A DESIGN/BUILD PREQUALIFICATION SYSTEM

by

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ABSTRACT

This research presents a model that a public sector owner can use to prequalify appropriate members for a design/build team. It is a systematic evaluation of the potential attributes and constraints that a proposed design/build team would bring to a project. Ideal attributes such as team and project specific experience and ability to meet schedule can be identified as critical during the preparation of requests for proposal. These same attributes, identified to be critical, can be consistently evaluated during proposal review.

The Design/Build Prequalification System (DBPS) model represents the key steps in the initial stages of prequalification. An owner should use this system once a management decision to deliver a project using design/build delivery has been made. Several key issues have been researched from current literature and refined through a review of a public sector owner's selection procedures. Key issues are developed into an information framework: the DBPS model. The model is tested by surveying public sector owner representatives routinely involved in design/build team selection and project management.

The DBPS model is proven as a valid framework for organizing the prequalification attributes of outside design/build teams. It is also proven to be flexible in allowing varying degrees of user experience to interpret relative importance of information constraint categories. A guideline is provided for implementing the DBPS model in the public sector.

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GLOSSARY OF TERMS

Bonding Capacity: Dollar value limit of third party guarantee for the performance of construction contract obligations. Includes all categories of bonds including bid bonds, performance bonds, and labor and material payment bonds.

Banking Arrangements: A history of a contractor's banking history which includes number of banking partners, number of years associated with a current bank, credit availability and limits, applicable interest rates on loans, level of debt, and foreclosure history within a specified time limit.

Complexity: A project risk factor that refers to the degree of difficulty of the project.

Constraints: The boundaries and limitations within which a project or process must be performed.

Construct Manager: A project team management entity responsible for coordinating efforts of all contractors, subcontractors, vendors, etc. to put physical work in place. This manager provides the necessary input to the entire building process to plan and carry out the project.

Corporate Policy Constraints: Constraints which are a result of internal policies set by a team member. Examples are decision making policies, preferred work methods, risk sharing ability, etc.
Cost: A project risk factor that describes the dollar amount specified for project completion (Vesay, 1991).

Credit Rating: A report on or an evaluation of a contractor's ability to secure and meet credit responsibilities.

Critical Project Success Factors: The project factors deemed essential for project success. The four factors are: the facility team, the contract, facility experience, and optimization information.

Design/Build: A team based system organized to provide efficient design and construction processes, where the owner contracts with a single entity to provide the whole service.

Design-Construct: Project organizational structure where the constructor acts as a general contractor providing all design and construction services in-house or contracts with professional firms.

Design Manage: Project organizational structure where construction is performed by a number of independent contractors and managed by a construction manager.

Design Manager: A project team management entity responsible for translating the building program into three dimensional form. Often a professional consultant coordinates the design effort of all architects, engineers, and consultants in order to prepare design documentation.

Economical Constraints: Internal limits on team members regarding finances. Examples are project fees or contract amounts, bonding capacity, insurance costs, etc.

Financial Statement: A summary of a contractor's financial history which includes information such as accounting history and transactions, financial control procedures, frequency of reporting, taxes paid, insurance, etc.

Integrated Building Process Model (IBPM): A model describing the processes required to provide a facility over its life. The functions comprising the IBPM include: Manage Facility, Plan Facility, Design Facility, Construct Facility, and Operate Facility.

Labor/personnel Constraints: Constraints relative to the current workforce employed or accessible to the team. Also included are the skills and training that the current labor pool has attained.

Legal Constraints: Laws and codes that govern the profession of team members; e.g. design professional licensure and trade certifications.

Outside Technical and Management Resource: Project manager, design manager, or construct manager employed on a particular project as hired by an owner's facilities staff to act as consultants.

Interaction Constraints: Constraints experienced by individual team members as a result of inter- or intra-company interactions. Examples are verbal agreements and deals, favors that are owed, and the limits of power and influence on employees.

Project Constraints: The constraints under which all team members and processes required to provide a facility must work. Project constraints are broadly classified into external and team member constraints.

Project Manager: A project team management entity responsible for overall project organization, leadership, administration, and fiscal accountability. May be an employee of the owner or a hired professional. (The design or construct manager may perform this function as a "secondary responsibility".)

Quality: A project risk factor, defined as industry standard or above, that refers to the features, described by the plans and specifications, comprising a building.

Quality Based Selection (QBS): A process of selecting design professionals, with quality as the first objective, based on the professional's qualifications rather than price or level of effort.

Risk: The chance of injury, damage, or loss. Individual team members are exposed to the chance of loss as a result of the variables in their respective profession; e.g. contractors risk a loss of profit; design professionals risk a loss of reputation and future work.

Scope: A project risk factor that describes the degree of definition or "what" of a project.

Team Member Constraints: Limitations underwhich a particular team member must perform processes. These limitations are introduced to the process by the team member performing the process.

Technical Team Skills: An assembled team's technical proficiency.

Technological Constraints: The in-house knowledge or equipment that is available for a team member to use in completing a process. Examples are the ability to use CADD or the capabilities of construction equipment avaialble to the team.

Turnkey: Project organizational structure where the owner contracts with a single firm to plan, implement, and control the entire project through completion. The turnkey firm must provide design and construction management services in-house or contract with other firms for these services.

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CHAPTER 1

OVERVIEW OF RESEARCH

1.1 INTRODUCTION

In the medieval age, the Master Builder encompassed the complete range of knowledge needed to carry out each stage of a building project from concept to operation. With this single individual responsible for the project and making all the decisions, communication and integration of knowledge and information was automatic.

The master builder concept of construction is no longer practiced. Buildings have become more complex and our society has experienced a resulting trend towards specialization. The overall complexity of a project has exceeded the grasp of a single individual. Individuals have been replaced by organizations. New organizational mechanisms continue to evolve which attempt to maximize the respective talents and experience of all the players in the building project. Design/build is one example of collaborative design and construction that continues to evolve as a viable project delivery system (Potter and Sanvido 1994).

The goal of this research is to define a method to assist owners in prequalifying a team to deliver a design/build project. The method will allow owners to differentiate between the attributes of the competing teams, thus prequalifying the one that best meets the owner's needs.

1.2. BACKGROUND

Recently, the Commonwealth of Massachusetts contracted to build a complex $52 million correctional facility using the design/build delivery strategy for the first time. Driven by a court order to ease prison overcrowding by April 1990, the state government investigated alternative building procurement techniques. In 1986 the state had organized itself to take on its initial design/build project, and by September 1987 had selected the team and negotiated its contract. The completed project had to be delivered in only 30 months. Design/build cut the jail delivery schedule by at least one year, when compared to a linear design, bid, and build process. It provided complex HVAC, electrical, and fire protection systems suitable for air conditioning and life safety in a correctional facility.

The reason cited for the successful delivery of this project was the use of an experienced, compatible designer/constructor team with previous experience on lump sum projects. The design professional had over 20 years of experience in fast track construction involving construction manager participation in the design process which reduced design redundancy. The project was considered a success despite the fact that the jail was the designer's first design/build project and first correctional facility design (Wright 1990).

More recently the Corps of Engineers awarded a contract for the $58.4 million, 600,000 square foot Sparkman Center for Missile Excellence in Huntsville, Alabama (Setzer 1992). It was one of the largest design-build projects the Corps had undertaken out of the Mobile district. Construction was expected to start in early 1993. Sixteen teams bid on the project. The 15 losing bidders contended that they could not afford to repeat the process. Their main problems, according to some of the teams, were uncompensated costs, subjectivity in selection, and a lack of feedback explaining why their respective teams did not win.

Due to the success of design/build in the private sector, public sector interest in design/build is again increasing. Its use, as illustrated above, is being met with varying degrees of success.

1.2.1. Design/Build Definition

Design/build definitions vary and it is difficult to categorize this delivery method. Many of the design/build approaches overlap one another. To synthesize the definitions and provide a uniform base, design/build is defined as:

A team based project delivery system organized to provide efficient design and construction processes, where the owner contracts with a single entity to provide design and construction as a whole service.

1.2.2. Critical Project Success Factors

The selection of the project team is critical to the success of a design/build project. Several factors were previously identified as Critical Project Success Factors (CPSFs). These are those few things that must go well and therefore, require management's special and continual attention to bring about successful projects (Sanvido 1989). The four CPSFs identified by this previous research are:

(1) A well organized, cohesive facility team to manage, plan, design, construct, and operate the facility.

(2) A series of contracts that allows and encourages the various specialists to behave as a team without conflicts of interest and differing goals.

(3) Experience in the management, planning, design, construction, and operation of similar facilities.

(4) Timely, valuable optimization information from the owner, user, designer, contractor, and operator in the planning and design phases of the facility.

All of these factors demonstrate the need for creation of a cohesive and well integrated team. The whole project activity is driven by people assembled by the owner into what is known as the facility team. This team starts with the facility champion and increases in size to include various members of management, planning, design, construction, and operations teams throughout the constructed project's life.

1.2.3. Team Selection - Current Practices

Selecting and retaining design professionals and constructors is a vital step in producing a quality project. Traditionally, design professionals are selected on the basis of qualifications and reputation with some consideration given to fee. Unlike design professional selection, construction contractor selection is usually based on competitive bidding of prices.

For the public sector owner, the need for open competition through public bidding presents unique challenges to the implementation of design/build delivery. Prequalification screening is essential. The proposal selection procedure must clearly reflect objective criteria and evaluation to attract quality bidders and minimize potential challenge by the public.

1.2.4. Key Issues of Design/Build for the Public Owner

Despite public scrutiny there is currently a trend for public agencies to utilize design/build on a selective, if not experimental, basis. Several public agencies have or are developing extensive procedures for its effective use as a project delivery strategy. To maximize design/build's benefits to the public sector owner, several factors should be addressed.

1.2.4.1. Business Issues

Andrew A. Hays, A.I.A., has identified several management implications of turnkey construction employed by public entities who require open competition (Hays 1991). Those that relate to team selection are:

"Statutory regulations and legal challenges may prevent its use". A variety of governmental restrictions may limit the use of design/build by the public agency. The Brooks Act prohibits the selection of design professionals using price only as a criteria. Acquisition regulations also exclude design firms from being awarded construction contracts in the United States. This is found in the Commonwealth of Pennsylvania where the Pennsylvania Law Governing Architects prohibits architects from working for an owner in any relationship other than that of a fiduciary position for protection of an owner against a third party contractor.

"Final scope and design is uncertain at time of contract award". Depending on the scope established in the request for proposal, significant details of the design may not be defined at contract award. As was seen in the Sparkman Center Project Case

Study, the unsuccessful proposer is constrained during the proposal preparation to a level of detail that may or may not remove all ambiguity. The prospect of an unsuccessful "bid" may limit the resources a team is willing to expend in preparing future proposals.

After award, potential redesign and scope revisions, or disputes due to lack of detailed design at contract award, may negate the intended benefits of this delivery strategy. Adversarial relationships, lawsuits, and a damaged public image can be experienced by this owner type without the proper selection process.

"Architect/engineer no longer acts as an agent for an owner". There exists the possibility of "divided loyalty" on the part of design professionals who enter into design/build arrangements. In spite of the team's good intentions there is a definite likelihood that the architect/engineer who acts as a subcontractor to a general constructor may be unable to perform, at all times, in the best interest of the owner. The public owner may find itself without the appropriate protection normally accorded to it by the conventional architect-owner agreements.

The private sector deals with this potential divided loyalty by selecting only design/build professionals with a proven record of compatibility, design reputation, and quality performance.

1.2.4.2. Technical Issues

Previous research and the literature discusses delivery strategies and emerging organizational structures from a contracting strategy point of view. The team formation has been shown to be critical to the success of the project. Key technical issues that must be addressed are:

There is no consistent, systematic approach to selecting team members. Some public sector owners have developed in-house procedures for employing design/build delivery. There is a need for a systematic approach to selecting design/build teams. This should be based on: (1) a strong program and, (2) outstanding professional prequalification.

This approach should cover a range of systems from the simple warehouse or parking structure type projects, through the middle range modern office buildings, to the complex R & D type projects (Denning 1992).

The proposal selection procedure should reflect clearly identified objective criteria. This is critical in order to bring about responsive proposals with minimal possibility of challenge to the public sector owner. These should include project specific scoring systems, selection panels, and any additional criteria to insure objective selection. The selection system should attempt to optimize the experience, resources, and chemistry of a team oriented delivery strategy (Hays 1991).

Technical oversight is critical. Management must consider the additional resources required to administer design/build projects in the public sector. Since the A/E is no longer an agent of the owner (depending on contract strategy) particular attention must be paid to professional project management to resolve design and construction management issues.

1.3. PROBLEM STATEMENT AND SIGNIFICANCE

Traditional selection methods for design professionals and constructors differ in approach. A consistent prequalification approach, based on a well defined program, is needed to maximize the benefits of design/build delivery in the public sector.

Consistent, project specific prequalification procedures, for a range of project complexities, will allow the owner a better opportunity to select highly cohesive teams and ultimately contribute to project success. Consistent procedures will prevent losing bidders from contending that they were uncompensated for costs, and not given an explanation at the end as to why their respective teams did not win a prospective project, as in the case of the Sparkman Missile Center.

1.4. OBJECTIVES

The overall objective of this research is to define those qualities in a design/build team which a public sector owner must consider when prequalifying a potential design/build project team. This information can best be defined through the development of a Design/Build Prequalification System (DBPS). The following are the sub-objectives of this thesis:

- Define design/build to provide a common base of understanding.
- Develop a model DBPS to provide an organized approach to evaluating team requirements suited to public sector projects.
- Test the model using public sector survey.
- Provide a guide for using the model based on "lessons learned" from the case study.

1.5. SCOPE

The study was limited to public sector owners which had responsibilities for a major land setting with multiple building types. These owners had public funded projects with mandates for timely, cost efficient delivery of projects. Typically, these owner types had in-house project management staff to monitor project delivery as well as a facilities management staff to opertate the facilities once completed.

1.6. METHODOLOGY

The following methods were used to meet the objectives of this study:

1.6.1 Model Development

The initial DBPS schema was based on the literature and the author's experience in the consulting engineering profession and as a project manager for design/build construction projects. The model was refined based on a literature review of research into contractor prequalification systems, and case studies of public sector design/build prequalification systems. The final refinement was based on a comparison of the DBPS to Information Architecture (Sanvido et. al. 1992) previously developed by the Computer Integrated Construction Research Team. This formed a conceptual basis to the model framework.

1.6.2. Model Testing

The model was tested through a survey of industry experts. Survey data was analyzed to determine which specific attributes of design/build teams were important in a potential design/build team. The test involved four public sector owners involved with over a total of $150,000,000 in public sector design/build projects .

1.6.3. User Guide Development

A DBPS model guide was developed from the industry representatives' reviews of the DBPS model. It can be used by the public sector owner's representative/project manager (OR/PM) to establish the relative importance of prequalification criteria during request for proposal (RFP) preparation. It also provides a consistent framework of criteria for evaluation during the proposal evaluation process.

1.7. ORGANIZATION OF THESIS

Chapter 1 has provided an overview of the DBPS study. Chapter 2 explores current literature in project delivery and contractor prequalification systems with particular emphasis on design/build. Chapter 3 develops the conceptual DBPS model framework. Chapter 4 explains the testing of the framework in the public sector. Chapter 5 outlines the DBPS model guide for use in the public sector. Chapter 6 addresses the conclusions of this study including limitations and areas of future research.

CHAPTER 2

LITERATURE REVIEW

2.1. INTRODUCTION

Current literature points to the need for prequalifying experienced design/build teams based on a complete building program. Topics explored in the literature review were "organizational structures," "design/build," "teams," and "selection."

2.2. PROJECT ORGANIZATIONAL STRUCTURES

Before design/build can be reviewed, background information on project organizational structures is required. Although there are many variations, there are six basic project organizational structures defined by the American Society of Civil Engineers (ASCE 1988).

2.2.1. Traditional System

This system is the industry's most popular approach, especially in the public sector. It is characterized by sequential execution of the planning, design/bid/award, construction, and occupancy phases of delivery.

The owner has little or no responsibility for coordination of work or performance. His/her role is limited to paying the team members and providing information and approvals. The architect/engineer prepares plans and specifications in accordance with the owner's desires. The construction contracts may be negotiated or competitively bid (ASCE 1988).

2.2.2. Owner Construction

This method is employed by large sophisticated owners. The owner usually does not rely on outside assistance for design or construction services.

There are four key players: the owner, the owner's staff designer, the owner's staff construction manager, and the prime constructor. Depending on the type of construction there may be more than one prime constructor or the owner may perform the construction with in-house forces. The owner holds all contracts (ASCE 1988).

2.2.3. Construction Management

This concept centers on a construction manager (CM) who has the responsibility for managing the entire project from conception through completion. The CM coordinates efforts of the owner, design consultants, and constructors. Besides coordinating the efforts of several contractors, the CM may provide other services including project planning and scheduling, review of design documents, and cost monitoring. Two basic CM forms are construction management-agency (CMA-with CM acting as an agent directly to the owner) and construction management-general contractor (CMGC-with CM acting as general contractor with guaranteed maximum price or GMP). There are a number of variations of these two basic forms (ASCE 1988).

