COMPATIBILITY OF CONSTRUCTION CONTRACTING METHODS

WITH PROJECTS AND OWNERS

by

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B.S. Civil Eng., Univ. of Maine (1985)

Submitted to the Department of Civil Engineering in Partial Fulfillment of the Requirements for the Degree of

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THESIS ABSTRACT

Compatibility of Construction Contracting Methods with Projects and Owners

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Christopher M. Gordon, P.E.

Submitted to the Dept. of Civil Eng. in Partial Fulfillment of the Requirements for the Degree of Masters of Science
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Thesis Supervisor: Fred Moavenzadeh, Director, Center for Construction Research and Education

This thesis is an overview of construction contracting methods and the compatibility of various methods to certain types of owners and projects. Contracting methods, as defined in this thesis, consist of four parts - Scope, Organization, Contract, and Award.

An owner must create a contracting method for each project. The most common method is the traditional system with an independent designer, a general contractor, and a competitively bid, lump-sum price. This method is still fine in many cases, however, for some projects this method causes problems. Various alternative methods have evolved for these projects which can:

- Speed up the project by overlapping design and construction and/or eliminating the bidding process
- Provide flexibility for changes during construction, without paying a premium for it
- Create more teamwork and cooperation by reducing adversarial relationships
- Allow for contractor participation in the design process
- Provide incentives to contractors to save the owner money
- Provide alternative financing methods

This thesis attempts to answer three basic questions:
1.) What are the various methods and their components?
2.) What are the advantages and disadvantages of each?
3.) Which methods are most compatible with certain projects and owners?

The thesis determined that there are six main organizations around which the contracting variations are created - general contractor, construction manager, multiple primes, design-build, turnkey, and build-operate-transfer. Guidelines are established to help the owner choose the organization, contract type, and award method most applicable for their project and themselves. It was found that while there may not always be only one appropriate method, there are always many that are clearly not appropriate.
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Author

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Introduction

1.1 General

Construction accounts for an average of ten percent of the gross national product of this country, and holds a similar position in most economies of the world. Obviously, any improvement in the efficiency of the process has the potential for large cost savings. It has been estimated that more efficient selection of contracting methods could reduce project cost by an average of five percent (The Business Roundtable 1982, 1). This thesis will examine the construction contracting methods available to owners, and the compatibility of various methods to different owners and projects. Too often, an owner uses a particular contracting method simply because it is what they are used to, it appears to be the easiest, or it was suggested by the designer or contractor, when in reality some are more suited for certain owners and projects than others.
1.2 Definition of a Construction Contracting Method

In this thesis the construction contracting method is defined as having four parts—scope, organization, contract, and award—described as follows:

1. Scope—The portion of the project tasks—design, construction, and finance—that is assigned to the contractor. These are the three main tasks for the owner, after the decision has been made to proceed with the project.

2. Organization—The business entity that the owner holds a construction contract with, such as a general contractor or a construction manager.

3. Contract—The agreement of how the owner will pay the contractor for work performed, such as a lump-sum or cost-plus. These can be divided into two major groups of fixed price and reimbursable contracts.

4. Award—The method used to select the contractor and/or the price, such as competitive bidding or negotiation.

Figure 1 shows a simplistic breakdown of the common components of the scope, organization, contract, and award parts. The contract and award types listed under each organization are possibilities only. An owner must go
Figure 1

Table of Construction Contracting Method Components
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through a logical decision process to choose one particular scope, organization, contract, and award, and combine them into the desired and appropriate contracting method for their project.

Choosing a contracting method is far from an exact science. In many cases, there is not one single best method, but several that are appropriate. The inexactness of the selection is complicated by the unique nature of each project, and the intangible nature of many of the judgement criteria, such as "project complexity". Chapter seven guides the owner through a logical process-of-elimination to weed out inappropriate methods until only appropriate ones are left for the owner to choose between. The advantages and disadvantages of each method as described in chapters four, five, and six can then be used to help the owner fine-tune which method is most appropriate for a given project.

1.3 The Traditional Method - Explanation and History

The "traditional method" consists of a separate designer, a general contractor, a fixed lump sum contract, and competitive bidding. A project is conducted in a linear fashion, with the construction following the design and bidding. This is a relatively modern method in the history of construction.
From Roman times to the beginning of the last century, the architect was a master builder, in charge of designing the project, purchasing the materials, hiring the craftsman, and managing the construction. Architects and engineers honed their skills designing and problem solving on site as the project progressed. Project schedules and budgets were not important, with some projects spanning an architect's entire career. Technology and materials were comparatively simple, and the financial return on the owner's investment was not considered (Goldhaber, Jha, and Macedo 1977, 3).

As society evolved in the last century, the demand for more buildings grew rapidly. This put pressure on the industry to reduce project duration and be cost efficient, making construction a more commercial industry. During the industrial revolution, projects became more complicated as technology developed for new materials and features such as power, central heat, plumbing, and vertical transportation. The new complexity and size of projects, combined with the new demands on the industry, required specialized construction skills, beyond what the architect had been performing. The architect's role was redefined to concentrate on the appearance and function of the project. The general contractor organization rose to handle the construction tasks, working from the designs of the architect. Subcontractors were often used by large general contractors to eliminate the burden of constantly employing
a large work force in the fluctuating industry (Goldhaber, Jha, Macedo 1977, 3). By 1909, the American Institute of Architects had gone full circle and adopted a code of ethics that forbade architects from engaging in building construction (Lund).

With general contractors now following predetermined plans, owners seeking to minimize cost saw the opportunity to apply free market competitive forces on the process through bidding. Public owners were especially attracted to bidding because of their accountability for public moneys. This responsibility has always been closely monitored by the public and media in this country to ensure money is not wasted and that contracts are not awarded for corrupt motives or favoritism.

This combination of the evolution of the general contractor and the popularity of competitive bidding formed the traditional contracting method most often used in this century. This method has advantages for the owner in that they have complete control over the design, a fiduciary relationship with the designer to monitor the contractor, a single source of construction, a known total price before construction starts, price competition, and impartial selection. This method is still fine in many cases where the project is clearly definable, well and completely designed, not necessary to complete in less time than the standard
process will take, and is unlikely to change during construction.

