can Lead to project success.*
- *The glossary in Appendix B is a good basis for communicating the concepts of pre-project planning.*
- *he-project planning is a complex process that decision makers must adapt to the business needs of their company.* ***Companies must modify the process*** *to meet their individual business needs.*
- *The decision maker is critical to the process.*
- *Pre-project planning is the only viable route to a "no change" project mentality.*

The following are best practices of pre-project planning:

- *Decision makers must define the corporate goals and guidelines for both pre-project planning and the project.*
- *Key individuals who are held accountable for their actions should control the project.*
- *Teamwork and communication are critical to the pre-project planning process.*

- *When organizing for pre-project planning, a multi-disciplinary team consisting of appropriately skilled and experienced personnel (including the project customer) is required. This means that operations, business, project management/technical, and, if applicable, key consultant personnel must be closely involved in pre-project planning early in the process. Smaller organizations may have to go outside of their own company (consultants, contractors, etc.).*
- *For pre-project planning to be successful, team continuity is necessary, and the team must be cultivated through team building and open communication.*
- *The project, business, and operations managers need to understand that they have different views concerningproject success andproject objectives. These managers must communicate these views, and project representatives* ***should agree on project objectives.*** *This agreement can be achieved through project objective-setting exercises that consider the views ofproject managers, business managers, and operations managers.*
- *Each company should establish a formal process for conducting pre-project planning based on the modelpresented in this handbook. This* ***should be specific to each company's needs and should maintain uniformity.*** *Through consistent application of a specific pre-projectplanning methodology, companies can measure performance and continuously improve it.*
- *To conduct* ***pre-project planning*** *successfully, companies must* ***authorize adequate time and resources.*** *Qualified teams of skilled and experienced personnel are required to verify inputs to the pre-project planning process, conduct analysis, and make recommendations to the decision maker(s).*
- *All pre-project planning personnel involved in the process need to understand their roles and responsibilities in the process.*

On a larger scale-what does the future hold for firms and organizations in terms of construction of capital facilities? We know that change is occurring rapidly: engineering staffs are being reduced, capital is tight, competition abounds, more work is required with fewer resources, renovation and repair work is expanding, and consultants are more involved in defining scope. Therefore, it is **essential** that all participants understand the sub-processes of pre-project planning and their effect on the overall facility life-cycle. The information in this handbook will help the user's company perform capital facility design and construction in a more efficient manner that will translate into more competitive business ventures. Remember, **performance of adequate pre-project planning is owner-driven -delegation of this work to consultants does not change their responsibility.**