The CMGC approach is used primarily for private work. Under this approach the owner and general contractor are committed, from the beginning, to reach an agreement on the guaranteed maximum price for the cost of construction (ASCE 1988). The GMP estimate of cost usually requires that design be about 50% complete and the specifications at least 80% complete. The general contractor is normally involved from the preliminary design phase.

2.2.4. Multiple Primes

Under this system, the owner or the owner's construction manager contracts with several prime contractors to perform phases of the project. This is different with the situation where a single general contractor is reponsible for performing all the work with his/her own forces or specialty subcontractors (ASCE 1988). The multiple primes system is usually used with either the traditional or construction management approaches. It is usually the result of a statute or law.

2.3. DESIGN/BUILD

There are several types of design/build delivery systems. Several of these will now be reviewed.

2.3.1. Design/Build and Design/Bid/Build

With the advent of design/build construction teaming in the 1960's the American Institute of Architects (AIA) commissioned a task force to study this delivery system as it emerged in the Midwest United States. The task force provided its definitions of design/build delivery process.

Per AIA (1975), the Design/Build Process is defined such that:

"An owner establishes a need and develops a program, with or without consultant input. A design/build team prepares a design concept and establishes a cost proposal. Upon acceptance of the cost proposal, the team completes detail drawings and constructs the facility."

Similarly, AIA (1975) defines the Design/Bid/Build Process as:

"An owner establishes a need and develops a program with or without consultant input. Design/build teams submit cost proposals based on a complete design concept. The owner evaluates the proposal and awards a contract. The selected team completes detail drawings and constructs the facility."

A subtle difference exists between these two processes. The former relies on the active input of the design/build team in preparing the design concept while the latter presumes a complete design concept is available to the design/builder for bidding.

2.3.2. Turnkey

The American Society of Civil Engineers (ASCE 1988) defines design/build as turnkey construction. The owner has a one-party responsibility for project delivery. The turnkey constructor provides design and construction management services in-house or contracts for these services from other professional firms. The design professional, constructor, and specialty constructors often form a corporate entity or joint venture for the duration of the project.

ASCE raises an issue of particular interest to the public sector owner. The design professional, while recognized as an important member of the team, has no contractual obligation with the owner. This may present a division of loyalty that may prejudice the designer's contribution to overall quality.

2.3.3. Design-Construct and Design-Manage

Table 2.1 defines "Design-Construct" and "Design-Manage (Turnkey)" which provide working definitions of these two organizational relationships. The terms are used interchangeably in the industry.

In design-construct, the constructor acts as a general contractor with control of all subcontractors, including the design professional (if one is hired from outside the design-construct firm). This is similar to ASCE's definition of "turnkey" construction.

Barrie & Paulson describe "turnkey" construction as "design-manage". Under design-manage, construction is performed by a number of independent contractors holding contracts directly with the owner, and managed by a construction manager.

SOURCE	STRATEGY	PROCESS DESCRIPTIONS
AIA (1975)	Design/Build	• Owner establishes need, develops program • Consultant input may be used • Design/Build team prepares design concept/ cost proposal • Upon acceptance, design team completes detailed design and constructs the facility.
	Design/Bid/ Build	• Owner establishes need, develops program • Consultant input may be used • Design/Build teams submit cost proposals based on complete design concept • Owner evaluates proposals/awards contract; team completes detail drawings and constructs the facility.
ASCE (1988)	Design/Build or Turnkey	• Owner has one party relationship • Turnkey constructor provides design and construction management services in-house or subcontracts with professional firms • Joint venture may be formed by design professional, constructor, specialty contractors.
Barrie & Paulson (1992)	Design-Construct	• Constructor acts as general contractor - provides all design and construction services in-house or contracts with professional firms.
	Design-Manage or Turnkey	• Owner has multiple party relationship • Independent contractors (including design professional) hold contracts directly with the owner • Contractors are managed by a construction manager with separate contract with the owner.

Table 2.1: Summary of Design/Build Process Descriptions

2.3.4. Summary Definition of Design/Build

Based on this review, design/build is defined for this study as :

> *"A team based system organized to provide efficient design and construction processes, where the owner contracts with a single entity to provide the whole service."*

2.4. SUCCESSFUL DESIGN/BUILD PROJECTS

A key to the successful delivery of a project is the use of the appropriate project delivery system for the project needs. Another key factor for using design/build is the existence of an outstanding project program. Given these two decisions, the selection of the project team is critical to the project's success. These two decisions are explored below. Their impact on project success and project teams are also explored.

2.4.1. Project Delivery Selection System (PDSS)

Rules exist to determine when design/build should be selected as an appropriate delivery system (Vesay 1991). The Project Delivery Selection System (PDSS) states that design/build is best used when a project is well defined, of industry standard quality or slightly complex, when time is of the essence, when the owner is experienced, when the team is experienced, and when the composite risk is low to medium.

2.4.2. Facility Programming Product Model (FPPM)

A project program is a key document for properly defining the project scope of work. A systemized approach to creating, organizing, and presenting facility programming information currently exists (Perkison 1991). The Facility Programming Product Model (FPPM) allows the owner's representative to review the building requirements, or program, for completeness by establishing a structure designed to readily access programming criteria at any phase of the building life cycle.

2.4.3. Critical Project Success Factors

Sanvido (1989) defined four Critical Project Success Factors (CPSFs) which are essential for a project's success. The four CPSFs identified by Sanvido are:

(1) A well organized, cohesive facility team to manage, plan, design, construct, and operate the facility.

(2) A series of contracts that allows and encourages the various specialists to behave as a team without conflicts of interest and differing goals.

(3) Experience in the management, planning, design, construction, and operation of similar facilities.

(4) Timely, valuable optimization information from the owner, user, designer, contractor, and operator in the planning and design phases of the facility.

The most critical factor identified was found to be the creation of a cohesive and well integrated team.

2.4.4. The Project Team

The master builder and master architect concepts of construction are becoming obsolete (Wheeler 1978). Individuals are being replaced by teams as buildings become more complex and our society experiences a trend towards larger organization. These teams are project specific, assembled for each project. As shown in Figure 2.1 building teams are related by a basic triad of functions with responsibilities for management, design, and construction.

According to the Construction Industry Institute (CII 1991) when an owner undertakes a construction project, it is really buying a service: the efforts of a team who work together to serve the needs of a project, yet also work apart in the service of different companies.

> *The use of a team is central to the construction project approach because a team is where the decision making process begins. . . . The team created to tackle a problem should be composed of individuals whose history and skills are matched with the tasks at hand. This team should be constructed so that the skill of its individual members are combined to serve the overall purpose of the team.*

CII describes a team as a group of people working together to accomplish a specific goal. In order for the goal to be accomplished, the team members must trust and respect each other. Friendship is not necessary. Teams function effectively on the basis of their professional relationships and should be assembled based on respective members' skills and experience.

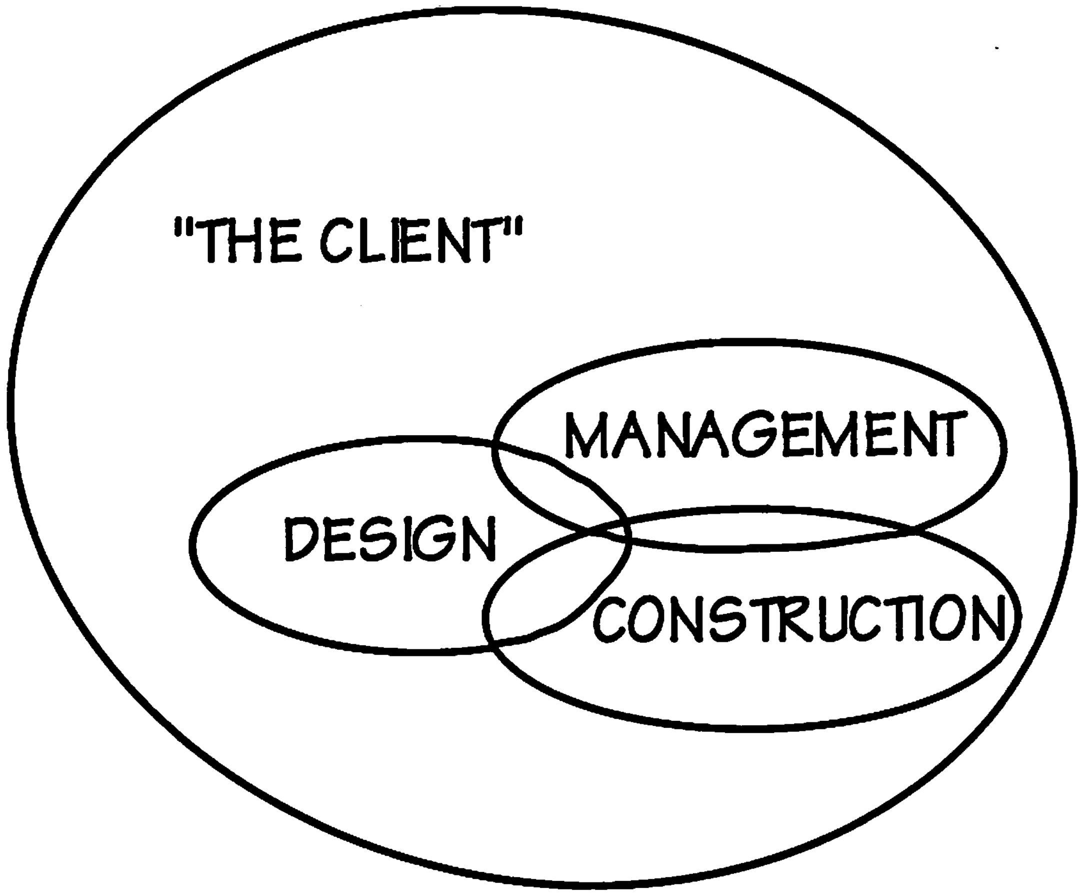

Figure 2.1: The Building Team Triad of Responsibilities (Wheeler 1978)

2.5. TEAM SELECTION-INDUSTRY PRACTICES

Selecting and retaining design professionals and constructors is an essential step for an owner as part of the teaming process. Historically, these two members of a team are selected on the basis of procedures outlined to maximize the owner's advantage of each party.

2.5.1. Design Professional and Contractor Selection

ASCE (1988) recommends selection of design professionals based on qualifications. The process is enhanced when the owner has the capability to describe the proposed project in detail and specifically outline in detail the services expected of the designer. The process normally follows a certain sequence: invitation or solicitation, receipt of proposals, review of proposals, interview of qualified parties, selection, negotiation, and contract execution. Bidding for professional services is discouraged by ASCE.

Selecting the constructor is just as important as selecting the design professional. Competitive bidding is the most commonly used method of selecting the constructor. For public sector work, the use of competitive bidding is typically mandated by law or regulation. This is an attempt to provide taxpayers fair value for spending taxpayer funds on construction work. Specific rules and criteria vary with each particular public owner; however, they generally follow a particular sequence: advertisement and invitation to bid, receipt of bids, opening of bids in public, award to most responsible bidder, and execution of contract.

There is an obvious difference in the selection approach for design professionals and contractors. Design professional selection is normally based on qualifications and reputation with some consideration of fee. Contractor selection is normally based on competitive bidding of prices with some consideration of qualifications and reputation.

2.5.2. Public and Private Sector Contractor Selection

According to Barrie & Paulson (1992), selection of contractors on competitively bid projects varies between the public and private sector. Public sector projects normally require bid, payment, and performance bonds to guarantee payment and performance on the part of the contractor. The public sector is traditionally open to all bidders and the agency awarding the contract often relies on bonding capacity in lieu of prequalification to select competent contractors. In some cases, agencies will prequalify bidders. For technically complex projects, two step bidding may be employed. The agency attempts to prequalify all firms on technical merit and then publicly opens price bids with the low bidder receiving the award.

Private sector owners often prequalify prospective bidders directly or through the design professional they hire. The private owner may require extensive financial information and past performance records be submitted in lieu of bonding capacity. A decision can then be made by the owner whether to require performance and payment bonds. Formal bid openings are not common with private owners.

2.5.3. Public Sector Design/Build Award

Andrew Hays (1989) has studied the implications of public agencies employing design/build delivery. He cites a number of business and technical issues (in Chapter 1) that should be considered.

It is essential that contract award be based in part or wholly on prequalification screening and non-price criteria. For a government agency, restricting potential proposers may bring protests from design and construction professionals. On the other hand, allowing proposals from a broad range of teams unfamiliar with design/build or team members presents the risk of poor performance due to inexperience or incompatibility of the team.

Another challenge in government use of design/build is the fact that the design professional has a different allegiance than the traditional fiduciary relationship with the owner. The government owner may need to acquire additional technical and professional assistance to monitor the project.

2.5.4. Design/Build Prequalification

The prequalification procedure for a public sector owner is thus critical in that it should clearly reflect objective criteria to minimize the possibilities of challenge. Nicholson (1991) proposes a nationwide system of prequalification for design/build contractors. In his opinion, prequalification should be limited to those design/builders that are willing to undergo a stringent peer-review process for quality.

2.5.5. Current Team Selection Process Table

A summary of the team selection methods for the design/build delivery methods in Table 2.1 is presented in Table 2.2. Note that detailed procedures for selecting design/builders in a systematic approach is not readily available from the literature.

SOURCE	PROFESSIONAL	SELECTION PROCESS
ASCE (1988)	Designer	• Select on basis of qualifications recommended. • Sequence: Invitation, proposal receipt, proposal review, interview qualified parties, select, negotiate fee, execute contract. • Competitive bidding may be mandated by law for public sector. Two envelope system recommended.
	Constructor	• Competitive Bidding.
Barrie & Paulson (1992)	Contractors	• Public Sector: Open competitive bidding, may prequalify. • Require bid, payment, and performance bonds to guarantee performance. • Formal bid opening.
		• Private Sector: Competitive bidding of prequalified bidders. • Owner may require substantial financial information in lieu of bonds. • Formal bid opening not usually held.
Hays (1989)	Design/Builder	• Essential that award is based on prequalification screening. • Non-price criteria. • For public sector, criteria should be objective and clear to avoid challenge.
Nicholson (1991)	Design/Builder	• Proposes a nationwide system of prequalification with stringent peer review. • Attitudes in the U.S. must change to implement competitive innovation.

Table 2.2: Current Team Selection Processes

2.6. PUBLIC SECTOR PREQUALIFICATION PROCESSES

A preliminary case study of two public sector owners was performed to support the literature and is discussed below. The Naval Facilities Engineering Command (NAVFAC) and United States Postal Service (USPS) were chosen. These owners, consistent with the scope of this research, had public funded projects with mandates for timely, cost efficient delivery of projects. They also have in-house management staff to monitor project delivery as well as extensive facilities management staff to operate the facilities once completed. The study consisted of a review of in-house policies and procedures furnished by project managers in the respective organizations.

2.6.1. NAVFAC

NAVFAC utilizes design/build to deliver a variety of facility types. NAVFAC uses three design/build strategies. These are:

- Two-step Sealed Bidding
- Source Selection
- Newport Design/Build

Details of these strategies, their prequalification and selection processes, and their use and implications are summarized in Table 2.3. Note that prequalification is recommended in the "source selection" strategy.

STRATEGY	SELECTION PROCESS	WHERE USED	IMPLICATIONS
Two-stepped Sealed Bidding	• Performance specification furnished to prospective bidders with reasonable flexibility in solution development • Proposals are submitted in two parts or "envelopes" - Technical proposal - Price proposal • Technical proposals evaluated; price proposals reviewed for technical proposals deemed acceptable • Award to lowest priced, technically acceptable, proposal.	• Where adequate technical requirements are not available, and: • Where industry is capable of providing alternative solutions in detail. • Example Project: - Infrastructure	• Somewhat less resource intensive, from owner perspective, than other methods.
Source Selection	• Competitive negotiations based on pre-qualification • Evaluation involves in-depth assessment of both the proposal and offeror's ability to execute the contract - Technical Review - Business Review - Professional Review • Award to most competent party; not necessarily the lowest bid.	• Where there is a well established design/build industry, or: • Where high cost, technically complex solutions are required. • Example Project: - R&D facility	• Allows negotiation • Flexibility in satisfying user requirements • Resource intensive for the owner
Newport Design/Build	• Provide proposers with performance specification to obtain lump sum competitive bids • Award goes to lowest bidder.	• Respond to an urgent demand for construction • Projects common in the private sector • Example Projects: - Warehouses - Housing - Dining facilities	• Front end expenses of bidders/owner minimized • Key to success is the quality of performance specifications

Table 2.3. NAVFAC's Design/Build Selection Process

2.6.2. USPS

USPS utilizes design/build to deliver its warehouse and distribution facilities. They emphasize prequalification and have established procedures for prequalification planning. Figure 2.2 is a checklist used to identify desired contractor qualifications during prequalification planning for these facility types.