However, many modern projects do not meet these criteria. Projects are constantly getting more complex as technology is developed and as the industry matures, and projects are constantly in need of time savings with lengthy approval processes and a faster-paced economy. Also, the cost of construction is increasing at a rate greater than inflation, making cost saving innovations critical.

Adding to the shortfalls of the traditional process is the growing inability of the design professional to be all knowing about construction, and to serve as protector of the owner's financial interests. The massive increase of technical requirements and the liability concerns of the designers seldom allow them to be construction experts. This is detrimental to the constructibility analysis, value engineering, and other construction planning tasks during design. Also, some feel the project financial and administrative authority role often held by the architect is incompatible with their responsibilities as designers, thus rendering them less effective (Irwig 1980).

A related concern is the adversarial relationship and lack of teamwork often created between the designer and
contractor by the zero-sum-game nature of fixed price contracts.

1.4 Alternative Methods

In response to the issues discussed above, various alternative methods have evolved over many years. New contracting components have been created, as shown in Figure 1, and combined in various innovative ways to meet the owners' needs for modern, complex projects. These new methods can improve on the traditional method for certain projects by:

1. Shortening the duration of projects by overlapping design and construction (fastracking) and/or eliminating bidding time.

2. Provide flexibility for changes during construction, without paying a premium for it.

3. Creating more designer - contractor teamwork by reducing adversarial relationships.

4. Allowing a contractor to participate in the design process, thus augmenting the designer's construction experience, for such tasks as value engineering, constructibility analysis, and cost estimating. The total project cost can be affected much more during design development and detail design than during the construction phase.
5. Providing incentives for the contractor to save the owner money.
6. Providing alternative financing methods.

1.5 The Three Objectives of This Thesis

This thesis will attempt to answer the following questions:
1. What are the various methods and their components?
2. What are the advantages and disadvantages of each?
3. Which methods are most compatible for certain projects and owners?

The bulk of the thesis is spent answering the first two questions, to build a clear understanding of the methods for the reader. The last chapter attempts to match the characteristics of the methods with various types of owners and projects.

1.6 The Scope of This Thesis

This thesis is written from the owner's point of view, as a guide for selection of a contracting method. It examines issues from an operational view point, not a legal view point. While various contract clauses and word groups are very important and interesting issues, they are not addressed in this thesis.
This thesis will examine the methods individually, as if they were always isolated, when in reality, many hybrids are common that combine and slightly alter the methods. (An example of this is the use of a construction manager to oversee a design-build team). After much thought, it was decided that the most efficient way to gain an understanding of the various methods was to look at them in their purest form. It then will be easy for the reader to create and understand many of the possible combinations.

While the thesis looks at all four components of the methods, the organizational section has been given the most emphasis since this is where the root of the owner's decision lies. The contract type is also discussed in the organization section because it became obvious that discussing them separately would create much duplication and confusion (For example, a general contractor working for a fixed fee or a reimbursable contract creates different issues for the owner. If the contracts were discussed separately, they would have to be applied to all the organization types and analyzed). The contract section itself is a general overview of how each contract works.

1.7 Conclusion

This chapter has created the framework of the thesis. The reader will first gain an understanding of the various
construction contracting methods used. Responsibilities will be described and advantages and disadvantages discussed. Finally, a process of selecting a method for a project will be developed. It is important to understand that no method is always better than all others, only that some are more appropriate for certain projects and owners than others.
2 Definitions

2.1 General

In order to better understand the discussion and comparison of the various methods that follow, this section defines the components as used in this thesis. Many of the terms defined here, such as construction manager and turnkey, have been used in different and confusing ways in various literature. I have attempted to define them as represented by a consensus of the literature, the most recent industry standards, and common sense.

One should also understand that many of the components of the methods, especially organizations, often become very similar in their various forms. For example, depending on the contractual arrangement, a construction manager and a general contractor can be almost indistinguishable in some instances. I have attempted to define each component in such a way that it is clearly distinguishable from other similar items.
2.2 Definitions

Organizations

**General Contractor** - A single business entity acting as the contractor in complete and sole charge of the field operations, including the marshalling and allocation of manpower, equipment, and materials (Clough 1981, 4).

**Construction Manager** - A single business entity acting as a construction consultant to the owner and project manager, either for a fixed fee or a fee as a percentage of the cost.

**Multiple Prime Contractors** - More than one contractor holding contracts directly with the owner to perform specific parts of the same project. The contractors can be general contractors overseeing various trades, or subcontractors performing one trade. The owner is responsible for overall project management and coordination, replacing a general contractor or a construction manager.

**Design-Build Team** - A single business entity that performs both the design and construction of a project. The team can be one company or a partnership of firms.

**Turnkey Team** - One business entity that performs the design, construction, and construction financing of the
project. Payment is made at the completion (when the contractor turns over the "key").

Build-Operate-Transfer Team - One business entity that performs the design, construction, construction and long-term financing, and temporary operation of the project. At the end of the operation period, which can be many years, operation of the project is transferred to the owner.

Contracts

Lump Sum - The contractor agrees to perform the stipulated work in exchange for a fixed sum of money (Clough 1981, 127). This lump sum commonly includes all labor, materials, project overhead, company overhead, and profit.

Unit Price - The contractor agrees to be paid a set cost per unit of each item, such as per-cubic-yard of excavation. The actual total amount paid is based on the actual measured units constructed on the project, times the unit price agreed to. The unit-cost for each item commonly includes all labor, materials, project overhead, company overhead, and profit. Sometimes overhead items are paid separately.

Cost-Plus - The contractor is reimbursed the cost of doing the work, including labor, materials, and project
overhead, plus a fee, including company overhead and profit. The fee can be a fixed sum, a percentage of the cost, or a formula incorporating both.

**Guaranteed Maximum Price** - The contractor is reimbursed the cost of doing the work, including labor, materials, and project overhead, plus a fee, including company overhead and profit, up to a prearranged maximum price. Once that price is reached the contractor must finish the job at no additional cost to the owner. If the job is finished under the maximum price, there is often a sharing of the cost difference between the owner and the contractor as an incentive to the contractor to reduce costs.

**Fixed Fee** - The contractor is paid a lump sum fee, including company overhead and profit, but reimbursed for labor, materials, and project overhead.