APPENDIX A

Diagrams

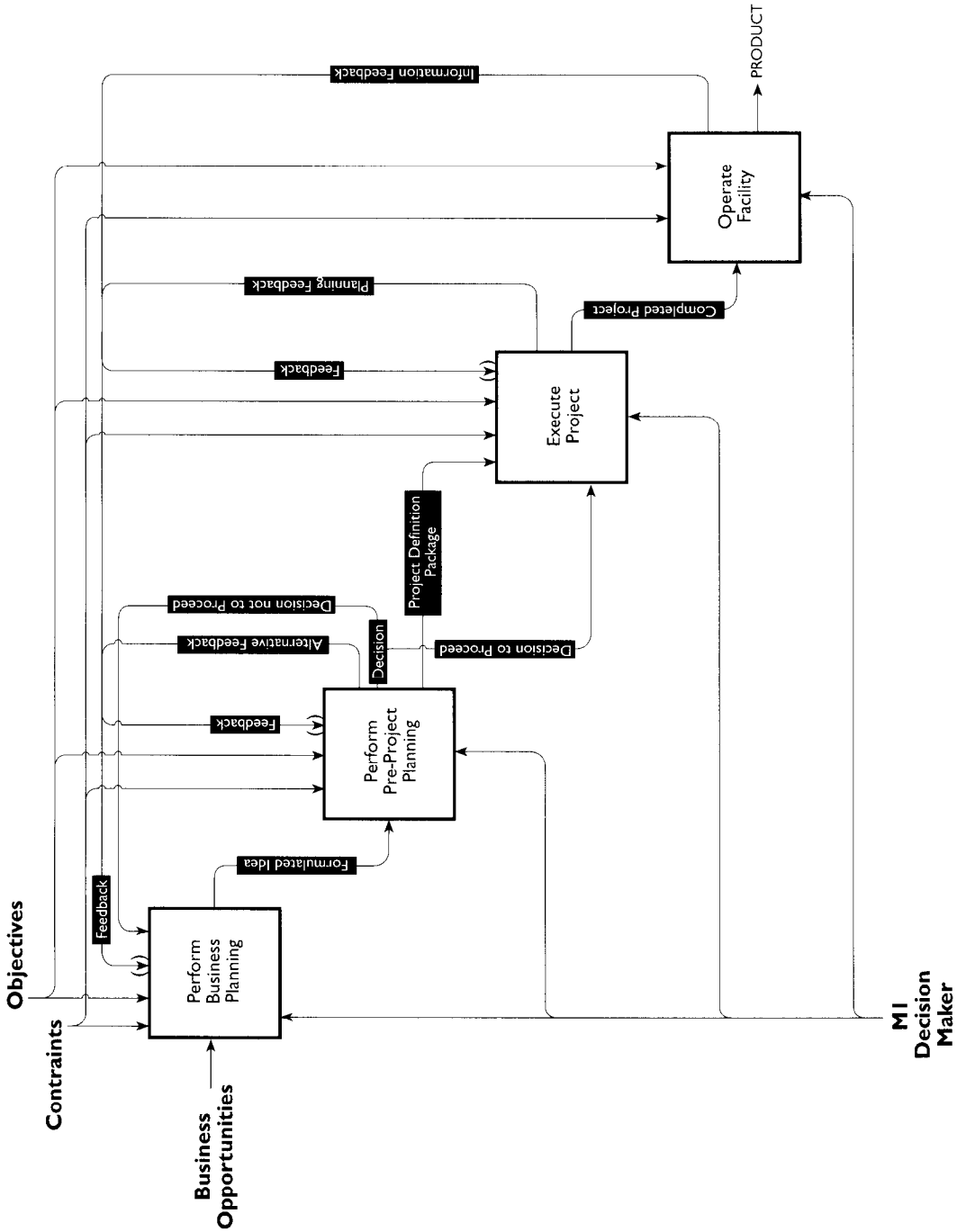


Figure A.I : ***FEO Diagram--Project Life Cycle***

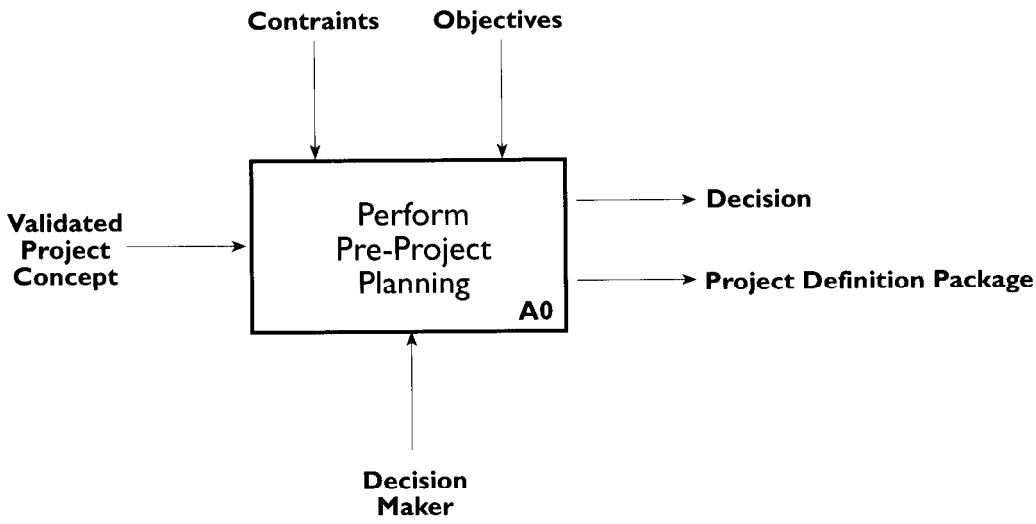


Figure A.2: ***A-O Diagram-Pre-Project Planning***

Purpose: Define the functions involved in pre-project planning of capital expenditures so that the measures of effort and project success can be developed and their interrelationship can be analyzed. Pre-Project Planning is defined as the process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximize the chance for a successful project. This process provides a comprehensive framework for detailed project planning.

Viewpoint: Senior management of owner companies.