2.7. CURRENT RESEARCH - PREQUALIFICATION PROCESSES

A study of research in the prequalification of contractors and design professionals follows.

2.7.1. Construction Contractor Prequalification

Russel (1990) presents a decision model for construction contractor prequalification which provides preliminary screening, contractor resource analysis, and project specific criteria analysis. He expands on this model to provide a decision framework for this process. The decision model and framework are reproduced in figures 2.3 and 2.4 respectively.

Contractor prequalification is largely based on subjective judgement and rules of thumb. The process is often performed in an ill structured manner without the use of computer aided decision support. Russel provides a framework for contractor prequalification only; however, this will serve as a basis for the model.

Exhibit 3

Checklist for Identification of Desired Contractor Qualifications

FACTOR	DESIRED QUALIFICATIONS		
	Low	Moderate	High
1. Financial Stability	____	____	____
2. Construction Experience	____	____	____
3. Past Performance	____	____	____
4. Firm Capacity	____	____	____
5. Current Workload	____	____	____
6. Bonding Capacity	____	____	____
7. References from Past Clients	____	____	____
8. Project Control Procedures	____	____	____
9. Staff Available	____	____	____
10. Home Office Location	____	____	____
11. Experience in Geographical Area	____	____	____
12. Project Management Capabilities	____	____	____
13. Quality Performance	____	____	____
14. Safety Performance	____	____	____
15. Company Organization	____	____	____
16. Manpower Resources	____	____	____
17. Equipment Resources	____	____	____
18. Work Performed with Own Forces	____	____	____
19. Substance Abuse Policy	____	____	____
20. Minority Business Participation	____	____	____
21. Other	____	____	____

Figure 2.2. United States Postal Service Design/Build Contractor Qualification "Checklist"

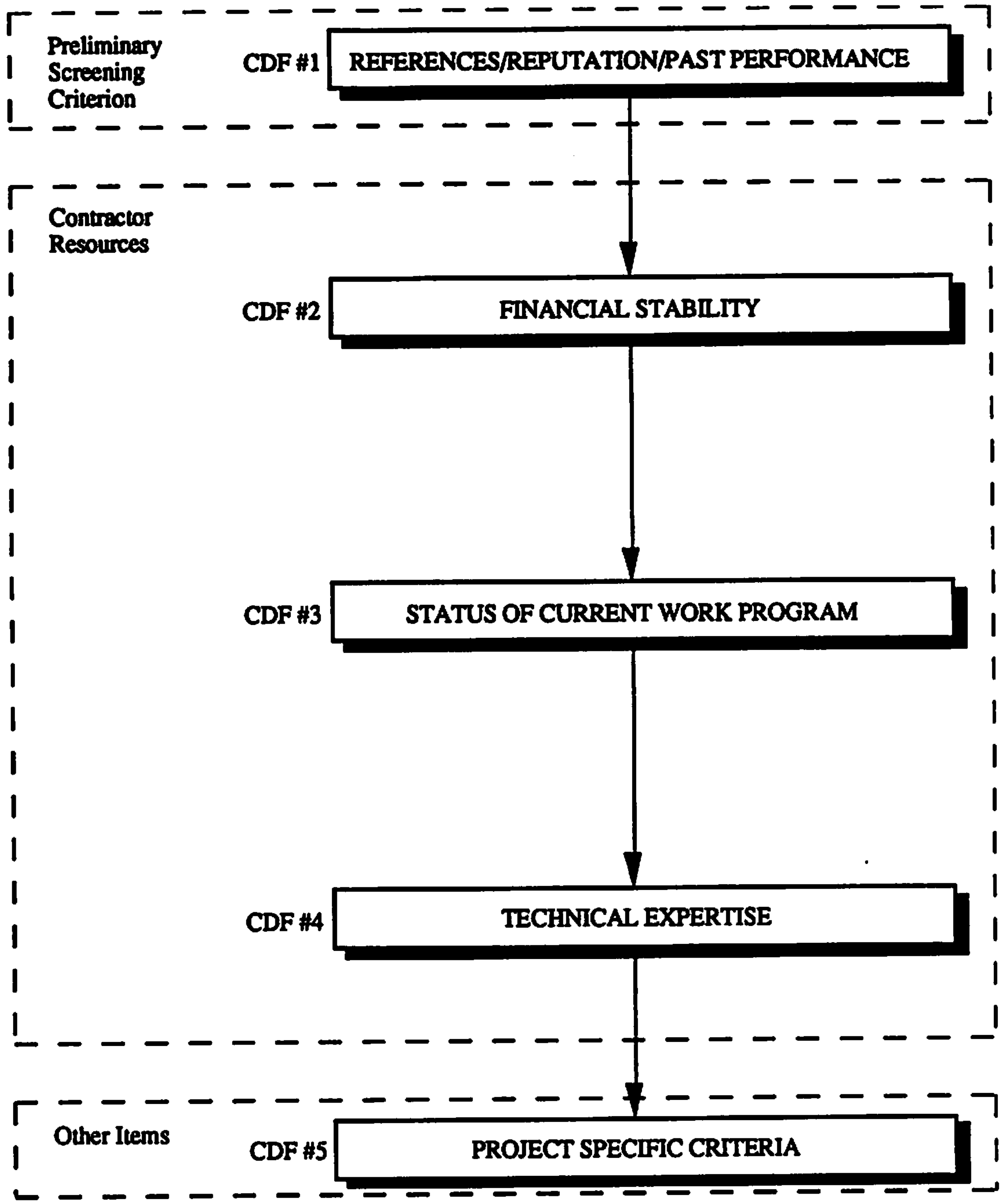

Figure 2.3: Decision Model for Contractor Prequalification (Russell 1990)

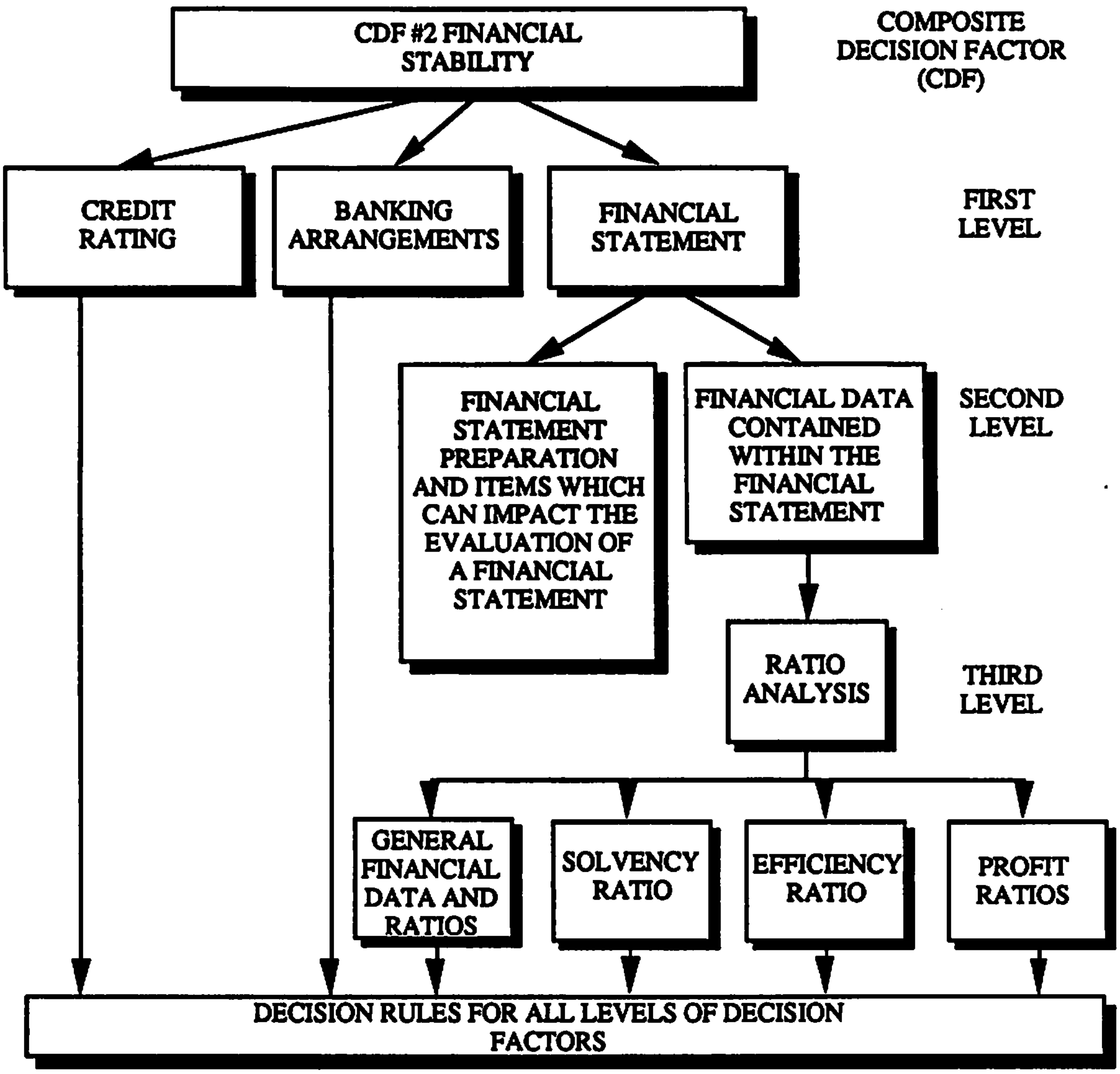

Figure 2.4: Hierarchial Framework for Composite Decision Factors for Contractor Prequalification (Russell 1990)

2.7.2. Acquiring Services for the Integrated Building Process

Computer Integrated Construction (CIC) Research has identified two factors that impact project team selection. First is the responsibility of the owner to provide certain elements to perform the manage, plan, design, construct, and operate functions of a building's life cycle. The Facility Team is one of these outputs. The owner must "Acquire Services to Provide the Facility", a function of the Integrated Building Process Model (IBPM). This model does not include a specific prequalification but will add a dimension to the model.

The second key item is defining the information required to support providing the facility. Part of this is the "Team Member Constraints" identified in the Information Architecture for Computer Integrated Construction (Sanvido et. al. 1992). These constraints are often a factor in determining which member of a team should perform a process. Team member constraints identified were: economical, political, technological, corporate policy, labor, and legal. They are indicated in Figure 2.5.

2.8. PREQUALIFICATION CRITERIA

The literature, industry practice, and current research summarize the current state of design/build prequalification criteria. These prequalification criteria can be generally separated into "business" and "technical skills" criteria. Figure 2.6 summarizes and categorizes business criteria for potential design/build teams as reflected in the literature. These criteria reflect business issues in considering design/build teams: i.e. financial stability, registration and licensing, and historical performance. Without positive indications in these areas, the public sector owner would not even consider doing "business" with the candidate team.

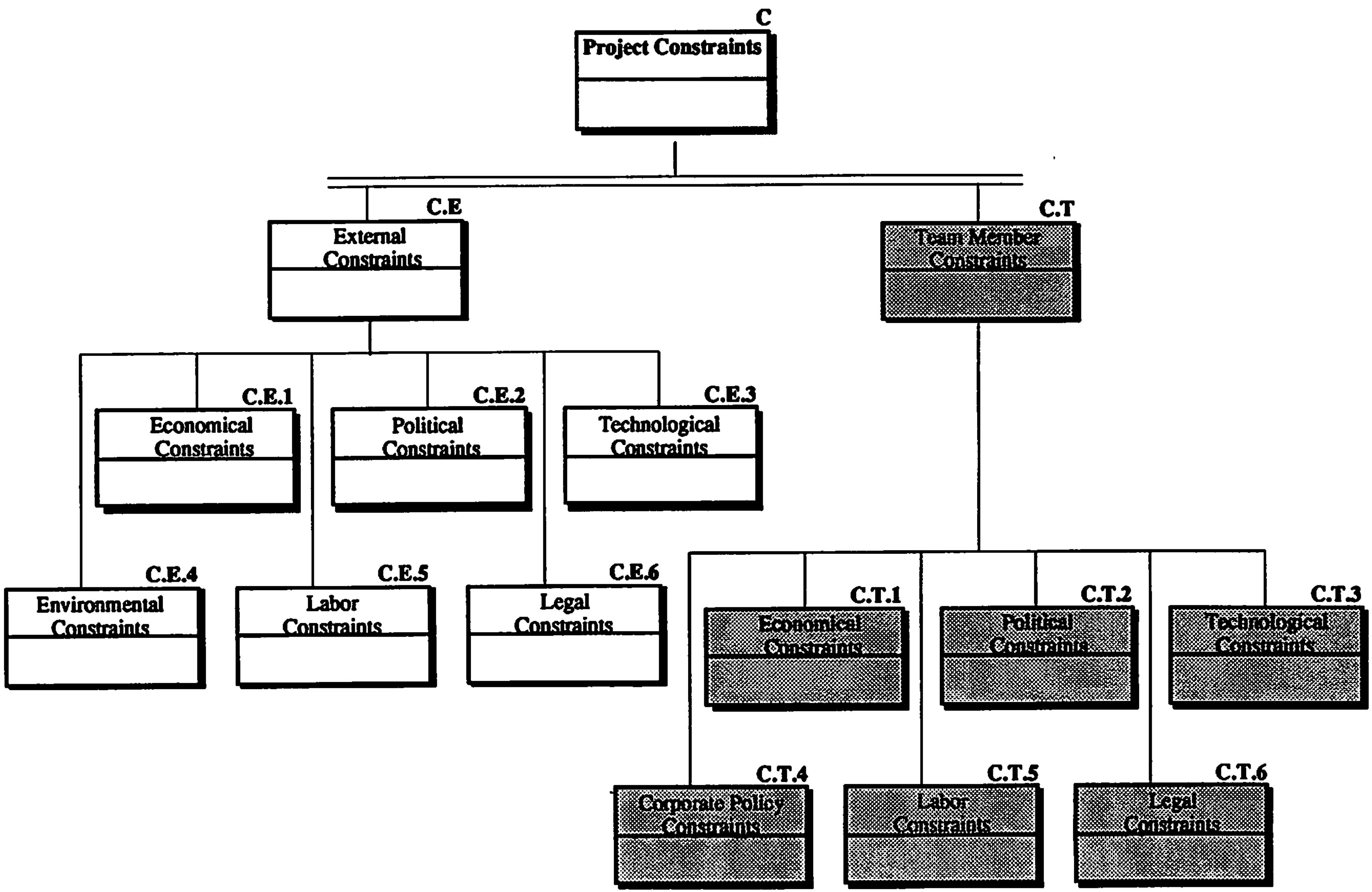

Figure 2.5: The "Project Constraints" of the Information Architecture (Sanvido et al 1992)

Figure 2.7 summarizes and categorizes technical skills criteria for potential design/build teams. This portion of the decision process is potentially more subjective depending on project scope and evaluator(s) experience in prequalification.

2.9. SUMMARY

The literature supports that there is a need in the public sector for consistent prequalification of potential design/build teams based on a defined program. Project organizational structures, specifically those for design/build, have numerous variations with overlapping responsibilities. The most critical factor identified for the success of any project, regardless of organizational type, is the creation of a cohesive and well integrated team. Industry practice and theoretical approaches to team prequalification are inconsistent. As more public sector owners turn to design/build as a delivery system, a consistent method of prequalification must be developed. There is a need for a model framework, a design/build prequalification system, in the public sector. This framework will be developed in Chapter 3.