**Award**

**Competitive Bid** - A contractor is selected by the lowest price proposal, in market competition.

**Cap** - A fixed price is set by the owner against which contractors propose a level of quality and options for a project.
Negotiation - The price and/or contractor are selected by negotiation between the owner and either several contractors or one contractor.

Qualification and Price Proposal - The contractor is competitively selected based on qualifications and price. The process is often quantified with a ranking formula.

Time and Price Proposal - The contractor is competitively selected based on the proposed schedule and price. The process is often quantified with a time-price formula.

Qualification, Time, and Price Proposal - The contractor is competitively selected based on their qualifications, proposed schedule, and price. The process is often quantified with a ranking formula.

Design and Price Proposal - The contractor is competitively selected based on their proposed design and price. The process is often quantified with a ranking formula.

2.3 Conclusion

These definitions are to help the reader better understand the text that follows. All the definitions will be expanded on as each component is developed on the thesis.
3

Scope of The Contract

3.1 General

A person or organization considering a construction project must start by performing some programing and feasibility exercises to determine the scope of the project. If they decide to proceed with a project, there are three broad segments of work to be done - design, construction, and financing.

![Diagram showing the segments of work: Design, Construction, and Financing.]

Each of these can be divided into two phases. Design is divided into design development, when creative solutions shape the basic project form; and detailed design, when detailed design is conducted and construction documents are produced. Construction is divided into pre-construction planning, when construction expertise can be used to analyze
and improve the design (this can overlap with design when
allowed by the contracting method) and detailed plans are
developed for physical construction; and implementation,
when the actual construction work is completed. Financing is
divided into short-term construction financing, which funds
the project during construction; and long-term financing,
which spreads out the construction capital payback over a
multi-year period.

This thesis defines the sum of these parts as the total
scope of the project, and the amount done by the contractor
as the scope of the contract. The contractor may be
responsible for portions of one, two, or all three of the
categories. The three main scenarios, as shown in Figure 1,
are:

1. Separate Design and Build (Traditional Method): the
contractor is responsible only for the construction
implementation portion of the project, with the
exception of any in-house planning they do. All of
the design is conducted by an independent consultant
or by the owner, and financing is arranged by the
owner.
2. **Design Build**: the contractor is responsible for the design and construction portions of the project. Depending on the contract, the development portion of the design is either done interactively with the owner, or by an independent designer, before a design-build contract is signed. The financing is arranged by the owner.

3. **Design, Build, and Finance**: the contractor is responsible for all three portions of the project. The contractor may be responsible for only short term financing, as in a turnkey arrangement, or both short and long term, as in a build-operate-transfer arrangement.
As the owner determines the contract scope for a particular project, the main issue revolves around the role of the designer, specifically if the designer is directly aligned with the owner or the contractor. The fiduciary relationship with the owner, the motivation, and possible conflicts of interest of the designer are all important issues, and will be discussed in detail in the design-build section of the organization analysis. Detailed analysis and assignment of responsibilities for each variation of these three groups is performed in the next sections of this thesis.

It should be noted that an owner could perform the construction work with its own employees, in a "force account" arrangement. This, however, is not covered in this thesis since no contracting method is needed.

One point of growing importance to the scope of a project is the new role of technology in the construction process, specifically CAD and management information computer systems. Integration of the design drawings, the
contractor's bidding and construction documents, and the owner's as-built drawings, on a CAD system, is rapidly becoming a reality. Therefore, theoretically, the owner, designer, and contractor could all be working from the same computer drawings and data throughout the project. As this information sharing becomes common, either the data will become transferable, with no compatibility and proprietary problems, or the team will be restructured to accommodate the common data. This could greatly increase the use of a cohesive team of designers and contractors. This integration of the project, adding coordination and communication, is seen as potentially very beneficial to the industry. This can be accomplished either through a design build team, or by contracting in such a way as to include the contractor in the design process; such as with a construction manager for a fixed fee or a general contractor for a reimbursable fee.

3.2 Conclusion

There are six tasks that make up the design, construction, and finance of a project. The scope of the construction contract describes how many of these tasks are going to be assigned to the contractor. This can range from having the contractor only construct the project to having them design, construct, short-term finance, long-term finance, and operate the project.
4

Organizations and Contracts

4.1 General

An organization, as defined in this thesis, is the business entity with whom the owner holds a construction contract. As we discussed in Chapter 3, this organization can be responsible for construction; design and construction; or design, construction, and finance of the project. This section looks at various organizations and how they perform under either fixed price or reimbursable contracts.

A major factor for an owner when selecting a type of organization for a project is the level of responsibility and the corresponding required capabilities of the owner. As will be shown, some organizational types require more owner sophistication and involvement than others. The main administrative responsibilities on a project—control, payments, safety, bonds, and insurance—are discussed and assigned for each organizational type.

One point to remember when reading this chapter is that most modern "contractors" of the organizational forms described
in this chapter, do little of the actual work with their own employees. Most of the work is subcontracted out to trade contractors, such as masons, steel erectors, and painters, reducing the "contractor", in essence, to project managers overseeing and coordinating many trade subcontractors. (Obviously, in a multiple prime contractor situation the owner is the manager).

4.2 General Contractor

4.2.1 Definition

A general contractor is a single business entity acting as the contractor in complete and sole charge of the field operations, including the marshalling and allocation of manpower, equipment, and materials (Clough 1981, 4). This is the traditional type of organization that owners have dealt with. The design professionals are a separate entity and contract separately with the owner. The following project organizational chart shows the contractual relationships:
The contractor takes total charge of the site and construction of the project, and, often subcontracts most of the work out to trade contractors. The distinct features of a general contractor arrangement are the contractor's total responsibility and the use of separate designers. A general contractor is always in charge of implementing the construction work, and may be involved in the construction planning phase, depending on the project.

An owner can hold any one of many types of contracts with a general contractor, and award the contract in a variety of ways. On public projects, a lump sum bid is common. On private projects, lump sums and GMP's are popular, with various award methods.
4.2.2 Responsibilities

**Control:** Once the contract has been signed, the general contractor is normally responsible for control of time, quality, and cost. The contract documents will specify the quality level, and the designer is normally retained to conduct inspection services to ensure that the contractor is meeting the requirements of the documents. A schedule will normally be made a part of the contract, and the contractor will have to meet various benchmark dates.