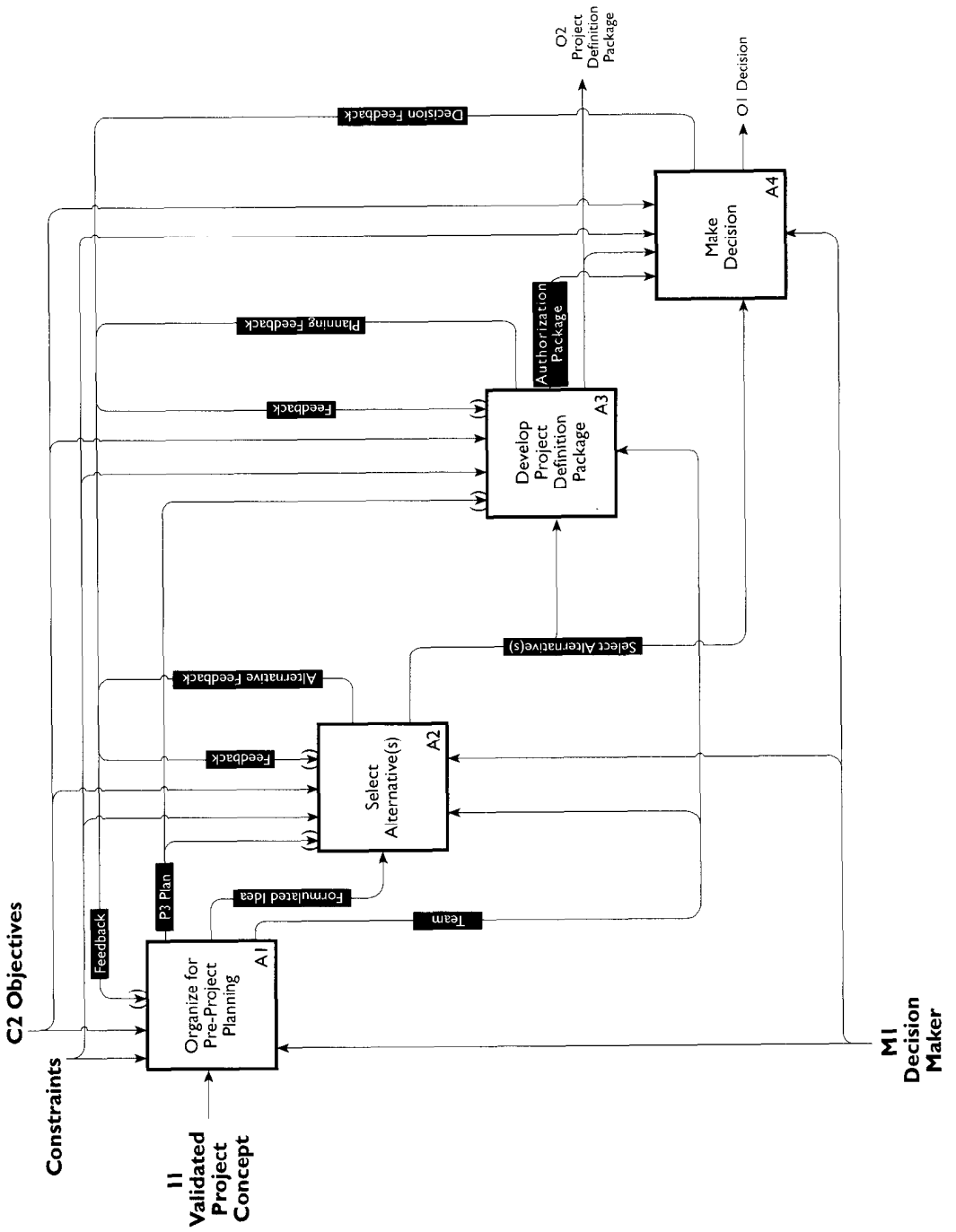


Figure A.3: ***A-O Diagram--Perform Pre-Project Planning***

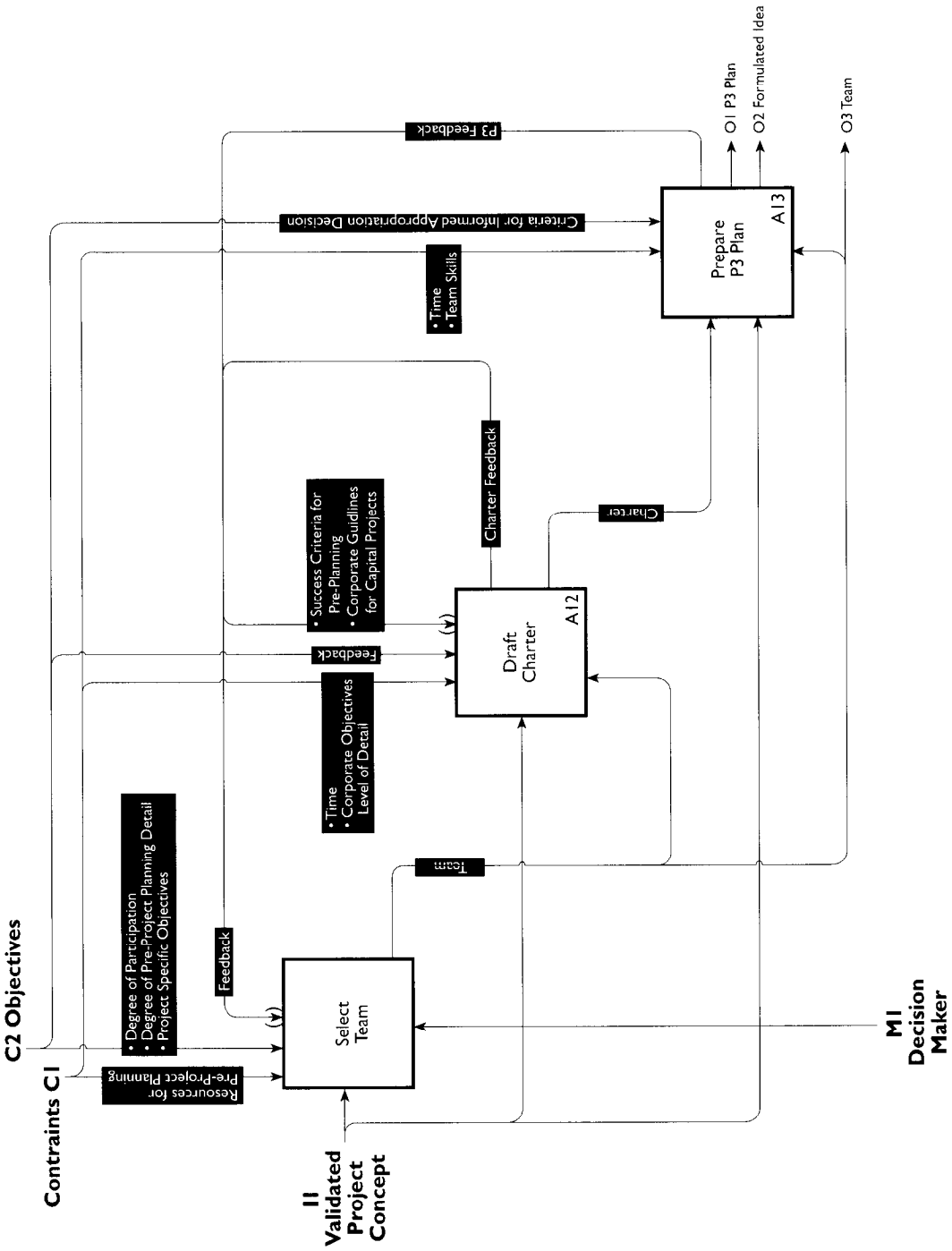


Figure A.4: ***A-l Diagram-Organize for Pre-Project Planning***

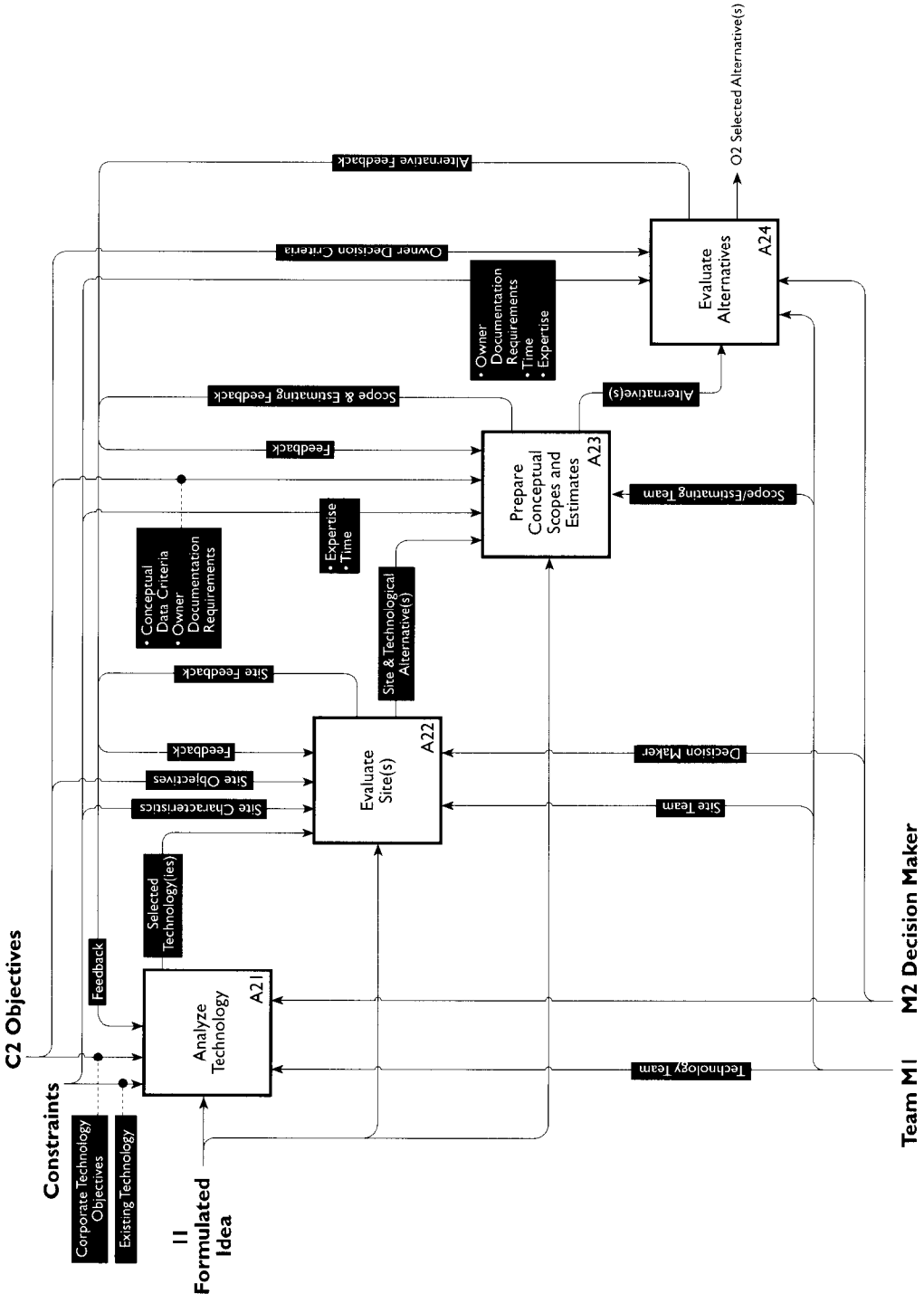


Figure A.5: ***A-2 Diagram-Select Alternative(s)***

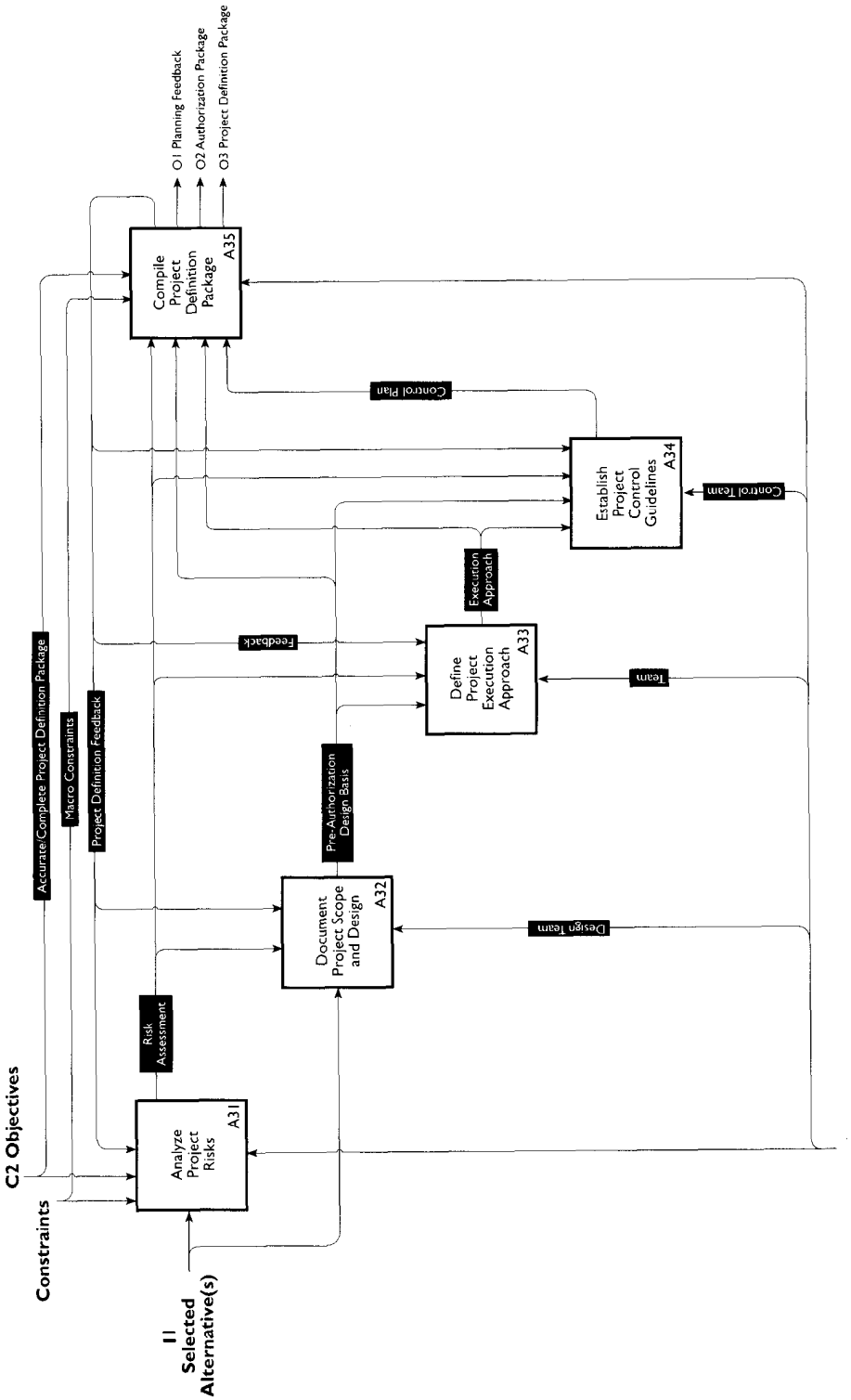


Figure A.6: ***A-3 Diagram-Develop Project Definition Package***

APPENDIX B

Glossary of Terms

Accurate/Complete Project Definition Package - The level of detail and accuracy of the project strategic plan which the owner has determined is necessary to maximize the chances for executing the project successfully.

Alternative Feedback - Additional information or requirements identified during the process of evaluating alternatives needed before a selection can be finalized.

Alternatives - Viable options for accomplishing the project objectives.