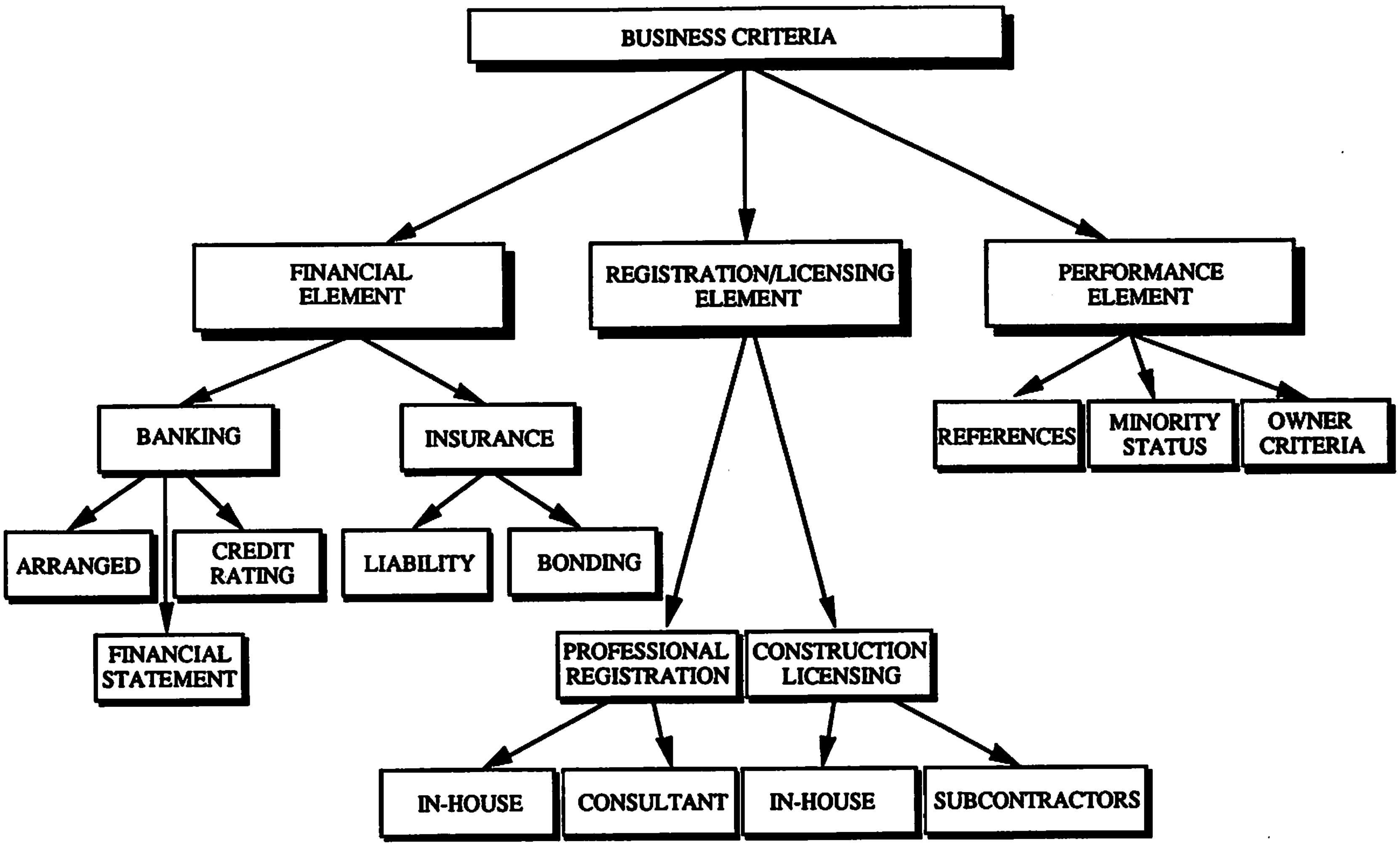

Figure 2.6: Summary of "Business Criteria" for Design/Build Prequalification

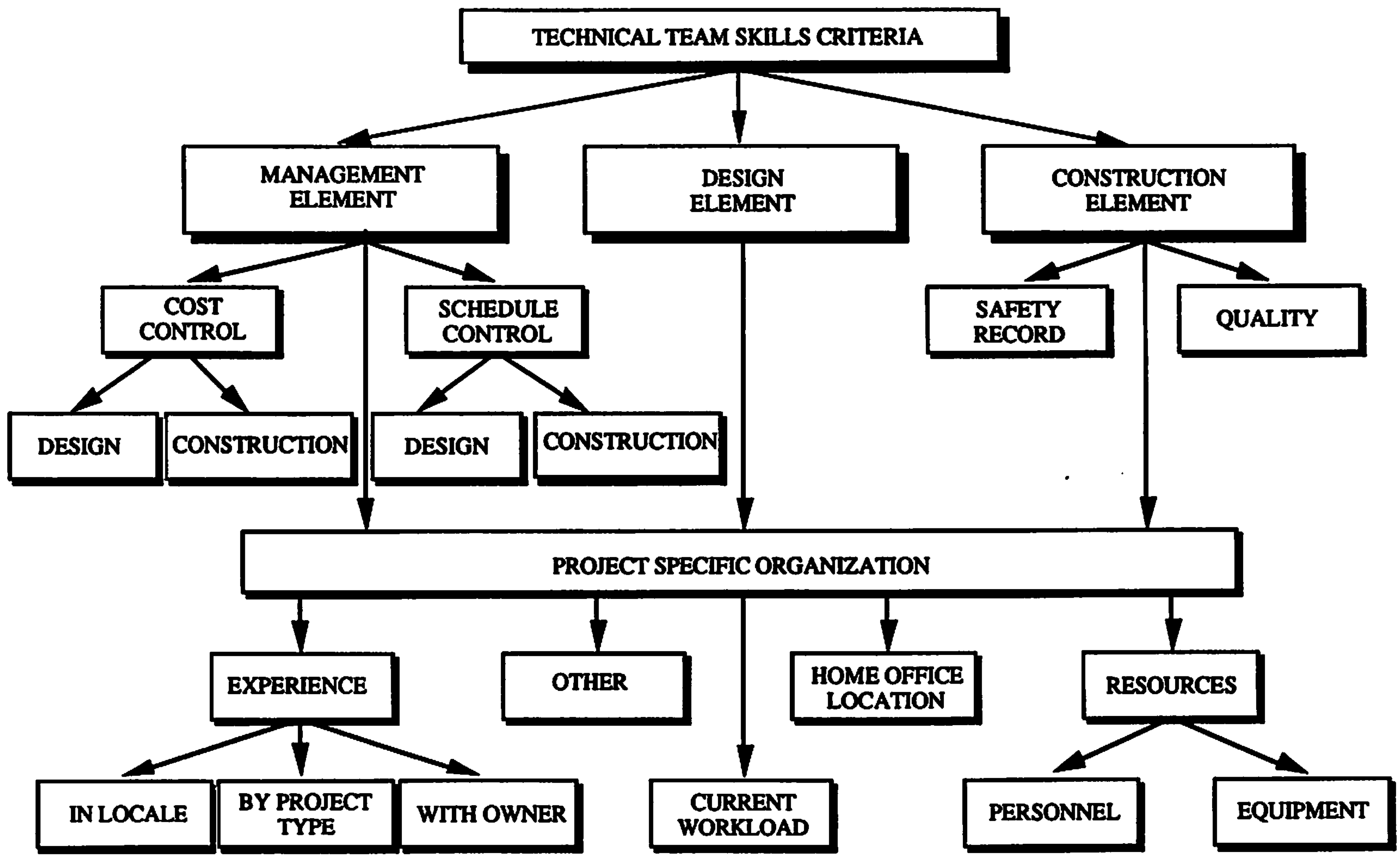

Figure 2.7: Summary of "Technical Team Skills Criteria" for Design/Build Prequalification

CHAPTER 3

THE DESIGN/BUILD PREQUALIFICATION SYSTEM (DBPS) MODEL

3.1. INTRODUCTION

The literature resulted in the basic conclusions that there is a need for a systematic approach to selecting design/build teams based on: (1) a well defined program, and (2) a consistent prequalification process. This systematic approach can be formulated by a Design/Build Prequalification System (DBPS) model. DBPS model development and refinement are described in this chapter. The structure of the model is also discussed.

3.2. MODEL DEVELOPMENT

An initial team selection scheme was developed based on the literature and the author's experience in the consulting engineering profession and in project management/oversight of design/build construction projects. Secondly, information found in the literature and public sector industry prequalification and selection procedures was used to identify the categories that should be evaluated in a prospective design/build team. Thirdly, a comparison with the Process Based Information

Architecture (Sanvido 1992) organized these categories into a framework of information constraints that a project team brings to a specific project.

3.3. A PROJECT TEAM SELECTION METHOD

Figure 3.1 is an overview of a project team selection system. This figure identifies the key requirements and decisions that typically lead to the selection of a design/build project team. First, the program needs as specified by The Facility Programming Product Model (Perkinson 1991) and an analysis of project risk factors (Vesay 1991) are used to determine the project type. Second, the in-house personnel are then reviewed to determine the in-house staff's management and technical review capabilities. Thirdly, the prospective outside design/build teams are reviewed to complement the owner's capabilities and meet the needs of the project. This third decision, shown as the highlighted diamond, is described in detail as the Design/Build Prequalification System (DBPS) model.

3.4. THE DBPS MODEL

The DBPS model is shown in Figures 3.2 through 3.8. It is a framework that provides a structure for the important categories of information that should be evaluated for a candidate design/build team during the prequalification process. The DBPS model is based on Figures 2.8 and 2.9 which summarize the business and technical criteria identified by the literature including a review of current prequalification/selection criteria. The model prequalification criteria are then reclassified in a system of "constraints." These constraints are based on the Information Architecture (Sanvido

1992) developed by the Computer Integrated Construction (CIC) research team at Penn State.

Team member constraints are introduced to the process by the team members performing the process. These constraints, if understood for a potential team, can provide information to determine who should be selected as a team member. Team member constraints are broadly classified as indicated in Figure 3.2: economical, interaction, technological, corporate policy, labor, and legal. These constraint categories are further decomposed into elements and attributes in Figures 3.3 thru 3.8. Constraint categories decompose into elements which decompose into attributes.

Attributes were identified for each element using the "Building Team Triad" approach. This decomposition categorizes respective attributes of project management, design, and construction team members. For example, element C.T.2.2 in Figure 3.4 (Experience with Owner) decomposes into respective experience attributes of project manager, design professional, and constructor. A more detailed description of each constraint category and its decomposition follows.

3.4.1. Economical Constraints

The economic constraints of a project team are related to the cost constraints on team resources associated with the job as decomposed in Figure 3.3. Professional fees, construction costs, and financial backing are internal limitations on team members and are categorized as attributes of element C.T.1.1. Costs of liability coverage and bonding are categorized as attributes of element C.T.1.2. Backlog of project management, design, and construction work constrains the teams resources and are therefore attributes of element C.T.1.3.

3.4.2. Interaction Constraints

Interaction constraints experienced by collective and individual team members as a result of inter- or intra-company interactions are decomposed in Figure 3.4. Originally, the IA listed this constraint category as "political". The researcher changed this designation to "interaction" to more closely identify the constraints felt by the team. Inter-company attributes are found within the proposed team and are decomposed as attributes of element C.T.2.1. Intra-company attributes are elements of element C.T.2.2. Other external attributes are found under element C.T.2.3. External constraint dictated in the public sector are attributes of element C.T.2.4.

3.4.3. Technological Constraints

The technological constraints of the in-house knowledge or equipment available to team members to use are decomposed in Figure 3.5. Knowledge and/or automated systems for controlling cost and schedule are attributes of element C.T.3.1. Communication, design, and construction equipment are attributes of element C.T.3.2. Knowledge attributes as technology in areas of design and construction experience are decomposed from element C.T.3.3.

3.4.4. Corporate Policy Constraints

Constraints which are a result of internal policies set by a team member are decomposed in Figure 3.6. Administrative and procedural issues are addressed as attributes in element C.T.4.1. Coorporate business philosophies are attributes of element C.T.4.2. The ability of respective elements to share risk are attributes of element C.T.4.3.

3.4.5. Labor/Personnel Constraints

Constraints relative to the current workforce employed or available to the team are decomposed in Figure 3.7. Project based experience levels are attributes of element C.T.5.1. Local experience levels are attributes of element C.T.5.2. Staffing levels are attributes of element C.T.5.3.

3.4.6. Legal Constraints

Constraints of law that govern the team members; e.g., design professional licensure and trade certifications, are decomposed in Figure 3.8. In-house professional licensing requirements are attributes of element C.T.6.1. Licensing of outside team members are attributes of element C.T.6.2. Pending legal actions against team members are attributes of element C.T.6.3.

3.5. SUMMARY

This chapter outlined the development of the DBPS model. It creates a systematic way to model prequalification criteria as an information framework of desirable attributes. The ability to use the model to assign relative importance to specific attributes is explored in Chapter 4.