Cost is determined either by a fixed fee or on a reimbursable basis. If it is fixed, the contractor assumes responsibility for monitoring their own costs and striving to stay under budget. If the contract is reimbursable, the owner must more carefully monitor the expenses to be sure that the contractor is providing what is required, and what has been billed for, in an acceptable manner. This requires site inspections and measurements, expertise in construction accounting and pricing, and a clear directive in the contract of what is chargeable to the project and what is not.

The contractor is normally responsible for meeting permit and hiring requirements, however, the owner should request proof of both. The owner also should request full sets of
design documents and as-built drawings as part of the permanent project record.

**Payments:** The owner is responsible for periodic, usually monthly, progress payments to the contractor for work completed to that date. This requires that the owner have both the means to pay for the work and procedures set up to verify the payments that the contractor is requesting. The owner must verify both that the amount of work is in place and that it meets the quality required. The contract should stipulate the amount of retainage (money held back by the owner as warrantee), payment schedules, and other money transfer details.

**Safety:** The general contractor normally assumes responsibility for all site safety issues. The role of the design professional in site safety is a controversial issue. Current contracts give the design professional responsibility for safety problems resulting directly from their design and for directives they give on the site. All other site safety issues are assigned to the general contractor, unless specifically stated differently in the contract.

**Bonds:** Surety Bonds are normally used in public construction, and sometimes in private projects. They protect the owner from debt, default, or failure of the
contractor. The most common bonds used in construction are (Clough 1981, 160):

1. Bid Bond: The surety company guarantees that the bidding contractor, upon being declared the successful bidder, will enter into a contract with the owner. If they do not, the surety will pay the difference between the next bid (so the owner gets the project for the same low cost) or will pay a predetermined lump-sum penalty.

2. Performance Bond: The surety guarantees to have a project completed, in the event of contractor default, for the same price as originally contracted for. This type of bond is most applicable for fixed price contracts.

3. Payment Bond: The surety guarantees that all labor, material, and subcontractor costs that are owed by the prime contractor will be paid, thus protecting the owner from claims and liens.

4. Maintenance Bond: The surety guarantees payment for repairs of defects of work for a limited period of time after completion, in the event of contractor failure to do so.

The bonding issue for this thesis discusses how the bonding arrangements are affected by the type of contracting method used. When using a general contractor, all four of the
common bonds can be used, with all being held by the contractor.

Many private owners do not feel the need to require bonds, which are expensive, if they are working with a reputable contractor who is unlikely to default on their commitments.

**Insurance**: Having proper insurance in the dangerous and high-cost construction industry is very important to the owner, designer, and contractor. Insurance protects the insured from financial responsibility for loss or liability (Clough 1981, 180). This thesis discusses how the project's insurance needs change with various types of contracting methods. The main types of insurance possibly held by a contractor are (Clough 1981, 180):

1. Property insurance on project property, such as an all-risk builder's risk policy, which normally insures the work in place, materials on site, equipment on site, and existing site features from damage caused by an outside force, such as fire.
2. Property insurance on the contractor's own property.
3. Liability insurance protecting the owner and contractor from injury or loss caused to third parties by their actions. Many types of liability insurance exist. Contractors employing design professionals also must carry professional liability policies.
4. Employee insurance, such as workmen's compensation, social security, unemployment, disability, and medical, protects the employee in a time of need, and the contractor from extensive costs.

5. Automobile insurance for the contractor's automobiles.

6. Business and accident insurance to insure that the business can operate in the event of major disruption.

While it is important for the owner to verify that the contractor has all the required insurance, the only two types that are affected by the contracting method are site property insurance and liability insurance. The owner must be sure that the investment on the site is protected from loss and the owner is protected from liability for actions related to the project.

When using a general contractor either the owner or the contractor can carry the all-risk builder's risk site insurance. It is most common for the contractor to carry it, because they are more familiar with what to get and may get a better rate (Clough 1981, 191). Liability insurance is more complicated and has many forms. The legal details of liability insurance are beyond the scope of this thesis, however it can be summarized by saying that the owner needs a general policy to protect them from actions of their employees, the contractor, and the subcontractors; and the
general contractor needs a policy to protect them from the actions of their employees and subcontractors. This will get more complicated later in the thesis as the work is divided among several contractors, and as design is introduced into the contract.

4.2.3 General Contractor Working for a Fixed Price – Advantages and Disadvantages

In order to obtain a reasonable fixed price, either lump sum or unit price, from a general contractor, the construction documents need to be complete. This is true whether the price is bid or negotiated, because the contractor is still agreeing to provide a project for a fixed fee. Having a general contractor working for a fixed fee has the following advantages:

Advantages:

1. The owner can select from a wide range of design professionals (Sweet 1985, 440).

2. The design professional, as an independent professional, can monitor the work with the owner's interest in mind (Sweet 1985, 440).

3. The owner can have great freedom during the design phase, working closely with the designer to make changes and explore alternatives.

4. Not awarding the contract until the design is complete should enable the contractor to bid (or
negotiate) more accurately, and the fixed price is less likely to be adjusted upward, except for design changes (Sweet 1985, 440).

5. The owner is able to delegate total site construction responsibility to one entity.

6. The total cost is known at the start of construction.

7. The use of a general contractor is well established and understood by owners, contractors, and the courts, and ample documents and case law exist.

Naturally, using a general contractor working for a fixed fee also has its disadvantages, as follows:

**Disadvantages:**

1. Separation of design and construction deprives the owner of the contractor's planning knowledge, which would be helpful with constructibility and value-engineering issues. One way to alleviate this is to hire a general contractor as a consultant during the design phase, however they are still not a constant part of the team.

2. A fixed price and separate design professionals can create an adversarial relationship between the owner, contractor, and design professional. The fixed price has created a zero-sum-game, in which anything gained by the owner is lost by the contractor and vice versa.
3. Making design changes during construction is often expensive and difficult for the owner. When pricing a change, the contractor often tries to regain profit lost to the rigid fixed price. This leaves the owner and designer in a bad negotiating position with few competitive market forces to help them.

4. The linear nature of waiting to start construction until the design and contract award is done, makes for the most lengthy process.