Analyze Project Risks - To identify and evaluate the risks associated with the project, including technological, site related, economic, political, legal, etc.

Analyze Technology - To identify the appropriate information on available technologies, identify the strengths and weaknesses, and recommend the optimum technology for producing the final product.

Authorization Package - Document(s) required by the owner, the approval of which will provide funds for the project. Typical requirements include justification for the project, cost of the project, benefits expected from the project, schedule, cash flow, people, material and utility resources, environmental impact, risk analysis with alternates considered, scope of project, and method of project execution.

Business Opportunities - Situations that have the potential to satisfy one or more business objectives.

Charter - A document defining the Pre-Project Planning team, its mission, and its responsibilities, accountability, and authority.

Charter Feedback - Feedback identifying any element of the pre-project planning charter definition that may impact timing on resources required to complete the pre-project planning draft.

Compile Project Definition Package -To assemble the various components of the project strategic plan into a single usable document.

Completed Project - A facility that has no missing or deficient systems or components.

Conceptual Data Criteria - Clearly defined criteria and guidelines to ensure that conceptual data are of sufficient quality to be used as the basis for preparation of project scopes and estimates.

Constraints - The limitations that establish the boundaries of the project and/or pre-project planning process. These limitations may include the following: available resources, company standards, regulatory issues, market conditions, available technology, etc.

Control Plan - The method to identify, collect, process, and disseminate that information which is needed to successfully execute the project, including planning and scheduling, cost information, management information systems, change management, etc.

Control Team - Those members of the pre-project planning team who are specialists in project control systems, such as planning and scheduling engineers, cost engineers, estimators, management information systems specialists, etc.

Corporate Guidelines for Capital Projects - Guidelines and targets set by the corporation for the construction of capital projects. These may include methods for selecting contractors, types of contracts, relationships with organized labor, methods of exchanging data, percentage of new technology, etc.

Corporate Objectives Level of Detail - The extent to which the objectives of the owner are defined and communicated to the team.

Corporate Technology Objectives - The goals of the owner in using technology to produce product, especially the use of new versus proven technology.

Criteria for Informed Appropriation Decision - Information, standards, rules, and guidelines that must be considered before a decision is made to appropriate funds.

Decision - A formal determination as to whether or not to provide the resources necessary to proceed with the execution of a project.

Decision Feedback - Additional information or requirements identified during the decision making process before the decision can be finalized.

Decision Maker - The entity that has the authority to make a decision to commit resources to an undertaking.

Decision Not to Proceed - A formal determination not to provide the resources necessary to proceed with the execution of a project.

Decision to Proceed - A formal determination to provide the resources necessary to proceed with the execution of a project.

Define Project Execution Approach - Document the method used to define basis of estimate, basis of schedule, WBS, plans for engineering, procurement and construction, owner/client objectives, etc.

Degree of Participation - The number of organizations represented on the pre-project planning team compared to the topics containing uncertainty that need to be addressed and the amount of quality effort expended by their representatives.

Degree of Pre-Project Planning Detail - The level of effort required to satisfy a complete authorization package.

Design Team - Those members of the pre-project planning team who are specialists in design, including engineers and designers, construction planners, technological consultants, etc.

Develop Project Definition Package - Process for formulating project definition package.

Document Project Scope and Design - To clearly identify the technical and commercial intent of the project and bring design to that stage of completion which is necessary to reasonably minimize the execution risks associated with the project.

Draft Charter - To prepare the charter document.

Establish Project Control Guidelines - To specify the detailed procedure to be used to manage risks during the execution of the project.

Evaluate Alternatives - The process to determine risk and assess the relative strengths and weaknesses of each project alternative to facilitate selection of the most favorable option, consistent with project objectives.

Evaluate Site(s) - To assess the relative strengths and weaknesses of alternative locations to meet owner requirements.

Execute Project - Perform the detailed engineering, procurement and construction, and start-up for a facility.

Execution Approach - The methods that will be used to complete the engineering and design, procurement, construction, and start-up of the project including management of the project. These include identification of project participants, the roles and interrelationships of the participants, contracting strategy, etc.

Existing Technology - Proven methods of producing intermediate or finished products.

Expertise - The aptitudes, qualifications, and experience of people required for pre-project planning.

Feedback - Additional information identified during a process that is required before the process can continue.

Formulated Idea - A more clearly defined, focused, and validated project concept.

Information Feedback - Additional information identified during a process that enhances the execution of other processes.

Macro Constraints - Identified constraints which are either explicit or implicit in the overall corporate business strategy and operating environment.

Make Decision - Process for finalizing whether to provide the resources necessary to proceed with the execution of a project.

Objectives - A series of key measurable targets, the fulfillment of which satisfies owner's expectations.

Operate Facility- The use of a facility for its intended purpose.

Organize for Pre-Project Planning - Process for developing the pre-project plan, the formulated idea, and organizing the team.

Owner Decision Criteria - The criteria that helps to ensure all corporate objectives and stakeholder requirements are considered.

Owner Documentation Requirements - The criteria defining the level of detail, format, and timing for information such as scope documents, estimates, financial data, alternatives, etc.

Perform Business Planning - Strategic planning involving the goals and objectives of a business entity.

Perform Pre-Project Planning - The process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximize the chance for a successful project. This process provides a comprehensive framework for detailed project planning.

Planning Feedback - Additional information requirements identified during the process of developing the Project Definition Package required before the process can continue.

Pre-Authorization Design Basis - A compilation of the engineering design information, including calculations, studies, specifications, drawings, etc.

Pre-Project Planning Feedback - Additional information identified during a process that is required before the process can continue.

Pre-Project Planning Plan - A detailed scheme for executing the pre-project planning process.

Prepare Conceptual Scopes and Estimates - The process of developing and assembling the required information on various alternatives in a format which allows valid comparisons.

Prepare Pre-Project Planning Plan - The formulation and documentation of the methods to be used to perform the pre-project planning process.

Product - The output of the facility

Project Definition Feedback - Additional information identified during a process that is required before the process can continue.

Project Definition Package - The detailed formulation of a continuous and systematic strategy to be used during the execution phase of the project to accomplish the project objectives. This package includes sufficient supplemental information to permit effective and efficient detailed engineering to proceed.