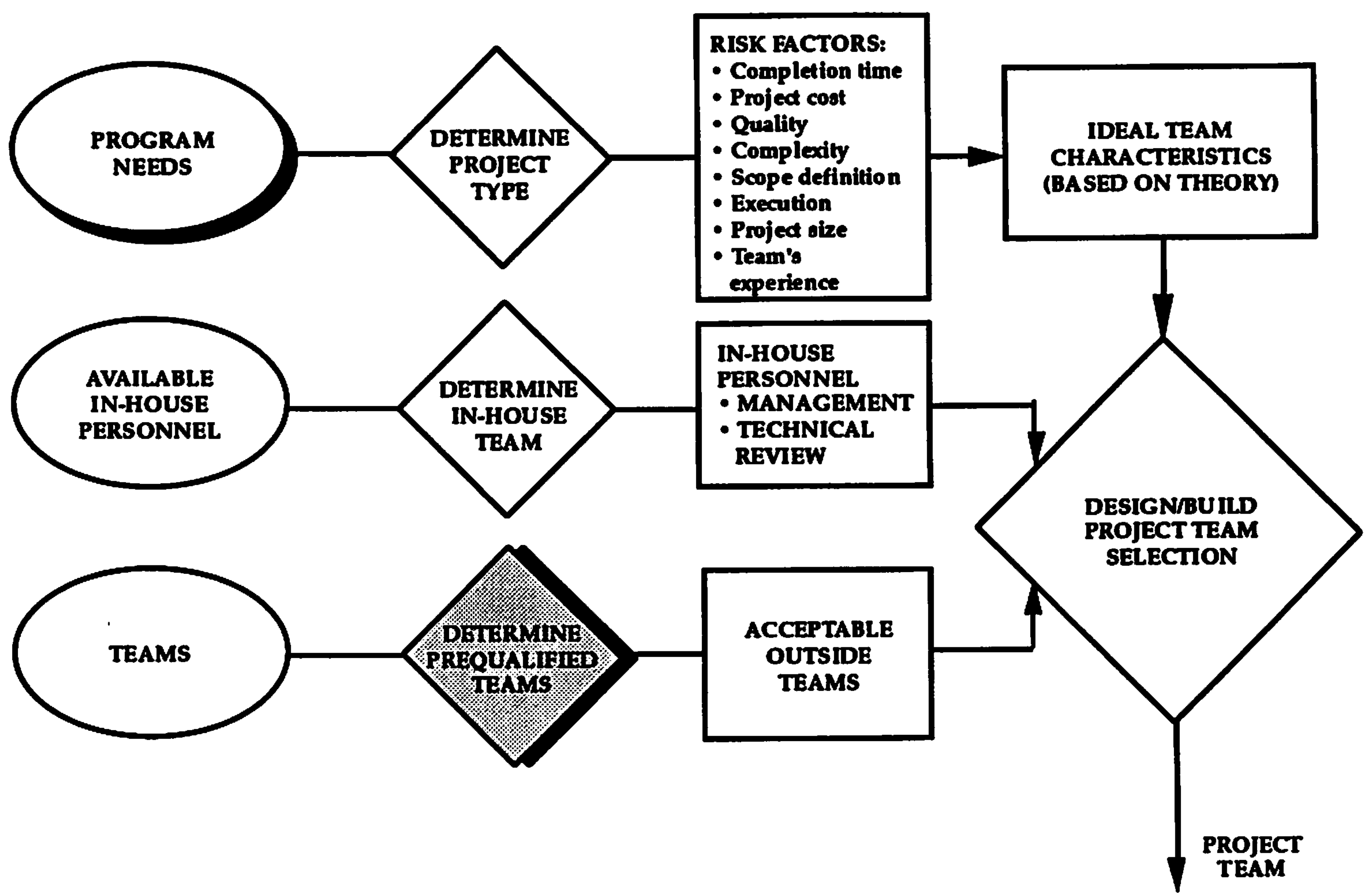

Figure 3.1: Preliminary Design/Build Selection Scheme

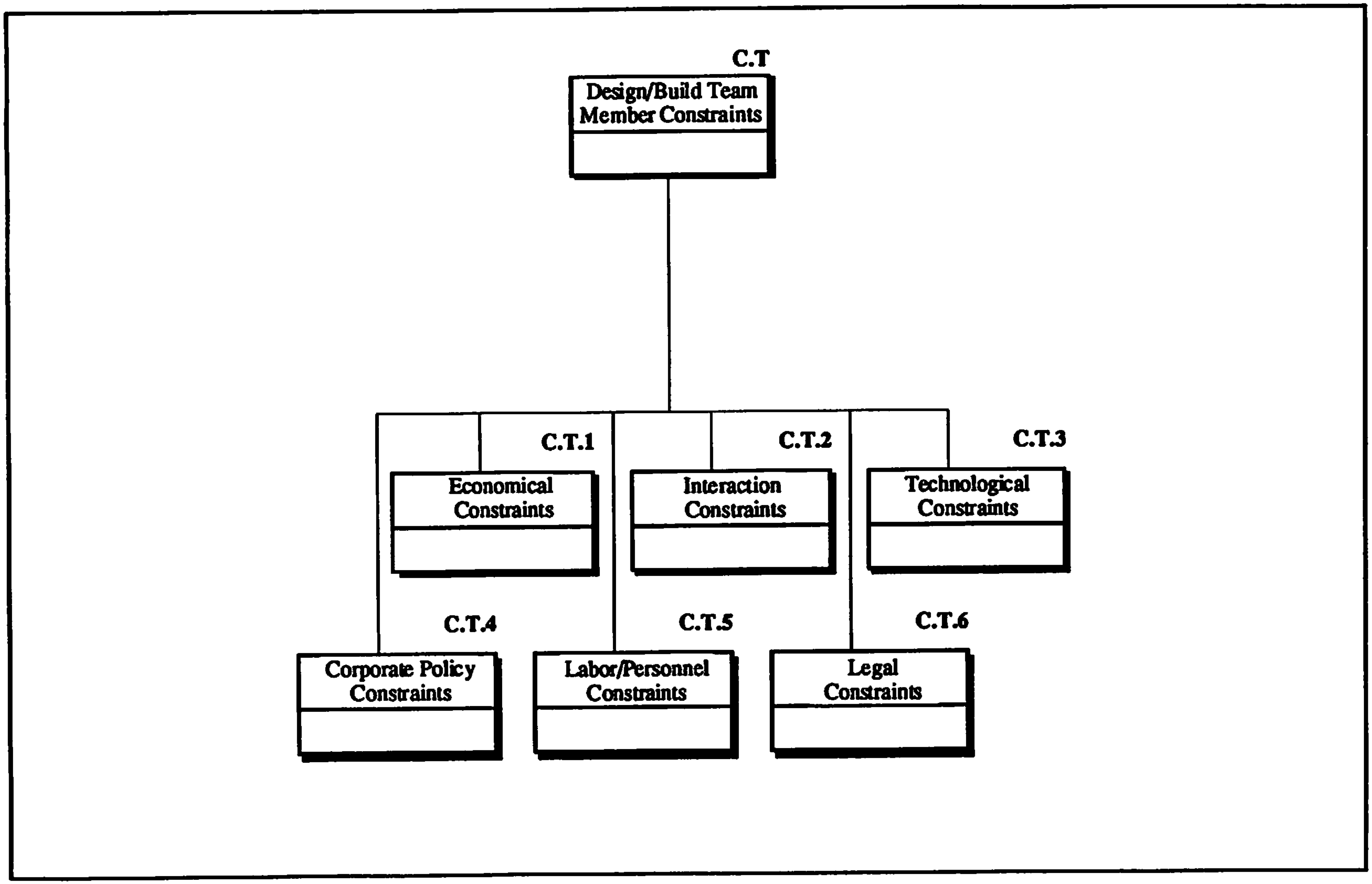

Figure 3.2: Design/Build Prequalification System (DBPS) Model

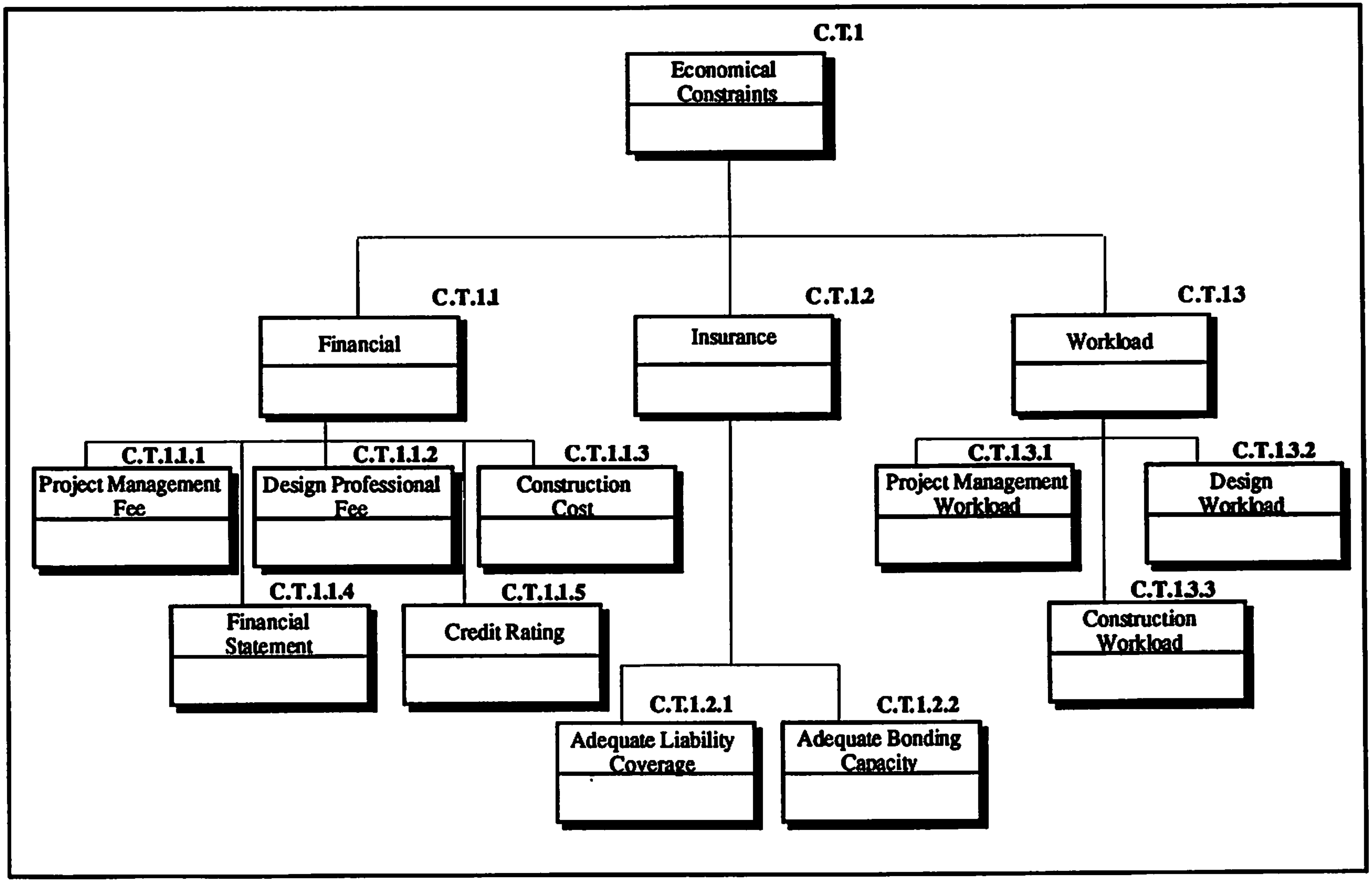

Figure 3.3: Economical Constraints of the DBPS Model

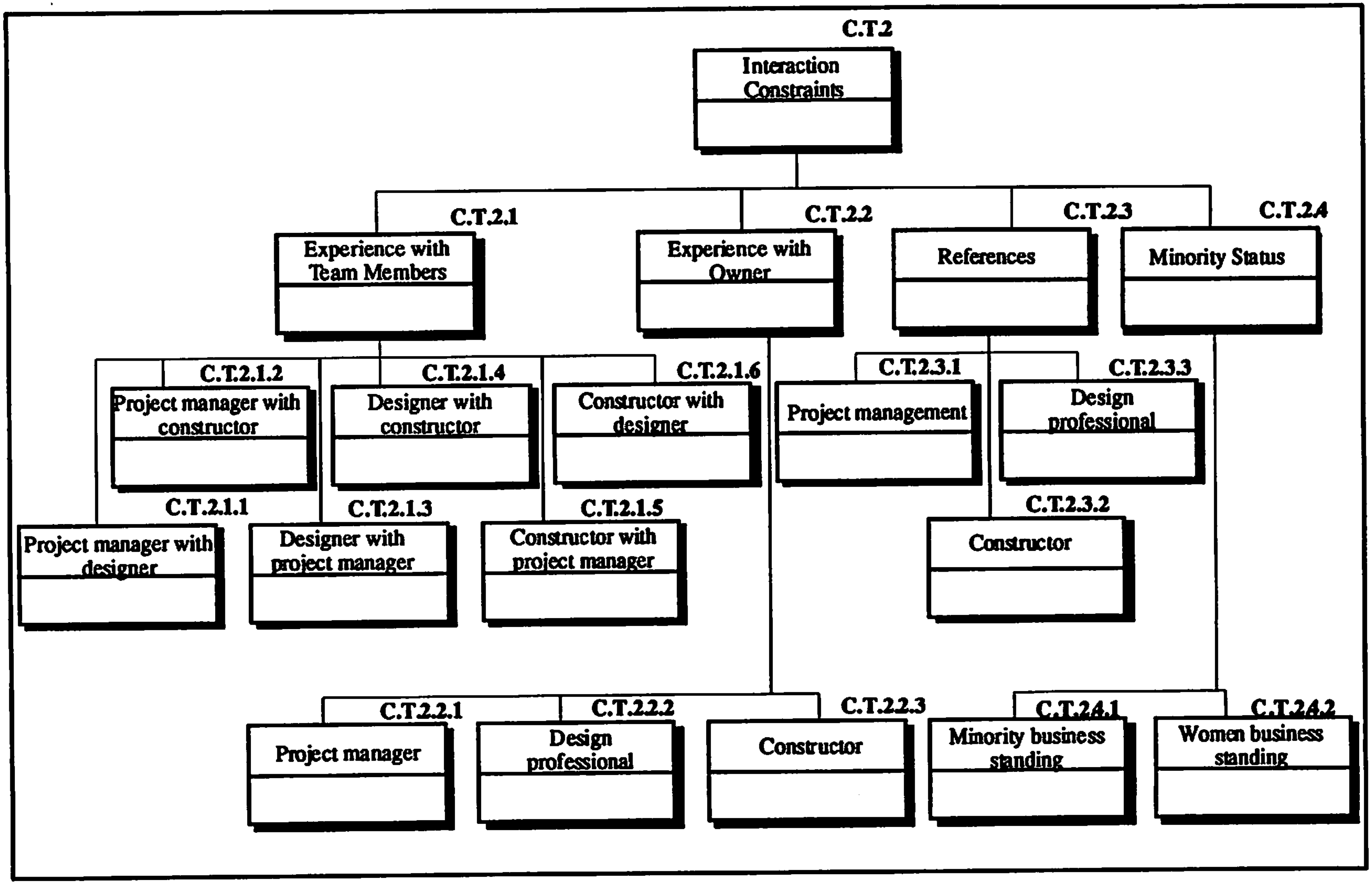

Figure 3.4: Interaction Constraints of the DBPS Model

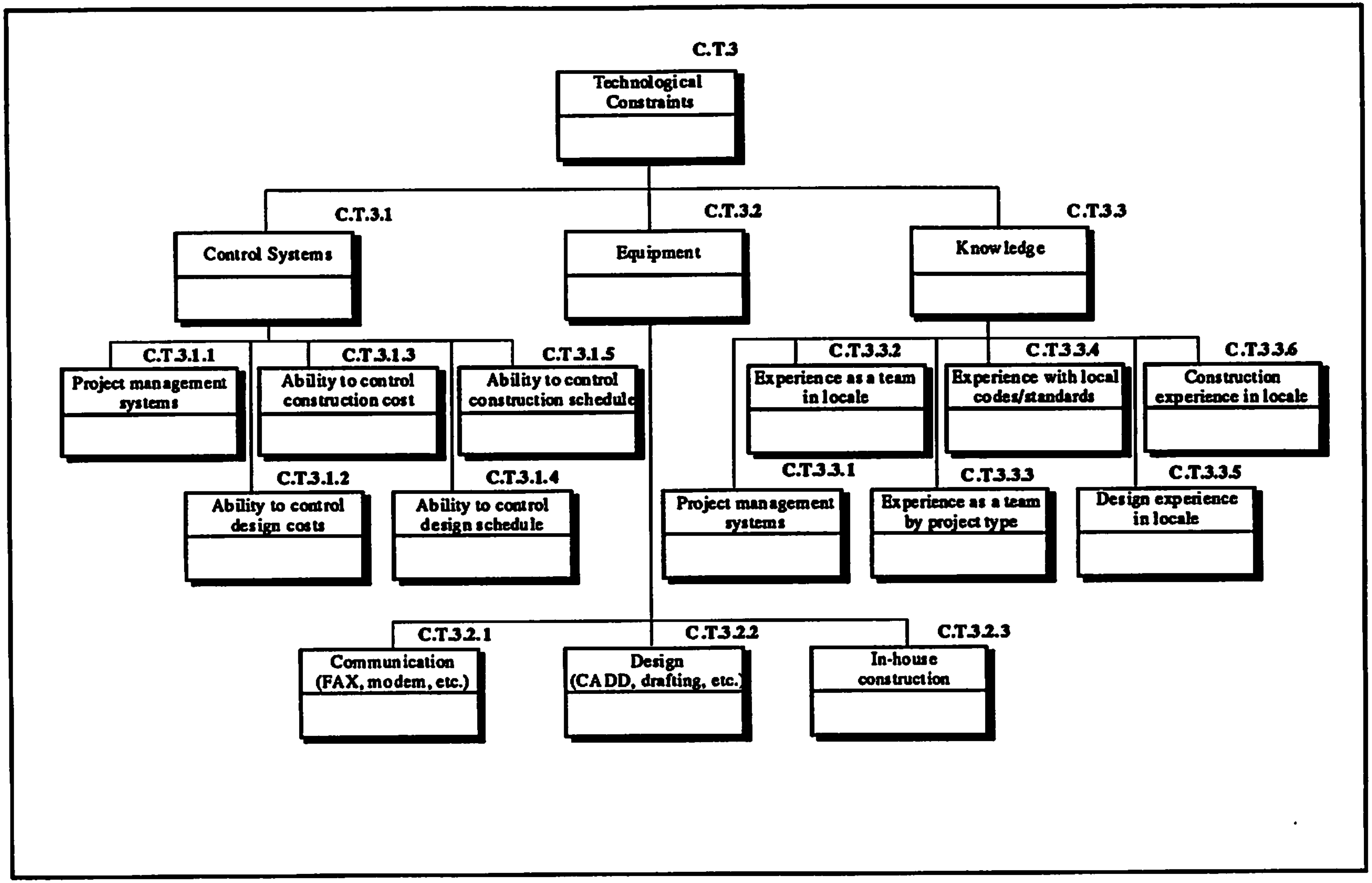

Figure 3.5: Technological Constraints of the DBPS Model

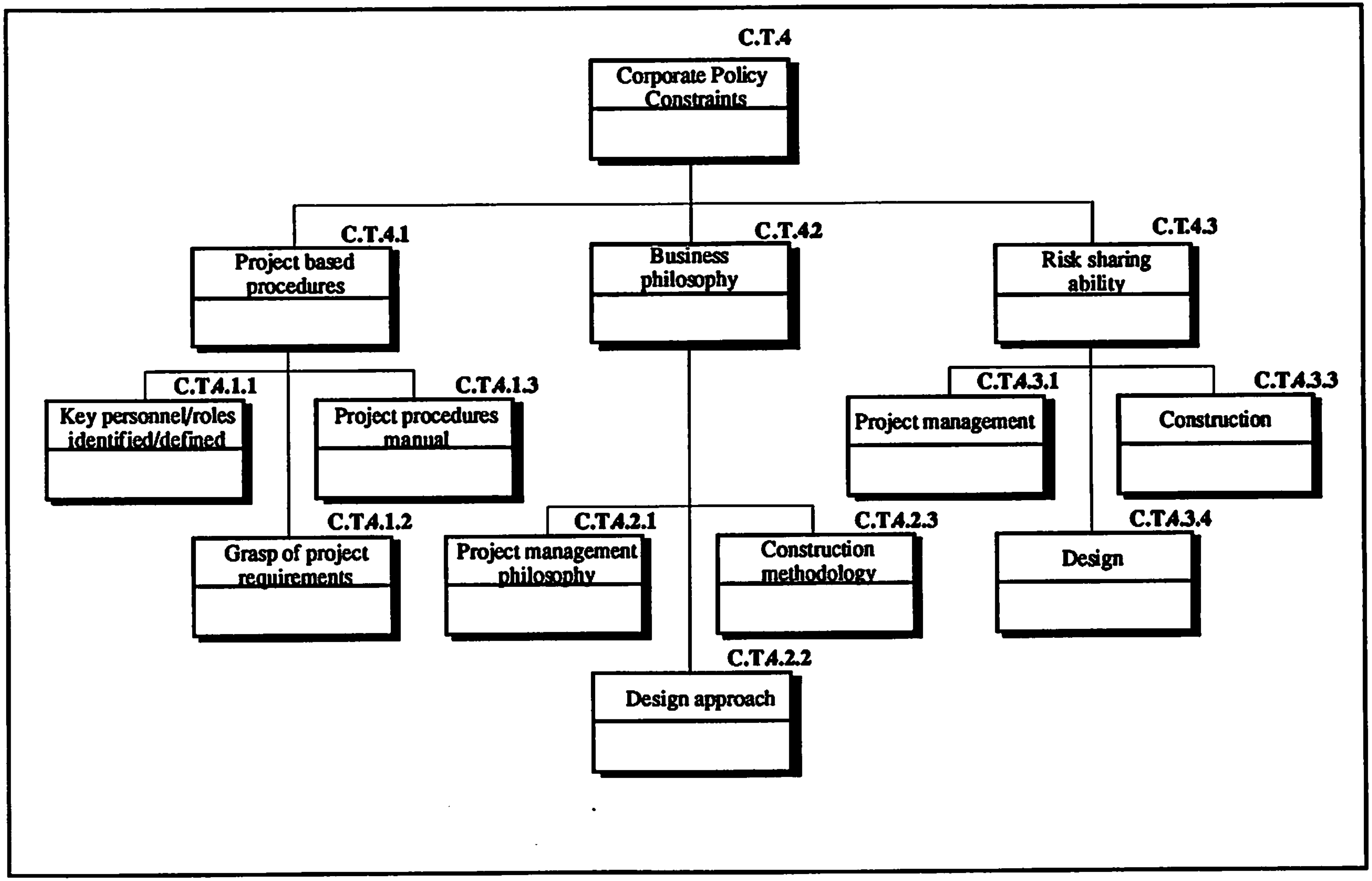

Figure 3.6: Corporate Policy Constraints of the DBPS Model

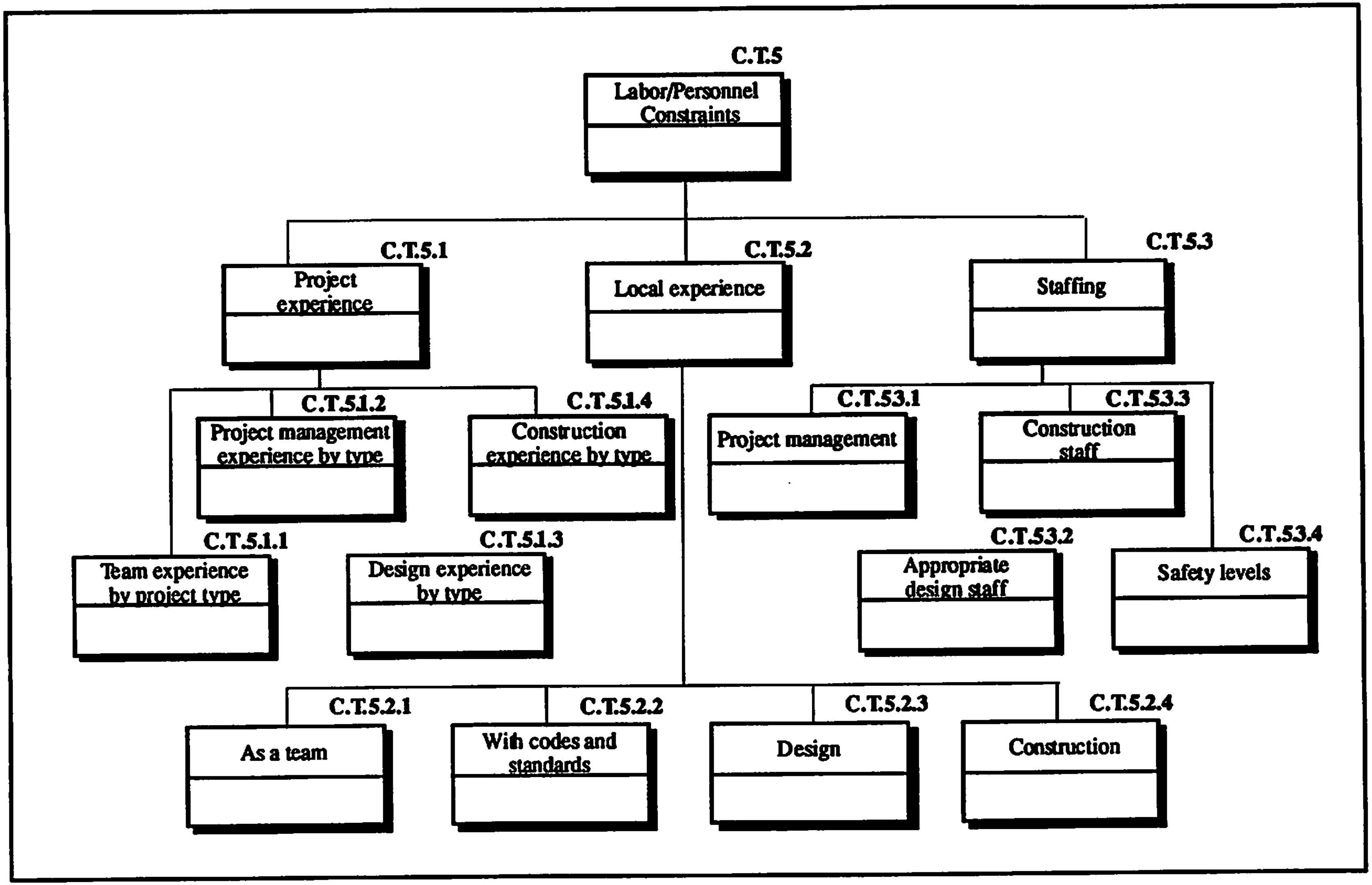

Figure 3.7: Labor/Personnel Constraints of the DBPS Model

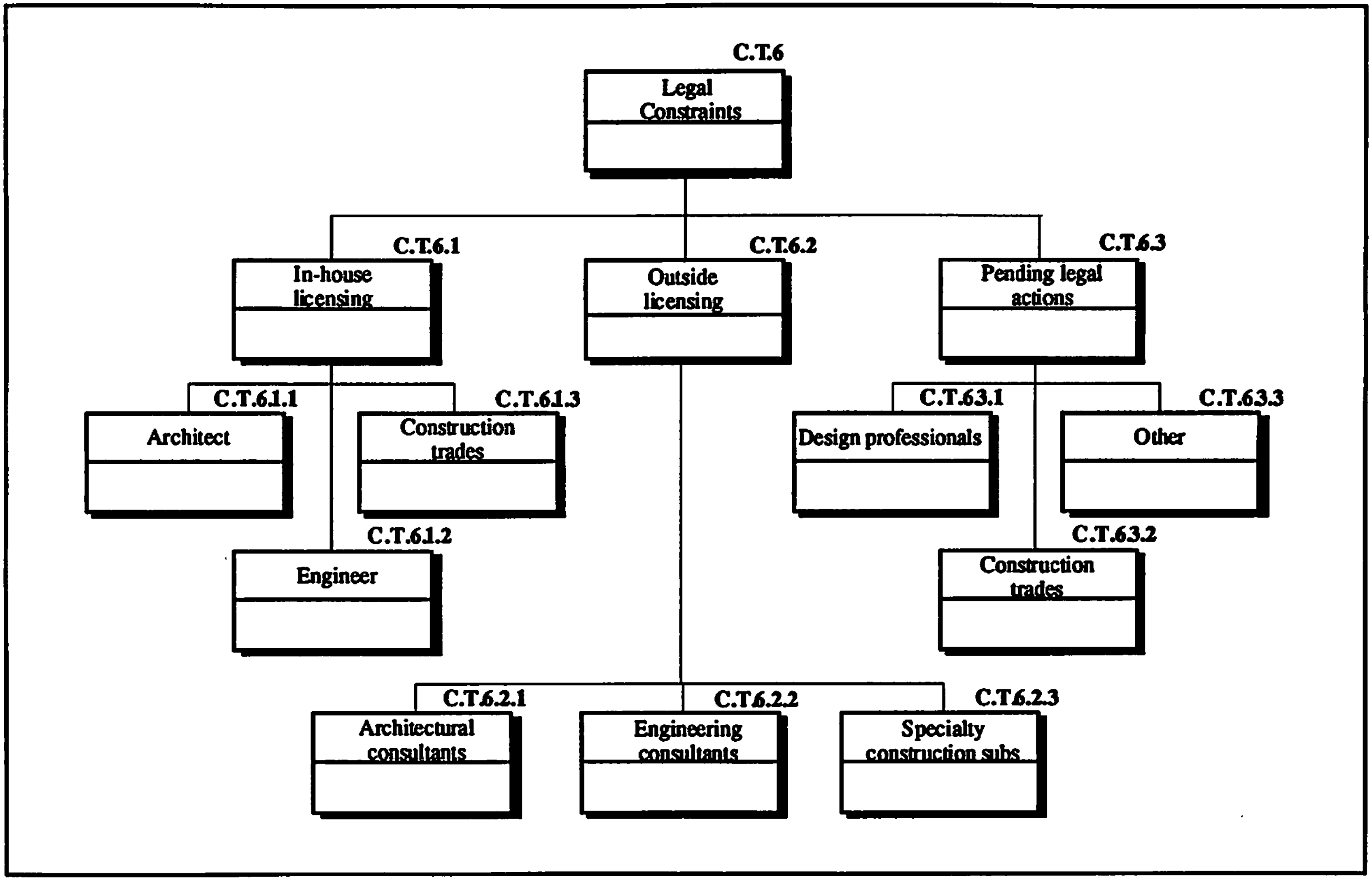

Figure 3.8: Legal Constraints of the DBPS Model

CHAPTER 4

TESTING THE MODEL

4.1. INTRODUCTION

The DBPS model was tested using a survey of public sector agency representatives. Survey data was analyzed to determine which specific attributes of design/build teams were important in a potential design/build team. In addition the model was tested for completeness.

4.2. TESTING PROCEDURE

Four public sector owner representatives (ORs) routinely involved in the prequalification process were selected, contacted by phone and then surveyed. These ORs were identified during the preliminary case study of NAVFAC and USPS. Additional contact was made with interested parties when the research status was presented to the ASCE Engineering Management Division.

General background on the ORs is summarized in Table 4.1. Personal experience of ORs is summarized in Table 4.2.

POINT OF CONTACT BACKGROUND SUMMARY				
ID	Name	Organization	Position	Survey Date
OR1	Sam X. Zanca	Southern Division NAVFAC (Charleston, SC)	Project Manager	6/28/93
OR2	Kim Zahn	U.S. Army Corps of Engineers (Albuquerque, NM)	Chief of Design	6/17/93
OR3	Bob Meehan	U.S. Army Corps of Engineers (Albuquerque, NM)	Chief of Construction	6/16/93
OR4	Jack Galuardi	University of Maryland (College, Park, MD)	Director Department of Engineering and Architectural Services for Capital Projects	6/28/93

Table 4.1: Point of Contact Background Summary

A questionnaire was used to collect data from experts to evaluate the importance of particular constraints of a project team (Appendix A). It reflects the model categories and elements identified in Chapter 3. The questionnaire includes an introduction that briefly explains the survey's purpose followed by some background questions for the point of contact. Six constraints were further subdivided into their respective attributes and a ranking system was developed to determine the importance of evaluating these attributes in a candidate design/build team.

The results of the surveys are presented in this Chapter. The data was evaluated to determine the importance of specific attributes in the team selection process. Responses showed that experts assigned varying levels of importance to specific attributes.

OR PERSONAL EXPERIENCE SUMMARY				
Category	OR1	OR2	OR3	OR4
Number of years in design/build selection process.	2	7 - 1/2	10	10
Number of specialized projects (Data processing, prison, etc.)	2	0	1 (Medical)	3
Number of complex projects (Courthouse, educational building with specialized facilities, enclosed parking structures, custom residence, etc.)	0	1	1 (Aircraft hangar)	3
Average projects (Community center, educational center with special buildings, office building, open air parking structure, multi-tenant housing, etc.)	0	0	1 (Housing 361 units)	6
Simple projects (Warehouse, housing, etc.)	0	1	0	8
Other	0	1	0	0
Locations	Florida	Military bases	No response	Urban campuses
Average cost of project ($ Million)	$3M	$30M	$25M	$6M
Average size (#stories; total SF)	1 story; 40,000 SF	N/A	No response	4 stories
Average duration	2 years	2 years	400 days	14 months

Table 4.2: OR Personal Experience Summary

4.3. RESULTS

Industry experts were asked to evaluate the importance of each category of the model on a scale from 1 (low importance) to 5 (high importance). They were then asked to weight the overall importance of entire constraint categories.

If the aggregate score for all responses is 17 or greater for a particular attribute, then that attribute is considered critical. An aggregate score of 14 to 16 is considered important. Critical attributes are identified by bold typeface, important by shading.

4.3.1. Economical Constraints