5. The owner has no share in any savings the contractor may find during the construction process.

4.2.4 General Contractor working for a Reimbursable Price - Advantages and Disadvantages

Retaining a general contractor for a reimbursable price has many of the same characteristics as above, with several very important exceptions. The following list highlights only those advantages and disadvantages that are different from above.

Advantages:

1. The reimbursable nature of the contract does not require that the contractor be selected after the documents are complete. Thus, the contractor can be involved in the design and planning, and the project can be accelerated on a fasttrack schedule (overlapping the design and construction).
2. Changes are easier to handle, if the subcontract for that portion of the work has not yet been awarded, since they are simply paid for at cost.

**Disadvantages:**

1. Less price accountability, and possibly less efficiency, exists. The general contractor has no motivation to limit costs, if a pure cost plus contract is used. Variations of reimbursable contracts, such as a guaranteed maximum price, that can reduce this risk, will be discussed later.

2. The total price is not known until the end. The contract may be switched to a GMP or a lump sum when the documents are mostly complete, but by this time, the competitive forces are not as strong on the contractor. If the contractor provides competition for the owner by bidding subcontracts, they are approaching the role of a construction manager.

4.2.5 General Contractor - Conclusion

The general contractor organization is still a very viable alternative for owners who want to use an independent designer and want to delegate all the construction responsibility to one entity. It also can allow for very strong market competition for price.
Hiring a general contractor for a lump sum price, however, is only recommended if the project is completely designed, unlikely to change, and able to proceed on a normal sequential schedule. Using a general contractor with a reimbursable contract can allow more flexibility but can be very risky for the owner, as will be discussed in the risk analysis portion of the contract chapter. This same kind of flexibility can be gained with a construction manager, working for a flat fee, who will act more as a fiduciary to the owner. A general contractor who claims to provide these same services is mislabeled, and should be called a construction manager.
4.3 Construction Manager

4.3.1 Definition

A construction manager, in its pure form, is a business entity acting as a construction consultant to the owner and as a project manager overseeing the project, either for a fixed fee or for a fee as a percentage of cost. The CM is on the project team, with the owner and design professional, from start to finish, providing both pre-construction planning and construction implementation.

This arrangement provides the owner with a fiduciary relationship with a construction expert, and still allows the actual construction work to be competitively bid to trade contractors or several general contractors. This gives the owner a similar relationship as with a general contractor, with the added advantages of a non-adversarial relationship with the managers of the project, fastrack ability while still using competitive bidding, and pre-construction advice from the contractor (a complete list of advantages will be detailed later).

Construction management evolved during the 1960's in response to the increasing size and complexity of projects. The first documented use was on Madison Square Garden in 1965 and the first well publicized use was on the World
Trade Center in New York in 1967, both by the Tishman Realty & Construction Co.. Inc. (Tishman 1988).

The following organizational chart shows the contractual relationships:

```
  OWNER
   /\  \
  /   \  \
ARCH/ENG CM FINANCE
   /\     /\    \
  /   \   /   \  \
  SUBS  
```

(Note: The subcontractors are shown in a lower position to represent their subordinate position to the CM and A/E, not to indicate in any way that they are of less importance.)

While this is the pure form of CM and the form discussed in this thesis, it should be pointed out that various adaptations of this form are sometimes used, depending on the situation. A list of CM titles as identified by Haltenhoff (1987, 6) are presented below for reference. As the reader will see, most are actually thinly vailed versions of other organizations described in this thesis,
thus creating much of the confusion surrounding the title of construction manager.

1. **Pure or "Agency" Construction Management:** As described above, is the root form, where the CM does no design or construction work and the owner holds the contracts. This is the form discussed in this thesis.

2. **Design Construction Management:** This form combines design and construction management services. This variation provides communication and cooperation between the design and construction professionals since they are all in one firm or joint venture, but is sometimes criticized for the potential of conflict of interest and no checks and balances between the two project parts. This variation resembles a design-build team working under a reimbursable contract, as will be discussed later.

3. **Constructor Construction Management:** This form uses a construction manager that also has its own forces to conduct the work. This form is very similar to a general contractor, working with his own forces, under a reimbursable contract. It is sometimes criticized for its potential conflict of interest and dilution of the fiduciary relationship of the CM as a consultant.

4. **Contracting Construction Manager:** Under this form the CM contracts with the subcontractors and suppliers
instead of the owner. If all else remains the same as in pure CM, including owner involvement in subcontractor selection and CM payment by fee, this form is very similar to the pure form. If the CM controls the subcontractor selection, it is basically a general contractor working under a reimbursable contract.

5. Guaranteed Maximum Price Construction Manager: This form is structured and administered the same way as a pure CM, except that sometime in the process the CM agrees to a guaranteed maximum price for the work. The price is typically agreed to when the drawings are sixty to eighty percent complete. When the GMP is established, the CM is virtually transformed into an independent contractor, with the introduction of such things as change order procedures. However, the pure CM responsibilities as a consultant theoretically remain, and the owner has gained the advantages of a pure CM through most of design and part of construction.

This variation has been both praised for introducing some financial risk to the contractor, and criticized for "contaminating" the professional service of the CM with conflicts and adversarial relationships (Tishman 1988).
6. **Owner Construction Management:** This form is when the owner's organization takes on the responsibilities of the CM. In this thesis, this arrangement is defined as multiple primes, and will be discussed in the next section.  

This thesis deals with the pure form of construction management. The variations discussed that are similar to other methods in this thesis can be better understood by reading the appropriate section. One important owner decision that arises from the variations is the use of a GMP. This is often referred to as the CM "at risk", because of their financial risk. This is a very controversial and cloudy area concerning the use of a CM. Many owners feel a CM will work harder to reduce costs if they have some risk involved, but do not want to introduce commercial issues associated with guaranteeing a price. An owner must make this decision based on the CM and project involved. For more on this subject, see the GMP contract section.

A construction manager's duties are sometimes expanded from single project responsibilities to managing a group of projects, which is often called a program manager. This charges the CM with coordinating a series of projects that an owner is conducting. Under this arrangement the CM can also manage each individual project as a CM; or they can use other organizational types, such as a general contractor or design-build team, for each project.
A CM is normally selected based on qualifications and fee, similar to a design professional. This allows both private and many public owners to choose a CM qualified for the task, not just because they are the low bidder. This separates the service nature of the CM, which is more difficult to price, from the manufacturing, commodity nature of the trade contractors, where bidding continues under the CM method.