Project Specific Objectives - Corporate objectives that relate to the specific project being considered.

Resources for Pre-Project Planning - The assets available to the pre-project planning effort which include funding, personnel, facilities, technology, and time.

Risk Assessment - The results of identifying and assessing risks associated with the project and of proactively seeking to minimize their impact on its success.

Scope and Estimating Feedback - Additional information requirements identified during the process of developing the conceptual scopes and estimates required before the process can continue.

Scope/Estimating Team - Those members of the pre-project planning team and others with expertise in scope definition, estimating, etc.

Select Alternative - Determine the best combination of physical, technological, cost, and schedule criteria to use such that the project will meet objectives.

Select Team - To allocate personnel to the pre-project planning effort.

Selected Alternative(s) - The alternative(s) that best meet the stated objectives.

Selected Technology(ies) - The technology(ies) recommended as providing the greatest opportunity to meet the owner objectives.

Site and Technological Alternatives - Combinations of sites and technologies that best meet the owner objectives.

Site Characteristics - Aspects of a location that make it more or less suitable for a project.

Site Feedback - Additional information requirements identified during the process of evaluating the site required before the process can continue.

Site Objectives - Attributes of a site which have been defined to be desirable.

Site Team - Those members of the pre-project planning team and others with expertise in site-related matters.

Success Criteria for Pre-Project Planning - Defined and measurable performance objectives, against which pre-project planning can be assessed.

Team - Personnel involved in and responsible for pre-project planning. These personnel may include owners, users, planners and consultants united for a common cause.

Team Skills - The competence of the team members to perform the pre-project planning tasks. This competence may be required in such areas a technological know-how, communication ability, interpersonal skills, legal and regulatory matters, economic and financial modeling, etc.

Technology Team - Those members of the pre-project planning team and others having expertise in technological matters.

Time - The available duration.

Validated Project Concept - The initial idea for the project which sets it in motion. The idea may involve new profit opportunity, compliance with regulations, or reduction of liability exposure (risk). The concept typically includes information relating to the preliminary project objectives.

APPENDIX C

Alternatives

Exhibit C.I *Concept and Design Basis*

Earned Score	Possible Score	
[ ]	2	1. Project goals, overall and concept
[ ]	2	2. Project measures, overall phase
[ ]	2	3. Design basis
[ ]	2	4. Conceptual solution estimate, plus preliminary estimate for early financial analysis work, with estimate accuracy shown
[ ]	2	5. Process selection
[ ]	2	6. Heat and material balances
	2	7. Major equipment list
[ ]	2	8. Process flow diagram and preliminary P & IDs
[ ]	2	9. Preliminary line list
[ ]	2	10. Preliminary motor list
[ ]	2	11. Preliminary instrument list
[ ]	2	12. Scope of project/work
[ ]	2	13. Plot plan and/or equipment
[ ]	2	14. Memorandum of explanation (project description)
[ ]	2	15. Financial analysis (including sensitivity)
[ ]	2	16. Identification of regulatory needs and permit applications
[ ]	2	17. Strategic alternatives evaluated and selection criteria
[ ]	2	18. Assessment of community impact
[ ]	2	19. Preliminary resource plans for facilities operation
[ ]	2	20. Identificationof funding needs through definition phase
[ ]	2	21. Conceptual solution work score according to CSE (Capital Spending Effectiveness) guidelines
[ ]	2	22. Identification of critical path and early purchase requirements
[ ]	2	23. Identification and estimation for needed services, S & D (Supply and Distribution) facilities, R&D facilities, railcars, etc., needed to support project
[ ]	2	24. Funding to allow detailed work to continue
[ ]	2	25. Team Continuity
	50	**Total Score**

A P P E N D I X D

Project Definition Package

Exhibit D.I *Design/Scope Package Deliverables Checklist*

Completed		
[ ]	1.	Project goals, overall and definition phase
[ ]	2.	Project measures, overall and definition phase
[ ]	3.	Detailed scope of work
[ ]	4.	Detailed cost estimate with estimate accuracy specified
[ ]	5.	Detailed project breakdown structure
[ ]	6.	Detailed project cost structure
[ ]	7.	Detailed project description
[ ]	8.	Preliminary building drawings
[ ]	9.	HAZOP reviews
[ ]	10.	MFL (Maximum Foreseeable Loss) study
[ ]	11.	Equipment lists
[ ]	12.	Approved equipment layouts
[ ]	13.	Approved P&ID's
[ ]	14.	Approved major equipment specifications
[ ]	15.	Motor lists
[ ]	16.	Piping line lists and quantities
[ ]	17.	Approved single line drawings
[ ]	18.	Assessment of community impact
[ ]	19.	Team continuity
[ ]	20.	Major equipment quotes
[ ]	21.	DCS (Distributed Control System) quote
[ ]	22.	Transportation network
[ ]	23.	Engineering drawings controls
[ ]	24.	Environmental permit application
[ ]	25.	Utilities requirements
[ ]	26.	Performance management plan
[ ]	27.	Design alternatives considered and criteria used from selection for value analysis
[ ]	28.	Process review for 'risk management' concepts
[ ]	29.	SER (Special Expenditure Requisition) package
[ ]	30.	Preliminary plan for moving from area based construction to system-based construction and identification of shutdown requirements
[ ]	31.	Engineer contractor selection and needed contracts
[ ]	32.	Assessment of community impact
[ ]	33.	Design, permit, construct information required for ARP (Applied Research Project) plan
[ ]	34.	Identification of construction
[ ]	35.	Detailed division of responsibilities matrix
[ ]	36.	Project procedure manual
[ ]	37.	Identification of standards and specifications to be used
[ ]	38.	Other team agreed to deliverables

Exhibit D.2 Table of Contents for Design/Scope Package

Scope definition
- Process Scope Summary
- Facilities Design Philosophy

Design Basis
- General
- Plant Capacity
- Feedstocks; Rate/Composition
- Design Yields and Variability
- Product Streams; Rate(s)
- Service Factor Assumed
- Plant Site Conditions Available
- Economic Criteria

Materials of Construction

Plot Plan(s)
- Block Plot or Typical Plot Plan (approximate dimensions)
- Preliminary Plot Plans (specific)