Construction cost is of critical importance to all surveyed. Credit rating is, in general, important to all. Adequate liability and bonding capacities are considered important. Of interest is the response to "workloads" of all parties which is generally considered of little importance. This may be the result of the experts' collective experience in an economic period where all potential team members had a less than ideal workload. This response may differ when the industry market is flourishing where the owner is competing with other clients for the time of the project team.

C.T.1. ECONOMICAL CONSTRAINTS (Rank: 1 - low; 5 - high)				
C.T.1.1. FINANCIAL CONSTRAINTS	OR1	OR2	OR3	OR4
C.T.1.1.1. Project management fee	1	2	N/A	3
C.T.1.1.1. Design professional fee	1	3	N/A	3
C.T.1.1.3. Construction cost	**5**	**5**	**5**	**4**
C.T.1.1.4. Financial statement	1	2	N/A	5
C.T.1.1.5. Credit rating	4	2	N/A	5
C.T.1.2. INSURANCE CONSTRAINTS				
C.T.1.2.1. Adequate liability coverage	5	4	N/A	5
C.T.1.2.2. Adequate bonding capacity	5	5	N/A	5
C.T.1.3. WORKLOAD CONSTRAINTS				
C.T.1 3.1. Project management workload	3	3	2	4
C.T.1.3.2. Design workload	3	2	5	3
C.T.1.3.3. Construction workload	3	2	3	5
OTHER ECONOMICAL CONSTRAINTS	NO	NO	NO	NO

Table 4.3: Summary Importance of Evaluating Economical Constraints

4.3.2. Interaction Constraints

Project manager experience with the constructor and design professional experience with the owner are considered critical. Collective team experience and previous experience with the owner is, in general, important to all. References are generally ranked as important. Of interest is the response to "minority issues." The current political climate dictates that certain minimum requirements must be met by law; therefore, these issues are of little consequence during prequalification.

C.T.2. INTERACTION CONSTRAINTS (Rank: 1 - low; 5 - high)				
C.T.2.1. EXPERIENCE WITH TEAM MEMBERS	OR1	OR2	OR3	OR4
C.T.2.1.1. Project manager experience with designer	4	4	4	3
C.T.2.1.1. Project manager experience with constructor	**5**	**5**	**4**	**3**
C.T.2.1.3. Designer experience with project manager	4	4	3	3
C.T.2.1.4. Designer experience with constructor	2	4	5	4 - 5
C.T.2.1.5. Constructor experience with project manager	4	5	2	3
C.T.2.1.6. Constructor experience with designer	2	4	5	4-5
C.T.2.2. EXPERIENCE WITH OWNER				
C.T.2.2.1. Project manager	5	3	5	3
C.T.2.2.2. Design professional	**5**	**3**	**4**	**5**
C.T.2.2.3. Constructor	5	3	3	5
C.T.2.3. REFERENCES				
C.T.2.3.1. Project management	3	4	3	4
C.T.2.3.2. Design professional	3	4	3	4
C.T.2.3.3. Constructor	3	4	3	5
C.T.2.4. MINORITY STATUS				
C.T.2.4.1. Minority business standing	2	2	1	4
C.T.2.4.2. Women business standing	2	1	1	4
OTHER INTERACTION CONSTRAINTS	NO	NO	NO	NO

Table 4.4: Summary Importance of Evaluating Interaction Constraints

4.3.3. Technological Constraints

Cost and schedule control is of critical importance to all surveyed. This owner type may desire sufficient documentation in the form of record sets, as-builts, etc. Experience of the team by project type and with codes and standards in the proposed project locale is ranked critical. Design equipment (i.e. CADD) is also ranked critical. Communication equipment and other experience attributes are ranked important.

C.T.3. TECHNOLOGICAL CONSTRAINTS (Rank: 1 - low; 5 - high)				
C.T.3.1. CONTROL SYSTEMS	OR1	OR2	OR3	OR4
C.T.3.1.1. Project management systems	1	3	4	5
C.T.3.1.2. Ability to control design costs	4	3	3	5
C.T.3.1.3. Ability to control construction costs	4	5	5	5
C.T.3.1.4. Ability to control design schedule	3	4	5	5
C.T.3.1.5. Ability to control construction schedule	4	5	5	5
C.T.3.2. EQUIPMENT				
C.T.3.2.1. Communication equipment (FAX, modems)	3	3	5	4
C.T.3.2.2. Design equipment (CADD, drafting, etc.)	4	5	4	4
C.T.3.2.3. In-house construction equipment	3	3	2	3
C.T.3.3. KNOWLEDGE				
C.T.3 3.1. Project management systems	2	4	3	4
C.T.3.3.2. Experience as a team in the locale	5	3	4	5
C.T.3.3.3. Experience as a team by project type	4	5	5	5
C.T.3.3.4. Experience with codes and standards in locale	5	4	4	5
C.T.3.3.5. Design experience in locale	4	2	4	5
C.T.3.3.6. Construction experience in locale	3	2	4	5
OTHER TECHNOLOGICAL CONSTRAINTS	NO	NO	NO	NO

Table 4.5: Summary Importance of Evaluating Technological Constraints

4.3.4. Corporate Policy Constraints

Key personnel identification and role definition is critical to all surveyed. A grasp of project requirements in terms of schedule, budget and quality is also considered critical. Construction methodology is ranked important. A project based procedures manual is important to all. The team's grasp of project requirements in terms of schedule, budget, and quality is also ranked significantly high by all surveyed.