The CM is paid either a fixed fee (possibly with some site expenses reimbursable) or a fee as a percentage of total cost. The fixed fee is more popular, since the percentage fee gives the CM an incentive to increase the project cost. Some argue that the use of a CM is more expensive than a general contractor because the fee is not subject to strong competitive forces. In reality, the CM fee is a small percentage (usually 2-5%) of the estimated construction cost (Goldhaber, Jha, and Macedo 1977, 195). The potential cost saving features of CM, such as fastracking and pre-construction advice, should reduce the total cost more than the costs due to the lack of market fee competition. This difference is even smaller when one remembers that the original construction cost of a typical building is about ten percent of the total life-cycle cost.
The following typical figures put the construction management fee in perspective with the total original cost of a project (Barrie, pg 35).

<table>
<thead>
<tr>
<th>Item</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property acquisition</td>
<td>5%</td>
</tr>
<tr>
<td>Preliminary programming &amp; planning</td>
<td>3%</td>
</tr>
<tr>
<td>Design</td>
<td>7%</td>
</tr>
<tr>
<td>Construction</td>
<td>54%</td>
</tr>
<tr>
<td>Construction Administration*</td>
<td>6%</td>
</tr>
<tr>
<td>(CM, Testing, Safety)</td>
<td></td>
</tr>
<tr>
<td>Financing</td>
<td>20%</td>
</tr>
<tr>
<td>Owner's internal costs</td>
<td></td>
</tr>
<tr>
<td>Total capital cost</td>
<td>100%</td>
</tr>
</tbody>
</table>

* The construction administration cost would be part of the general contractor's cost to the owner if a general contractor was used.

Variations in the CM's fixed fee, as a percentage of the estimated cost, from one project to the next is caused by many factors including the required service, award method, and the quality level of the building. The last issue is explained by a CM providing identical services for two projects of the same design, but with different specified quality of materials, such as carpeting and painting. Their fee may be two percent for the expensive version of the project and five percent for the less expensive version, although the actual amount of the fee is the same.
4.3.2 Responsibilities

**Control:** The construction manager takes on the management tasks normally handled by the general contractor, and often some of the owner's responsibilities. In order to understand the CM's control functions, one first must look at their overall project responsibilities. The amount of involvement of the owner, in such things as subcontractor selection, can vary depending on the capabilities and interest of the owner, and their confidence in the CM. The typical tasks of the CM are grouped into three areas - consulting with the owner and the design professional, contract letting to subcontracts, and construction administration (Goldhaber, Jha, and Macedo 1977, 13) and are defined as follows:

**Consulting:**

- Economic Feasibility
- Financial Planning
- Estimating and Pricing
- Budget Costing and Scheduling
- Value Engineering
- Alternative Design Evaluation (and Constructibility)

**Contract Letting:**

- Bid Packaging (and Bid List Preparation)
- Bid Analysis (and Recommendation to Owner)
- Contract Negotiation
Construction Administration:
Supervision and Coordination (including general condition items, such as site clean up, common equipment, fire protection, and security)
Public and Labor Relations
Scheduling and Cost Monitoring
Change Order Control
Performance and Quality Control

From this list, one can see that the CM has most of the control responsibilities on the project. They are on site monitoring quality, schedule, and cost, as well as looking at macro issues such as the overall financial situation. The owner will obviously be involved in the control of the project, but only in a position of analyzing data and making decisions, not gathering data and coordinating between contractors. This works well since most owners are not knowledgeable enough to perform these functions.

An important issue when using a CM is the major complications facing the CM in coordinating the many independent contractors, and it's importance to the success of the project. Someone must be "in charge" on the site, and the CM is the only link between fragmented project components. Also, the design documents must be very well
coordinated, so as not to leave any "gaps" between contracts, further aggravating the coordination problems.

Depending on the structure of the project, either the owner, CM, or contractors may have responsibility for permit and hiring requirements. If it is not the owner, the owner should request proof of both. The owner must also arrange with the CM to create a full set of as-built drawings for the permanent project records.

**Payments:** Payments to subcontractors and suppliers, as well as to the CM, are all handled by the owner. Payments are normally made on an ongoing basis throughout the project, based on requests by the contractors, and the analysis and recommendations of the CM. The owner is normally responsible for obtaining any financing required to make the payments.

**Safety:** Safety on a site where a construction manager is used is a complex and controversial issue. The actual construction work is performed by independent contractors, while the overall management of the site is done by the CM, as well as involvement in general conditions of the site such as operation of common equipment, clean up, and fire protection arrangements. The CM is also involved in inter-contractor coordination, necessarily including safety issues. The level of involvement of the CM in site safety, and the accompanying potential for liability to the CM and
the owner, is a function of how the responsibilities are divided in the contract. Little case law exists on CM safety issues, which makes clear determination difficult. The common characteristics of CM safety responsibilities in contracts, as described by Gans (Gans 1981), are as follows:

1. **Contractor Only:** A total reliance on individual contractors to provide a safe working environment for their employees. No central, site-wide safety coordination of any type. No safety professional employed by the CM or the owner. This removes the CM from site safety responsibilities, thus there will undoubtedly be inter-contractor safety issues for which no forum exists for mediation or resolution. This method also may not isolate the CM from liability, as intended. Some courts have found that just by the nature of a CM's role in a project, they assume some safety responsibility.

2. **CM Assist:** Responsibility for contractor employee safety rests with individual contractors, but the CM has a safety professional on its staff to provide certain supplementary services such as coordinating site safety meetings, distributing literature and posters, maintaining a central safety library, providing liaison with government agencies, providing professional safety training, and the like. The CM in this role often maintains first aid facilities and fire prevention and fighting tools.
This method is favored by many CMs and owners because it allows them some control in areas that will likely affect the safety of their own employees and their liability to others' employees, while minimizing their actual hands-on involvement. The CM must take care, however, to avoid having inappropriate reliance for safety placed on them under this method.