Environmental
- Effluent Description(s)
- Treatment Facilities

Piping and Instrument Diagrams
- Typical P&ID's
- Preliminary P&ID's

General Specifications
- Owner's Standards
- Project Specifications
- Project Philosophy
- Local conditions

Process Description and Characteristics
- Process or System Flow Diagram
- Special Processing or Design Conditions

Control Philosophy

Catalyst Requirements

Chemical Requirements

Utility Requirements; Estimated Complete Balance

Operating Guidelines; Start-Up Shut-Down Reaction Regeneration
- General
- Detailed

Design Considerations: Specific Equipment

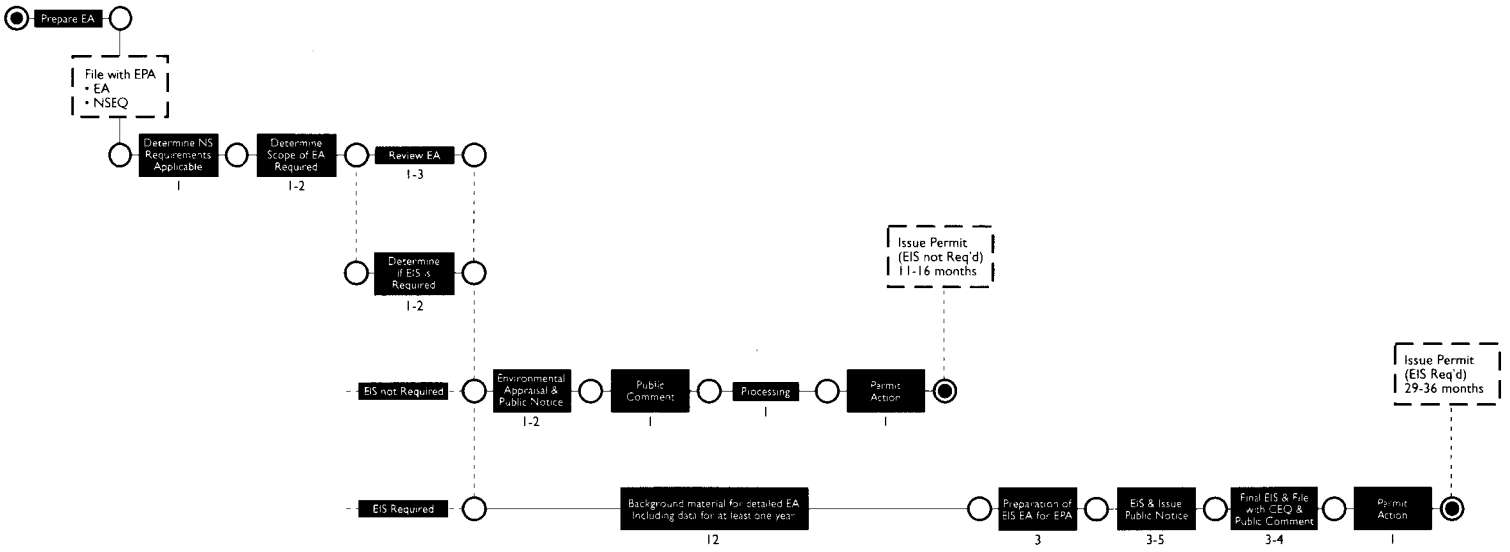
Equipment Data
- Equipment List
- Process and Operating Data by Class
- Reactor Design Data & Drawings
- Equipment Data Sheets by Class (include design data)
- Piping
- Special Items
- Equipment Specifications

Pressure/Temperature Diagram

Electrical; One-Line Diagrams, Specifications

Design Package For General Plant Facilities
- Fencing: Type of Fencing, Data Sheets
- Roads and Paving: Extent and Type
- Landscaping: Description, Extent
- Drainage and Sewers: Description, Specification, & Plot Plan Indicating Extent
- Buildings: Floor Plans and Descriptive Specifications

Exhibit D.3. Typical *Environmental Assessment Activities and Schedule*



NOTES:

1. The above agency times are official estimates and are used for scheduling. However, it should be noted that agency times for preparing an EIS have run almost twice as long under other regulations.

2. NSEQ solicits information concerning new sources of air and water pollution which may require EPA approval
   A. National pollutant discharge elimination system (NPDES)
   B. Prevention of significant deterioration (PSD)
   C. New sources performances standards (NSPS)
   D. National emission standards for hazardous pollutants (NESHZPS)

3. Permit procedures are constantly undergoing changes through interpretation and litigation. This schedule may not be the latest information and requirement.

4. Numerous other state and/or local regulations apply. This may include:
   A. Air quality construction permit
   B. Ground water appropriation
   C. Local building permits
   D. Industrial siting permit
   E. Etc.

LEGEND:

EA	Environmental Assessment
NSEQ	New Services Environmental Questionnaire
EIS	Environmental Inspect Study
EPA	Environmental Protection Agency
CEQ	Council of Environmental Quality
- - - - -	EPA activities
———	Owner and/or contractor activities

Exhibit D.4. *Typical Content of Summary Report for a Large Project*

A typical summary report for a large project would include:

- Narrative analysis (brief)
- Overall project schedule showing progress and forecast to complete or a tracking curve
- Cumulative cost statement including expenditures, commitments, trends, and estimate to complete
- Design progress and work hours, planned and actual
- Purchasing and delivery status
- Problems, encountered or anticipated, with plans for corrective action
- Critical needs including decisions reached
- Photographs, if appropriate

Other details for a project report may include:

- Progress analysis
- Design and drawing releases
- Purchase orders placed
- Material deliveries
- Engineering labor data
- List of design changes
- Design curves by plant
- Construction curves by plant
- Construction labor data
- List of field changes
- Cost analysis by plant
- Contingency analysis by plant
- Cost trend analysis
- Analysis of allowances
- Analysis of escalation
- Indirect cost analysis
- Contract/subcontract
- Contract change log summary
- Expenditure and photographs, as appropriate commitment curves
- Safety/accident experience

Exhibit D.5. *Sample Outline of an Authorization Package*

Transmittal Memorandum

- Introduces the project to those approving
- Provides title and cost information
- States how funds will be used in general
- Request for approval of funds