Responses vary greatly on how much risk sharing individual team members should be expected to bear with the constructor expected to bear the most risk. The owners may consider design/build teams as "contractors" with some consideration given to acountability of design professionals for errors and omissions.

C.T.4. CORPORATE POLICY CONSTRAINTS (RANK: 1 - low; 5 - high)				
C.T.4.1. PROJECT BASED PROCEDURES	OR1	OR2	OR3	OR4
C.T.4.1.1. Key personnel identified; roles defined	4	5	3	5
C.T.4.1.2. Grasp of project requirements in terms of schedule, budget, quality	4	5	5	5
C.T.4.1.3. Project procedures manual	4	3	4	4
C.T.4.2. BUSINESS PHILOSOPHY				
C.T.4.2.1. Project management philosophy	3	3	3	5
C.T.4.2.2. Design approach	4	2	5	5
C.T.4.2.3. Construction methodology	5	4	4	5
C.T.4.3. RISK SHARING ABILITY				
C.T.4 3.1. Project management risk	4	3	2	4
C.T.4.3.2. Design risk	3	3	3	5
C.T.4.3.6. Construction risk	5	3	5	5
OTHER CORPORATE POLICY CONSTRAINTS	NO	NO	NO	NO

Table 4.6: Summary Importance of Evaluating Corporate Policy Constraints

4.3.5. Labor/Personnel Constraints

Again project experience of team members by project type is of critical importance to all surveyed. Project staffing in terms of adequate construction manpower and a good safety record is also considered critical.

Of interest is the response to "local experience" of all professionals. Responses vary greatly on how much local experience is ideal for individual team members. It is difficult to see a relationship between "local experience" and "project experience" categories for individual respondents.

C.T.5. LABOR/PERSONNEL CONSTRAINTS (Rank: 1 - low; 5 - high)				
C.T.5.1. PROJECT EXPERIENCE	OR1	OR2	OR3	OR4
C.T.5.1.1. Experience as a team by project type	4	5	5	5
C.T.5.1.2. Project management experience by project type	4	5	4	5
C.T.5.1.3. Design experience by project type	5	5	3	4
C.T.5.1.4. Construction experience by project type	5	4	3	4
C.T.5.2. LOCAL EXPERIENCE				
C.T.5.2.1. Local experience as a team	5	3	2	5
C.T.5.2.2. Local experience with codes and standards	5	4	3	5
C.T.5.2.3. Local design experience	4	2	3	4
C.T.5.2.3. Local construction experience	5	2	3	4-5
C.T.5.3. STAFFING				
C.T.5.3.1. Project management staff	3	4	2	5
C.T.5.3.2. Appropriate design staff	3	3	4	5
C.T.5.3.3. Adequate construction staff	4	4	4	5
C.T.5.3.4. Safety levels	5	5	5	4
OTHER LABOR/PERSONNEL CONSTRAINTS	NO	NO	NO	NO

Table 4.7: Summary Importance of Evaluating Labor/Personnel Constraints

4.3.6. Legal Constraints

Appropriate licensing is of critical importance to all surveyed with the exception of one respondent. OR3 has a strong construction background but is not as interested in professional licensure issues. Of interest is the response to "pending legal action" of all professionals. Responses vary greatly on how much a pending legal action impacts prequalification. OR2 is a design chief and does not feel legal issues should impact prequalification. OR1 and OR4 are management experts and considered lack of pending legal actions critical to the evaluation of a design/build team.

C.T.6. LEGAL CONSTRAINTS				
C.T.6.1. IN-HOUSE LICENSING	OR1	OR2	OR3	OR4
C.T.6.1.1. Architect	5	5	2	5
C.T.6.1.2. Engineer	5	5	2	5
C.T.6.1.3. Construction trades	5	5	2	3
C.T.6.2. OUTSIDE LICENSING				
C.T.6.2.1. Architectural consultants	5	5	3	5
C.T.6.2.2. Engineering consultants	5	5	3	5
C.T.6.2.3. Specialty construction trade subcontractors	5	5	3	4
C.T.6.3. PENDING LEGAL ACTION				
C.T.6 3.1. Design professionals	5	2	N/A	5
C.T.6.3.2. Construction trades	5	3	N/A	3
C.T.6.3.3. Other (Describe)	-	1	N/A	-
OTHER LEGAL CONSTRAINTS	NO	NO	NO	NO

Table 4.8: Summary Importance of Evaluating (1 - lowest, 5 - highest) Legal Constraints of a Team

4.3.7. Weighting of Constraint Groups

Responses to the weighting of importance of constraint groups varies tremendously. One trend does appear when reviewing the respondents' weights of interaction, technological, and labor/personnel constraints. These three categories all contain experience attributes that were considered "critical" in the respective sections of the questionnaire. The team members past experience, individually and collectively, is therefore considered the most important factor in design/build prequalification.

RELATIVE WEIGHTING FACTORS				
CONSTRAINT GROUP	OR1	OR2	OR3	OR4
C.T.1. Economical Constraints	5	45	10	20
C.T.2. Interaction Constraints	20	25	20	10
C.T.3. Technological Constraints	15	5	70	45
C.T.4. Corporate Policy Constraints	10	5	0	10
C.T.5. Labor/Personnel Constraints	30	15	0	10
C.T.6. Legal Constraints	20	5	0	5

Table 4.9: Summary of Relative Weighting (Total = 100) Ranking

4.4. DISCUSSION OF RESULTS

Redundancy was purposely built into the survey to check results. For example, category C.T.3.3. "Knowledge" contains such attributes of the team's experience in the locale and with local codes and standards. Category C.T.5.2. "Local Experience" contains similar attributes. The respondents gave these experience attributes critical importance and in most cases match exactly. Categories C.T.3.3.3. and C.T.5.1.1.

"Experience as a team by project type" also provide an exact match of importance value for each respondent.

At the end of each constraint group, the respondents were asked if there were any other attributes, by section, that needed to be considered. None of the respondents furnished additional attributes; therefore, the model can be considered complete.

Overall weighting does vary greatly for respondents. This can be attributed to the variety of project experience by type and years that was indicated for the respondents. This demonstrates the flexibility of the model to be used by individuals with varying degrees of personal experience.

4.5. SUMMARY

The DBPS, through this study, was proven as a valid framework for organizing the prequalification attributes of outside design/build teams. The input to the model, in the form of survey data, indicates that the team members' individual and collective experience in the locale, as a team, and by project type are critical elements in evaluating a candidate team. The model was shown to be flexible in allowing varying degrees of experience to interpret relative importance of overall categories. Chapter 5 will present more specific guidelines for applying the model to design/build prequalification processes.

CHAPTER 5

USING THE DBPS MODEL

5.1. INTRODUCTION

This chapter will provide a DBPS model guide. The uses of the guide are described followed by an explanation for the target user.

5.2. INTENDED USES OF THE DBPS MODEL

Two basic uses for the guide in public sector design/build are proposed. They are: (1) to assist in establishing prequalification criteria for use in request for proposals (RFPs); (2) to provide a consistent framework for evaluating teams in the prequalification process.

An owner's representative can use the guideline to establish prequalification criteria by determining specific prequalification criteria with appropriate weighting factors and values for the specific project. The owner can also use the model to prepare appropriate RFPs based on these prequalification criteria to solicit proposals from outside teams. The model serves as a checklist for the person preparing RFPs to assure that project specific attributes are incorporated into the RFP. The model can also be used as a guideline to determine which attributes are not being considered in existing prequalification procedures.

During the prequalification process, the owner's representative can use the guideline as a reminder to the public sector selection committee of the criteria established in the request for proposal. Ultimately a screening committee will assign the weighted value to a given area. The framework provides a reminder to this committee that consistency is required in this process to satisfy issues of public scrutiny.

5.3. INTENDED USERS

The guide is intended for use by public sector owner's representatives/project managers (OR/PM) routinely involved with the prequalification process for design/build projects. Specific public sector agencies may be able to adapt this guide to establish new or review existing criteria.

More specifically, the guide would best be used by the OR/PM to guide a prequalification committee within a public sector organization. This committee's size and make-up will vary from one organization to another. Regardless of committee size, make-up, or organization source, this type of committee is "charged" with screening candidate proposals and identifying prequalified outside design/build teams to insure that the potential successful team will saitisfy the public sector owner's building needs.

5.4. THE DBPS MODEL GUIDE

The DBPS model guide is presented in Appendix B. A worksheet is provided for each of the constraint categories: economical, interaction, technological, corporate policy, labor/personnel, and legal. The guide provides a general description of the constraint category, followed by instructions for use during RFP preparation and proposal evaluation stages. The worksheet concludes with a summary of the attributes in tabular form. The final worksheet is used for summarizing evaluation of candidate teams.

Figure B.7 is used to summarize the results of proposal evaluations by providing total scoring. Each subtotal for constraint categories, by team, is transferred to this worksheet. These values are then totaled for each team. The team with the highest total would be the successful candidate.

5.4.1. Use during RFP Preparation

The OR/PM can use the DBPS model guide as a checklist to establish ideal attributes of candidate design/build teams while preparing RFPs. Column 1 in the worksheet is coded during the RFP preparation process: (0) not required; (1) minimal requirement; (2) average requirement; (3) strongly required. Overall constraint categories (i.e. economical, interaction, etc.) are then given a weighting factor (WF) by dividing 100% between the six categories.

For example, a simple housing project may require a strong emphasis on meeting schedule to satisfy demands caused by a critical housing shortfall. Obviously, a candidate team's ability to control design and construction schedule now outweighs other attributes in importance. In this example attributes C.T.3.1.4 and C.T.3.1.5 will require a (3) to be entered in column 1. Category C.T.3. would be given an overall WF of 20% (out of a possible 100%).

5.4.2. Proposal Evaluation

Attribute values and category weighting values that are determined during RFP preparation will remain with the documentation for use during proposal evaluation. This will insure consistency despite potential personnel changes on selection committees. The owner's representatives can then use the guidelines in developing score sheets. The appropriate weighting factors are used in assessing individual attributes based on the information that was furnished to candidate teams during the RFP process.

Column 2 in the worksheet is coded during the evaluation process: (0) does not meet requirements; (1) minimally meets requirements; (2) generally meets requirements; (3) highly meets requirements. For the housing example, if a candidate team displays a history of projects meeting schedule in their proposal the OR/PM would indicate a (3) in column 2 for attributes C.T.3.1.4 and C.T.3.1.5.

Column 3 in the worksheet represents the relative scoring for each attribute. Multiplying columns 1 and 2 gives a value to be entered in column 3. In the family housing example, the candidate team that displays a strong history of projects meeting schedule would receive a (9) in this column (3 x 3 = 9). Each constraint category can then be totalled by adding the values in column 3. This subtotal is then multiplied by the weighting factor.

5.5. SUMMARY

The DBPS model guide presented in this chapter achieved the basic objectives for use in the public sector use of design/build delivery: It can be used by the public sector OR/PM to establish the relative importance of prequalification criteria during

RFP preparation. It also provides a consistent framework of criteria for evaluation during the proposal evaluation process. This satisfies the overall objective of the design/build prequalification process.

CHAPTER 6

CONCLUSION

6.1. INTRODUCTION

This chapter compares the research results to the original objectives. The limitations of the DBPS model study are discussed and areas of further research explored.

6.2. COMPARING RESEARCH RESULTS WITH OBJECTIVES

The four objectives of this thesis were to define design/build to provide a common base of understanding, develop a DBPS model, test the model, and develop a DBPS model guide. Each objective is discussed below.

6.2.1. Design/Build Defined

The first objective was accomplished by reviewing the current literature and performing a preliminary public sector case study of design/build. Based on the literature, there was difficulty in neatly categorizing design/build delivery. Many delivery systems, including terminology and contract strategy, overlap one another. Based on this study, design/build is defined simply as:

> *A team based system organized to provide efficient design and construction processes, where the owner contracts with a single entity to provide the whole service.*

6.2.2. Design/Build Prequalification System (DBPS) Model

The second objective, developing the DBPS model, was accomplished. The model was refined after reviewing team member constraints identified in previous research against the model. The DBPS model is intended for use by public sector owner's representatives/project managers routinely involved with the prequalification and selection processes for design/build projects.

6.2.3. Testing the Model

The DBPS model was tested to evaluate the ability of potential users to assign relative value to specific attributes. It was also tested for completeness. Aspects of the model confirmed to be critical were the team member individual and collective experience in the locale, as a team, and by project. None of the experts surveyed furnished additional attributes; therefore, the model is considered complete.

6.2.4. Using the DBPS Model

The development of a guide for using the DBPS model as the final objective of this thesis was accomplished. The guidelines were written for the public sector owner's representative/project manager (OR/PM) use in two areas of the prequalification process: (1) during the RFP preparation, and (2) during prequalification evaluation.

The DBPS model guide establishes the framework/structure for this representative to establish project specific criteria for prequalifying potential design/build teams. It also serves as a guideline for evaluating outside team proposals for adherence to established criteria. It provides consistency from RFP through evaluation which satisfy issues of public scrutiny in the prequalification process.

6.3. LIMITATIONS OF THE DBPS MODEL STUDY

Both the DBPS model and its guidelines are limited in current application to industry.

6.3.1. DBPS Model Limitations

The DBPS model was developed based on the public sector employment of design/build. This owner type is faced with "public scrutiny" issues which place additional constraints on the prequalification process. Private sector constraints and professional practice vary from that found in the public sector. Private sector case studies using the DBPS could impact the model and broaden its application in industry.

6.3.2. DBPS Model Guide Limitations

The guidelines for use are also limited to public sector use of design/build. If the model was tested in the private sector, guidelines for the private sector could be developed. The DBPS model guide does not, as presently developed, include rules for minimum team scores to assure probable success of a team. This would be a fruitful area of future research.

6.4. AREAS OF FUTURE RESEARCH

While this research focused on the prequalification process in public sector design/build delivery, areas of future research that may be identified are:

- Validation of the model with teams assembled from remote locations with respect to each team member.
- Validation of the model in the private sector.
- Develop similar framework and testing procedures for other delivery systems.
- Define impact of owner management and technical review capabilities on the model.
- Define impact of project types on the model's use.

The guidelines will also require further testing to verify their effectiveness in assuring team success based on proposal evaluation.

6.5. SUMMARY

This chapter outlined the original objectives and the results of the research involved for each objective. Limitations of the model and guidelines for use, based on public sector application, were also presented. Areas of future research were discussed.

Overall the DBPS serves as a framework for evaluating existing prequalification procedures and for maintaining consistent prequalification selection. Applying the model in conjunction with its guidelines can result in consistent, project specific prequalification of design/build teams. This will promote a cohesive team, satisfy issues of public scrutiny, and should ultimately contribute to design/build project success in the public sector.

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APPENDIX A
DBPS SURVEY

DESIGN/BUILD PREQUALIFICATION SYSTEM QUESTIONNAIRE

Introduction:

The intent of this questionnaire is to review the design/build Prequalification System model in selecting design/build project team members on a public sector project.

The survey consists of some background information followed by questions on the importance of identifying the importance of "constraints" within a potential team. <u>Team member constraints are those elements introduced by team members to the construction process.</u> Identifying these constraints within a potential team is important because it is often a factor in determining which team member should perform a process, or even who should be selected. All information you provide will remain confidential.

Point of Contact Background

1.1. Interview date:______________________________

1.2. Organization name:______________________________

1.3. Point of contact:______________________________

1.4. Personal experience of point of contact:

Number of years in design/build selection process ______________

Number of design/build projects you have personally managed, by type:

______ Specialized projects (Data processing, prison, etc.)

______ Complex projects (Courthouse, educational building with specialized facilities, enclosed parking structures, custom residence, etc.)

______ Average projects (Community center, educational center without special buildings, office building, open air parking structure, multi-tenant housing, etc.)

______ Simple projects (Warehouse, housing, etc.)

______ Other (Please describe.) ______________________

____

____

____

______ Locations (Urban or rural.) ______________________

______ Average cost ______________________

______ Average size (#stories); total SF______________________

______ Average duration ______________________

C.T.1. Economical Constraints

Economical constraints are the internal limitations regarding finances or resources.