3. **CM Direction**: The owner/CM contract provides specific language for the CM to actively direct a site-wide safety program for the benefit of all contractors and employees. This is often used on large and complex projects where the owner wants strong central direction for site safety. The CM will have a safety supervisor and inspectors on site, and will require formal safety programs by the contractors, request written reports, hold training sessions, and conduct inspections. This method gives the CM extensive control and liability.

4. **Owner Representative**: The owner employs a safety professional on the site, separate from the CM, either to actively direct a safety program or to function in a supporting role. This gives the owner direct involvement to the extent desired and removes the CM from much of the safety responsibilities and liabilities.
5. **Safety Consultant:** The owner employs a separate safety consultant organization to provide site safety management services. This method can produce a highly professional safety program, but caution must be used when examining the expense of such consultants and the increased coordination needs with another organization on site.

6. **Safety Corporation:** Project participants (contractors, owners, CM, etc.) form and finance a special corporation established for the specific purpose of managing the site-safety program. Each group contributes money to the corporation, which in turn hires a safety professional. This method has been used, but not enough to judge its merits.

7. **Owner Wrap-up Insurance:** The owner secures overall insurance coverage on the site to include worker's compensation, general liability, auto, and other coverage for all project participants. An insurance underwriter has an active role in overseeing the site safety program. This approach may not be a distinct option, but may be applied in conjunction with one of the other approaches. It is mentioned here, because the role of the insurance underwriter may take on some of the safety coordination tasks of the CM, owner, or contractors.
There is no clear answer to the question of which option the owner should require of the CM. There is growing opinion, however, that the CM should at least have some safety coordination involvement. This is because, as professionals in a central role, they are likely to have some liability regardless, and also they have a vested interest in safety because their employees are also walking around the site. In all of these options, great responsibility for hands-on worker safety still rests with the individual contractors, since they choose the methods of construction and supervise the workers.

**Bonds:** The traditional bonds in construction - Bid, Performance, Payment, and Maintenance - are normally not required of a pure CM since they are in a professional agent position. The bonds may be required of the individual contractors as applicable, and described as applied to a general contractor in Section 4.2.2. If some of the variations of CM, such as constructor or contracting CM, are used, it is more likely that bonds will be required because some of the work is performed or contracted for directly by the CM. Some owners have required a maintenance bond of the CM as if they were a general contractor.

**Insurance:** As with safety, insurance is a complicated issue that must be clearly defined in the owner/CM contract. The two insurance issues that arise as the contracting method is
changed are property insurance on the site and liability insurance. Since there is no general contractor, the owner is the most likely one to hold the property insurance, such as an all-risk builder's risk policy. The owner, CM, and individual contractors all must obtain adequate liability insurance, as recommended by an insurance expert. One alternative, as mentioned in the section above, is for the owner to purchase a wrap-up policy that is an umbrella policy for everyone, covering workman's compensation, general liability, auto, and other coverages.

4.3.3 Pure Construction Management – Advantages and Disadvantages

The pure construction management alternative has distinct owner advantages for some projects as follows:

Advantages:

1. CM allows a fastrack schedule, which saves time through overlapping of design and construction. The individual contracts can be awarded as soon as the design professional completes the documents for that section. The shorter duration project can also save the owner financing costs, fixed project costs, and lost income from the project, and reduce their exposure to inflation.

2. Flexibility for changes is allowed by the nature of the fee arrangement with the CM. This allows the
owner to make changes resulting from rethinking, technology updates, or end-user requests, and still pay a market price, provided that the portion to be changed has not yet been bid. The CM's fee would not change.

3. The potential for adversarial relationships between the contractor, the owner and design professional is reduced and teamwork is encouraged. The CM is a consultant to the owner with a fiduciary relationship and an owner orientation. The CM can lend advice throughout the project in situations the owner might normally have to handle alone.

4. The CM can be on the team during the design process providing pre-construction planning advice about such things as cost estimates, scheduling, constructibility, value engineering, and labor analysis.

5. The CM can be chosen as a professional service, by qualification, even for most public projects, while the majority of the work is still competitively bid.

6. Construction management allows the owner direct access to the materials and sub-contractor markets, thus allowing them to realize savings from efficient bid packaging and the ability to use different contract types (such as lump-sum or unit-prices) tailored to different types of work, and involvement in the selection of sub-contractors. This can reduce
cost and provide a portfolio effect by eliminating the owner's dependence on one large contractor (Gilbreath 1983, 37). If several general contractors are used, similar savings can be gained from smaller bid packages as a result of the increased numbers of capable contractors bidding on the more manageable contracts.

The disadvantages for the owner using a pure construction management organization are as follows:

**Disadvantages:**

1. The total cost and schedule are normally not known, nor guaranteed, at the start of construction. The exception is if the project is not fastracked and all contracts are awarded before construction.

2. The skills of the CM, such as estimating, scheduling, and management, are essential to the success of the project. Poor bid packaging, resulting in "gaps" between contracts, or inadequate site management, can result in costly and unpleasant chaos. The CM has an unusually important role in the success of the project.

4.3.4 Construction Management - Conclusion

A construction manager can provide the owner with great flexibility in the schedule and for changes, as well as a
fiduciary relationship with the contractor both before and
during construction, while still providing market
competition for most of the work. As the method matures, CM
is gaining acceptance in all types and sizes of projects.
For many owners, the CM has replaced some of the lost
services of the architect as a manager on the project. Also,
teamwork can increase between the contractor and design
professional, while the owner still maintains control over
the design.

A CM also is often used to represent an owner who is using
another organization, such as a general contractor. This can
be very effective in helping the owner through the process,
provided the situation is such that the CM is not an
unnecessary layer.

Construction management is the most cost effective way to
conduct many projects that require more than a lump-sum
general contractor can provide. One issue that an owner must
decide is whether or not the CM should be required to
guarantee a maximum price.
4.4 Owners Managing Multiple Prime Contractors

4.4.1 Definition

The project organization known as multiple prime contractors is characterized by more than one contractor holding contracts directly with the owner to perform specific parts of the same project. The owner is responsible for overall project management and coordination, replacing the general contractor or construction manager. This is also called "owner construction management" as described in Section 4.3.1. The organizational chart for a multiple prime project is as follows:

```
  OWNER
   |   |   |
  ---|---|---|
 ARCH/ENG | SUBS | FINANCE
```

This method can provide the owner with the advantages of fastracking and the flexibility of individual contracts, as discussed in the last section. It also, however, requires great construction knowledge and involvement of the owner, and eliminates pre-construction advice from a contractor.
(except in some reimbursable contracts). The required expertise and involvement of the owner is proportional to the number of individual contracts into which the project is divided. As the number of contractors increases, often to forty or fifty, the management responsibility of the owner obviously grows. If only several large contractors are used, the coordination required is less. In some projects the owner assigns the management responsibilities to one of the larger contractors. This is also called "Contracting Construction Management" as described in Section 4.3.1.