Capital Project Support Documents

- Contains project number, project title, owner groups, location of facility to be provided
- Background and objective
- Discussion of customer satisfaction requirements and need for this project
  - Discussion of objectives of the project
  - Alternative solutions
  - Reason for selection of the recommended alternate
- Major work to be done - Summary level scope of work discussion
- Major risks - Identification of major risks and discussion of how to control/reduce risks
- Funding considerations
  - Expected capital cost and expected estimate accuracy
  - Expected yearly expenditure profile
  - Discussion of capital budget provisions
- Economic justification
  - Financial analysis and comparison to minimum requirements
  - Financial sensitivity analysis to cover major potential business risk situations
- Capacity effects - Discussion of present and planned capacity and timing of that capacity becoming available
- Product quality effects - Discussion of change in product quality or product form as a result of this project
- Health, safety, and environmental considerations - Discussion of anticipated situation concerning health, safety, and environment
- Raw materials, supplies, inventory requirements - Listing of needs or change in needs
- Labor requirements - Listing of needs or change in needs
- Utility and energy requirements - Listing of needs or change in needs

Exhibit D.5 (Cont'd)

- Other requirements
  - Maintenance
  - Research and Development
  - Information and computer systems
  - Miscellaneous
- Remarks - Discussion of related projects and/or project priority
- Scope of project
  - General description
  - Schedule mechanical completion date
- Detailed discussion for:
  - Engineering and construction provisions
  - Building provisions
  - Civil provisions
  - Equipment provisions
  - Piping provisions
  - Insulation provisions
  - Electrical provisions
  - Demolition or use of surplus items
  - Other provisions
- Approval signature sheet
- Special requisition with authority to approve the funds
- Project cost summary estimate showing estimated labor and material cost for code of accounts for each building
- Shutdown requirements
- Escalation provisions

- Project Milestones Schedule - showing mechanical completion and product avail ability dates
- Project Sketch - showing process and location or layout to be provided
- Capital Construction Permit, Application
- Capital Project Manpower Requirements
- Materials Management Plan

Table D. I *Federal and Local Agencies and Statues by Issue*

ISSUE AREA	FEDERAL		LOCAL	
	Agencies	Statues	Agencies	Statues
Air Contaminants	EPA OSHA	SARA Title III CAA	AQMD/APCDs Planning Depts. Fire Depts.	AQMD/APCD Rules Use Permit Codes Fire Dept. Regs
Environmental Impact	EPA Coast Guard DOT OSHA Army Corps of Engineers	NEPA CAA CWA	AQMD/APCDs Fire Depts. Planning Depts. Health Depts. Lead Agency (CEQN	Health Dept. Ordinances Land Use & User Permit Codes
Hazardous Waste & USTs	EPA DOT OSHA	TSCA RCRA CWA OSHA SARA Title II Hazardous Material Transport Regs	Health Depts. Fire Depts.	Health Dept. Ordinances Local UST Ordinances
Endangered Species	FWS National Marine Fisheries Federal Lead Agency (NEPA)	FESA Marina Mammal Protection Act Fish &Wildlife Act Migratory Bird Conservation Act	Local Lead Agency (CEQA)	Local Habitat Conservation Plans
Pollution	Coast Guard MMS	OPA(CWA) CERLA Hazardous Material Transport Regs.	Health Depts. Fire Depts.	Harbor Rules Fire Dept. Regs. Uniform Fire Code Uniform Building Code

APCD-Air Pollution Control District
AQMD-Air Quality Management District
CAA-Clean Air Act
CPA-Oil Pollution Act
CERLA-Comprehensive Environmental Response, Compensation and Liability Act (1980 "Superfund")
CWA-Clean Water Act
DOT-Department of Transportation
EPA-Environmental Protection Agency
FESA-Federal Endangered Species Act
FWS-Fish and Wildlife Service
MMS-Mineral Management Service (SOI)
NEPA-National Environmental Policy Act (1969)
OPA-Oil Pollution Act (1990)
OSHA-Occupational Safety and Health Act
TSCA-Toxic Substances Control Act
RCRA-Resource Conservation and Recovery Act
SARP-Superfund Amendments & Reauthorization Act (1986)
UST-Underground Storage Tank

APPENDIX E

CII Related Publications

Chapter 2

Publication 39-l) *Pre-Project Planning: Beginning a Project the Right Way,* September 1994

Source Document 105, *Analysis of Pre-Project Planning Effort and Success Variables for Capital Facility Projects,* August 1994

Source Document 94, *Modeling Pre-Project Planning for the Construction of Capital Facilities,* July 1993.

Source Document 102, *Perceptions of Project Representatives Concerning Project Success and Pre-Project Planning Effort,* August 1994.

Chapter 3

Special Publication 12-2, *Organizingfor Project* Success, February 1992.

Source Document 31, *Project Objective Setting by Owner's and Contractors,* August 1987.

Source Document 45, Owner's *Project Planning: The Process Approach,* March 1989.

Source Document 58, *Human Factors of Project Organization,* September 1990.

Source Document 87, *Team Building: Implications for the Design/Construction Process,* February 1993.

Source Document 89, *Alliances in International Construction,* April 1993.

Chapter 4

Publication 6-2, *Scope Definition and Control,* July 1986.

Publication 8-1, *Evaluation of Design Effectiveness,* July 1986.

Source Document 16, *Evaluation of Design Effectiveness,* July 1986.

Source Document 94, *Modeling Pre-Project Planningfor the Construction of Capital Facilities,* July 1993.

Special Publication 004, *Project Materials Management Handbook,* Sept. 1987

Chapter 5

CII Publication 6-2, *Scope Definition and Control,* July, 1986.

CII Publication 6-3, *Model Planning and Controlling System for EPC of Industrial Projects,* April 1987.

CII Publication 6-6, *Work Packagingfor Project Control,* November 1988.

A Special CII Publication, *Manualfor Special Project Management,* July 1991.

CII Source Document 41, *Risk Management in Capital Projects,* October 1988.

CII Special Publication 34-1, *Constructability Implementation Guide,* May 1993.

Chapter 6

Source Document 94, *Modeling Pre-Project Planning for the Construction of Capital Facilities,* July 1993

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