For a potential design/build team, rank the importance of evaluating (1 - lowest, 5 - highest) economical constraints of a team:

C.T.1.1. FINANCIAL CONSTRAINTS	Rank (1 - low, 5 - high)
C.T.1.1.1. Project management fee	
C.T.1.1.2. Design professional fee	
C.T.1.1.3. Construction cost	
C.T.1.1.4. Financial statement	
C.T.1.1.5. Credit rating	
C.T.1.2. INSURANCE CONSTRAINTS	Rank (1 - low, 5 - high)
C.T.1.2.1 Adequate liability coverage	
C.T.1.2.2. Adequate bonding capacity	
C.T.1.3. WORKLOAD CONSTRAINTS	Rank (1 - low, 5 - high)
C.T.1.2.1. Project management workload	
C.T.1.2.2. Design workload	
C.T.1.2.3. Construction workload	

Are there any other economical constraints of a project team that you evaluate during the selection process? If so, list them and give the appropriate ranking:

C.T.2. Interaction Constraints

Interaction constraints are those that result from inter- or intra-company interactions. For a potential design/build team, rank the importance of evaluating (1 - lowest, 5 - highest) interaction constraints of a team:

C.T.2.1. EXPERIENCE WITH TEAM MEMBERS	Rank (1 - low, 5 - high)
C.T.2.1.1. Project manager experience with designer	
C.T.2.1.2. Project manager experience with constructor	
C.T.2.1.3. Designer experience with project manager	
C.T.2.1.4. Designer experience with constructor	
C.T.2.1.5. Constructor experience with project manager	
C.T.2.1.6 Constructor experience with designer	
C.T.2.2. EXPERIENCE WITH OWNER	Rank (1 - low, 5 - high)
C.T.2.2.1. Project manager	
C.T.2.2.2. Design professional	
C.T.1.2.2. Constructor	
C.T.2.3. REFERENCES	Rank (1 - low, 5 - high)
C.T.2.3.1. Project management	
C.T.2.3.2. Design professional	
C.T.2.3.3. Constructor	
C.T.2.4. MINORITY STATUS	Rank (1 - low, 5 - high)
C.T.2.4.1. Minority business standing	
C.T.2.4.2. Women business standing	

Are there any other interaction constraints of a project team that you evaluate during the selection process? If so, list them and give the appropriate ranking:

C.T.3. Technological Constraints

Technological constraints are the in-house knowledge or equipment that is available for a team member to use in completing a process. For a potential design/build team, rank the importance of evaluating (1 - lowest, 5 - highest) technological constraints of a team:

C.T.3.1. CONTROL SYSTEMS	Rank (1 - low, 5 - high)
C.T.3.1.1. Project management systems (Manual or computer)	
C.T.3.1.2. Ability to control design costs	
C.T.3.1.3. Ability to control construction costs	
C.T.3.1.4. Ability to control design schedule	
C.T.3.1.5. Ability to control construction schedule	
C.T.3.2. EQUIPMENT	Rank (1 - low, 5 - high)
C.T.3.2.1. Communication equipment (FAX, modems)	
C.T.3.2.2. Design equipment (CADD, drafting, etc)	
C.T.3.2.2. In-house construction equipment	
C.T.3.3. KNOWLEDGE	Rank (1 - low, 5 - high)
C.T.3.3.1. Project management systems	
C.T.3.3.2. Experience as a team in the locale	
C.T.3.3.3. Experience as a team by project type	
C.T.3.3.4. Experience with codes and standards in locale	
C.T.3.3.5. Design experience in locale	
C.T.3.3.6. Construction experience in locale	

Are there any other technological constraints of a project team that you evaluate during the selection process? If so, list them and give the appropriate ranking:

C.T.4. Corporate Policy Constraints

Corporate policy constraints are the result of internal policies set by a team member. For a potential design/build team, rank the importance of evaluating (1 - lowest, 5 - highest) corporate policy constraints of a team:

C.T.4.1. PROJECT BASED PROCEDURES	Rank (1 - low, 5 - high)
C.T.4.1.1. Key personnel identified and roles defined	
C.T.4.1.2. Grasp of project requirements in terms of schedule, budget, and quality	
C.T.4.1.3. Project procedures manual	
C.T.4.2. BUSINESS PHILOSOPHY	Rank (1 - low, 5 - high)
C.T.4.2.1. Project management philosophy	
C.T.4.2.2. Design approach	
C.T.4.2.2. Construction methodology	
C.T.4.3. RISK SHARING ABILITY	Rank (1 - low, 5 - high)
C.T.4.3.1. Project management risk	
C.T.4.3.2. Design risk	
C.T.4.3.3. Construction risk	

Are there any other corporate policy constraints of a project team that you evaluate during the selection process? If so, list them and give the appropriate ranking:

C.T.5. Labor/Personnel Constraints

A team member's labor constraints pertain to the current workforce employed or accessible to the team. For a potential design/build team, rank the importance of evaluating (1 - lowest, 5 - highest) labor/personnel constraints of a team:

C.T.5.1. PROJECT EXPERIENCE	Rank (1 - low, 5 - high)
C.T.5.1.1. Experience as a team by project type	
C.T.5.1.2. Project management experience by project type	
C.T.5.1.3. Design experience by project type	
C.T.5.1.4. Construction experience by project type	
C.T.5.2. LOCAL EXPERIENCE	Rank (1 - low, 5 - high)
C.T.5.2.1. Local experience as a team	
C.T.5.2.2. Local experience with codes and standards	
C.T.5.2.3. Local design experience	
C.T.5.2.4. Local construction experience	
C.T.5.3. STAFFING	Rank (1 - low, 5 - high)
C.T.5.3.1. Project management staff	
C.T.5.3.2. Appropriate design staff	
C.T.5.3.3. Adequate construction staff	
C.T.5.3.4. Safety levels	

Are there any other labor/personnel constraints of a project team that you evaluate during the selection process? If so, list them and give the appropriate ranking:

C.T.6. Legal Constraints

Legal constraints that affect team members are the laws and codes that govern the profession of the respective team members. For a potential design/build team, rank the importance of evaluating (1 - lowest, 5 - highest) legal constraints of a team:

C.T.6.1. IN-HOUSE LICENSING	Rank (1 - low, 5 - high)
C.T.6.1.1. Architect	
C.T.6.1.2. Engineer	
C.T.6.1.3. Construction trades	
C.T.6.2. OUTSIDE LICENSING	Rank (1 - low, 5 - high)
C.T.6.2.1. Architectural consultants	
C.T.6.2.2. Engineering consultants	
C.T.6.2.3. Specialty construction trade subcontractors	
C.T.6.3. PENDING LEGAL ACTIONS	Rank (1 - low, 5 - high)
C.T.6.3.1. Design professionals	
C.T.6.3.2. Construction trades	
C.T.6.3.3. Other (Describe)	

Are there any other legal constraints of a project team that you evaluate during the selection process? If so, list them and give the appropriate ranking:

Weight Factors

Please rank the relative weight you would assign to each group of constraints. The total of the weight factors should add up to 100 points.

C.T.1. Economical constraints	________
C.T.2. Political constraints	________
C.T.3. Technological constraints	________
C.T.4. Corporate policy constraints	________
C.T.5. Labor/personnel constraints	________
C.T.6. Legal constraints	________
TOTAL	100 points

Other Comments

Do you have any additional comments you wish to share at this time regarding design/build team selection or the structure of this survey?

APPENDIX B
DBPS MODEL GUIDE

DESIGN/BUILD PREQUALIFICATION SYSTEM GUIDE

Introduction:

The intent of this guide is to apply the Design/Build Prequalification System model in selecting design/build project team members on a public sector project. This guide has two basic uses in public sector design/build. They are: (1) to assist in establishing prequalification criteria for use in request for proposals (RFPs); (2) to provide a consistent framework for evaluating teams in the prequalification process.

The guide consists of tables to be used in determining the importance of identifying "constraints" within a potential team. Team member constraints are those elements introduced by team members to the construction process. Identifying these constraints within a potential team is important because it is often a factor in determining which team member should perform a process, or even who should be selected.

A worksheet is provided for each of the constraint categories: economical, interaction, technological, corporate policy, labor/personnel, and legal. The guide provides a general description of the constraint category, followed by instructions for use during RFP preparation and proposal evaluation stages. The worksheet concludes with a summary of the attributes in tabular form. The final worksheet is used for summarizing evaluation of candidate teams.

C.T.1. Economical Constraints

Economical constraints are the internal limitations of a design/build team regarding finances or resources.

RFP PREPARATION

In column 1 identify the required qualifications and their importance using the following code: (0) Not required (1) minimal requirement; (2) average requirement; (3) strongly required.

PROPOSAL EVALUATION

In column 2 use the following code: (0) does not meet requirements; (1) minimally meets requirements; (2) generally meets requirements; (3) completely meets requirements. Multiply columns 1 and 2 to enter "score" in column 3. Add items in column 3 to provide subtotal.

C.T.1.1. FINANCIAL CONSTRAINTS	1 RFP	2 EVAL	3 = 1 x 2 SCORE
C.T.1.1.1. Project management fee			
C.T.1.1.2. Design professional fee			
C.T.1.1.3. Construction cost			
C.T.1.1.4. Financial statement			
C.T.1.1.5. Credit rating			
C.T.1.2. INSURANCE CONSTRAINTS			
C.T.1.2.1 Adequate liability coverage			
C.T.1.2.2. Adequate bonding capacity			
C.T.1.3. WORKLOAD CONSTRAINTS			
C.T.1.3.1. Project management workload			
C.T.1.3.2. Design workload			
C.T.1.3.3. Construction workload			

SUBTOTAL ________

Figure B.1: Economical Constraints Guidelines

C.T.2. Interaction Constraints

Interaction constraints are those experienced as a result of inter- or intra-company interactions.

RFP PREPARATION

In column 1 identify the required qualifications and their importance using the following code: (0) Not required (1) minimal requirement; (2) average requirement; (3) strongly required.

PROPOSAL EVALUATION

In column 2 use the following code: (0) does not meet requirements; (1) minimally meets requirements; (2) generally meets requirements; (3) completely meets requirements. Multiply columns 1 and 2 to enter "score" in column 3. Add items in column 3 to provide subtotal.

C.T.2.1. EXPERIENCE WITH TEAM MEMBER	1 RFP	2 EVAL	3 = 1 x 2 SCORE
C.T.2.1.1. Project manager with designer			
C.T.2.1.2. Project manager with constructor			
C.T.2.1.3. Designer with project manager			
C.T.2.1.4. Designer with constructor			
C.T.2.1.5. Constructor with project manager			
C.T.2.1.6. Constructor with designer			
C.T.2.2. EXPERIENCE WITH OWNER			
C.T.2.2.1 Project manager			
C.T.2.2.2. Design professional			
C.T.2.2.3. Constructor			
C.T.2.3. REFERENCES			
C.T.2.3.1. Project management			
C.T.2.3.2. Design professional			
C.T.2.3.3. Constructor			
C.T.2.4. MINORITY STATUS			
C.T.2.4.1. Minority business standing			
C.T.2.4.2. Women business standing			

SUBTOTAL ________

Figure B.2: Interaction Constraints Guidelines

C.T.3. Technological Constraints

Technological constraints are the in-house knowledge or equipment that is available for a team member to use in completing a process.

RFP PREPARATION

In column 1 identify the required qualifications and their importance using the following code: (0) Not required (1) minimal requirement; (2) average requirement; (3) strongly required.

PROPOSAL EVALUATION

In column 2 use the following code: (0) does not meet requirements; (1) minimally meets requirements; (2) generally meets requirements; (3) completely meets requirements. Multiply columns 1 and 2 to enter "score" in column 3. Add items in column 3 to provide subtotal.

C.T.3.1. CONTROL SYSTEMS	1 RFP	2 EVAL	3 = 1 x 2 SCORE
C.T.3.1.1. Project management systems (Manual or computer)			
C.T.3.1.2. Ability to control design cost			
C.T.3.1.3. Ability to control construction cost			
C.T.3.1.4. Ability to control design schedule			
C.T.3.1.5. Ability to control construction schedule			
C.T.3.2. EQUIPMENT			
C.T.3.2.1 Communications (FAX, modem, etc.)			
C.T.3.2.2. Design equipment (CADD, drafting,etc.)			
C.T.3.2.3. In-house construction equipment			
C.T.3.3. KNOWLEDGE			
C.T.3.3.1. Project management systems			
C.T.3.3.2. Experience as a team in locale			
C.T.3.3.3. Experience as a team by project type			
C.T.3.3.4. Experience with codes/standards in locale			
C.T.3.3.5. Design experience in locale			
C.T.3.3.6. Construction experience in locale			

SUBTOTAL ________

Figure B.3: Interaction Constraints Guidelines

C.T.4. Corporate Policy Constraints

Corporate policy constraints are the result of internal policies set by a team member.

RFP PREPARATION

In column 1 identify the required qualifications and their importance using the following code: (0) Not required (1) minimal requirement; (2) average requirement; (3) strongly required.

PROPOSAL EVALUATION

In column 2 use the following code: (0) does not meet requirements; (1) minimally meets requirements; (2) generally meets requirements; (3) completely meets requirements. Multiply columns 1 and 2 to enter "score" in column 3. Add items in column 3 to provide subtotal.

C.T.4.1. PROJECT BASED PROCEDURES	1 RFP	2 EVAL	3 = 1 x 2 SCORE
C.T.4.1.1. Key personnel identified & roles defined			
C.T.4.1.2. Grasp of project requirements in terms of schedule, budget, quality			
C.T.4.1.3. Project procedures manual			
C.T.4.2. BUSINESS PHILOSOPHY			
C.T.4.2.1 Project management philosophy			
C.T.4.2.2. Design approach			
C.T.4.2.3. Construction methodology			
C.T.4.3. RISK SHARING ABILITY			
C.T.4.3.1. Project management risk			
C.T.4.3.2. Design risk			
C.T.4.3.3. Construction risk			

SUBTOTAL ________

Figure B.4: Corporate Policy Constraints Guidelines

C.T.5. Labor/Personnel Constraints

A team member's labor constraints pertain to the current workforce employed or accessible to the team.

RFP PREPARATION

In column 1 identify the required qualifications and their importance using the following code: (0) Not required (1) minimal requirement; (2) average requirement; (3) strongly required.

PROPOSAL EVALUATION

In column 2 use the following code: (0) does not meet requirements; (1) minimally meets requirements; (2) generally meets requirements; (3) completely meets requirements. Multiply columns 1 and 2 to enter "score" in column 3. Add items in column 3 to provide subtotal.

C.T.5.1. PROJECT EXPERIENCE	1 RFP	2 EVAL	3 = 1 x 2 SCORE
C.T.5.1.1. Experience as a team by project type			
C.T.5.1.2. Project management experience by project type			
C.T.5.1.3. Design experience by project type			
C.T.5.1.4. Construction experience by project type			
C.T.5.2. LOCAL EXPERIENCE			
C.T.5.2.1 Local experience as a team			
C.T.5.2.2. Local experience with codes/standards			
C.T.5.2.3. Local design experience			
C.T.5.2.4. Local construction experience			
C.T.5.3. STAFFING			
C.T.5.3.1. Project management staff			
C.T.5.3.2. Appropriate design staff			
C.T.5.3.3. Adequate construction staff			
C.T.5.3.4. Safety levels			

SUBTOTAL ________

Figure B.5: Labor/Personnel Constraints Guidelines

C.T.6. Legal Constraints

Legal constraints that affect team members are the laws and codes that govern the profession of the respective team members.

RFP PREPARATION

In column 1 identify the required qualifications and their importance using using the following code: (0) Not required (1) minimal requirement; (2) average requirement; (3) strongly required.

PROPOSAL EVALUATION

In column 2 use the following code: (0) does not meet requirements; (1) minimally meets requirements; (2) generally meets requirements; (3) completely meets requirements. Multiply columns 1 and 2 to enter "score" in column 3. Add items in column 3 to provide subtotal.

C.T.6.1. IN-HOUSE LICENSING	1 RFP	2 EVAL	3 = 1 x 2 SCORE
C.T.6.1.1. Architect			
C.T.6.1.2. Engineer			
C.T.6.1.3. Construction trades			
C.T.6.2. OUTSIDE LICENSING			
C.T.6.2.1 Architectural consultants			
C.T.6.2.2. Engineering consultants			
C.T.6.2.3. Specialty construction trade subcontractors			
C.T.6.3. PENDING LEGAL ACTIONS			
C.T.6.3.1. Design professionals			
C.T.6.3.2. Construction trades			
C.T.6.3.3. Other (describe)			

SUBTOTAL ________

Figure B.6: Legal Constraints Guidelines

Constraints Summary

1. Provide a weighting factor for each overall constraint category in column marked "WF". (Note that the sum of this column should equal 100.)

2. Multiply the WF by the subtotals (column 3 from previous worksheets) for each constraint category for each team and enter weighted score in respective team's column.

3. Add team columns for final score.

	WF	TEAM A	TEAM B	TEAM C	TEAM D
C.T.1. Economical Constraints					
C.T.2. Interaction Constraints					
C.T.3. Technological Constraints					
C.T.4. Corporate Policy Constraints					
C.T.5. Labor/Personnel Constraints					
C.T.6. Legal Constraints					
TOTAL	100				

Figure B.7: Constraints Scoring Summary