The level to which the project is broken down under multiple primes can vary from several large general contractors to individual contractors for each trade. The work on a site can be divided by work area, or by trades working in the same area. The individual contracts can be different types, and awarded in various ways to meet the needs of the work involved. By skilled breakdown of the work into bid packages, competition and flexibility can be increased.

4.4.2 Responsibilities

**Control:** Ultimate control of the project rests with the owner, as usual. However, in this structure the owner also takes on much of the detailed management tasks of control, with the help of the design professional. The owner must monitor the cost, schedule, and quality of the project, as
well as contractor coordination issues. The design professional is normally responsible for conducting inspections to monitor the quality and compliance with the contract documents.

The owner must have experienced construction personnel on it's staff to successfully use a multiple prime arrangement. The tasks which a construction manager performs, instead of a general contractor, outlined in the Construction Management section, now all belong to the owner. There are general condition items, such as site clean up, common equipment, and fire protection, as well as the inevitable coordination problems between contractors. In order to make the control and management process easier, the owner must insist on very complete design documents from the design professional.

The owner must be sure that all permit and hiring requirements are met, either directly by them, or by the contractors. The owner also must arrange for a complete set of as-built drawings to be completed.

**Payments:** The owner is responsible for all payments to the contractors as the project progresses. The owner will work with the design professional to verify that the work for which payments are requested is in place and satisfactory.
The owner is responsible for obtaining any financing that may be required.

**Safety:** The owner takes on the role of the CM, as well as their own role, in the various safety arrangements described in Section 4.3.2. These options range from leaving total safety responsibility up to the individual contractors, to having the owner in complete control of a formal safety program. While delegating total responsibility to the contractors may seem to limit the owner's involvement and liability, problems are likely to arise involving general conditions, such as common equipment and fire protection, as well as coordination problems between contractors working in the same areas. Also, many owners feel they want a say in site safety since they likely will have some liability. Regardless, they have a vested interest in safety for their own workers, and since accidents can be bad public relations for sensitive projects.

With these factors in mind, most owners on a multiple prime project either contract for, or employ, safety professionals to coordinate site safety. The degree of involvement depends on the type and size of the contractors involved, and the characteristics of the project. For example, if a large industrial facility is divided by area between several large, responsible general contractors, they can be charged with safety responsibilities in their area, with only
monitoring by the owner. On the other hand, if the owner is building a high rise with the work divided into fifty or more trade contracts, all working in the same area, someone must be in charge of safety to coordinate and monitor overall compliance with safety regulations.

**Bonds:** The bonds often required of a general contractor - Bid, Performance, Payment, and Maintenance - as described in Section 4.2.2, are applicable for use with the various contractors in varying degrees. If large general contractors are used, all the bonds can be used for their portion of the work. If smaller trade contractors are used, the first three can be used as normal. The application of a maintenance bond on a trade contractor is sometimes done, but must be carefully crafted to acknowledge overlapping work with other trades. With any of the bonds, problems can arise if one contractor holds up or disturbs the work of another since they have no contractual relationship between each other, and no general contractor exists to take overall responsibility.

**Insurance:** The owner will need to hold the property insurance, such as all-risk builders risk, because they are the only overall firm on site. The exception to this is if large general contractors are used, who can insure their own area. The owner and each contractor must obtain adequate liability insurance.
4.4.3 Multiple Prime Contractors - Advantages and Disadvantages

The multiple prime contractor alternative has distinct owner advantages for some projects as follows:

Advantages:

1. Multiple prime contractors allows a fastrack schedule which saves time through overlapping of design and construction. The individual contracts can be awarded as soon as the design professional completes the documents for that section. The shorter duration project can save the owner money in financing costs, fixed project costs, lost income from the project, and less exposure to inflation.

2. Flexibility for changes is allowed by the nature of the system. This allows the owner to make changes resulting from rethinking, technology updates, or end user requests, and still pay a market price, provided that the portion to be changed has not yet been bid.

3. Multiple prime contractors allow the owner direct access to the materials and sub-contractor markets, thus allowing them to realize savings from efficient bid packaging and the ability to use different contract types (such as lump-sum or unit-prices) tailored to different types of work, and involvement in sub-contractor selection. This can reduce cost and
provide a portfolio effect by eliminating the owner's
dependence on one large contractor (Gilbreath 1983,
37). If several general contractors are used, similar
savings can be gained from smaller bid packages, as a
result of the increased numbers of capable
contractors bidding on the more manageable contracts.

The disadvantages for the owner using a multiple prime
contractors organization are as follows:

Disadvantages:

1. The total cost and schedule are normally not known at
the start of construction. The exception is if the
project is not fastracked and all contracts are
awarded before construction.

2. The owner must be heavily involved in the project and
knowledgeable about construction. The skills of the
owner, such as estimating, scheduling, and
management, are essential to the success of the
project. Poor bid packaging, resulting in "gaps"
between contracts, or inadequate site management, can
result in costly and unpleasant chaos.

3. The project does not have pre-construction services
from a contractor, such as estimating,
constructibility analysis, and value engineering. The
exception is if some of the contractors are on a
reimbursable contract and are selected during design.
4.4.4 Owner Managing Multiple Prime Contractors - Conclusion

While the use of multiple prime contractors can provide great flexibility for the owner, it also provides great responsibility and risk. The method should only be used by an owner who has the experience and available staff to become fully involved in the project as a construction manager.

If the owner is capable, the method can provide the owner with complete control over all aspects of the project and direct access to materials and sub-contracting markets.
4.5 Design-Build Team

4.5.1 Definition

A Design-Build Team (DBT) is a single business entity that performs both the design and construction of a project. The team can be one integrated company, employing both design and construction professionals, or a partnership of firms where separate design and construction firms join forces.

The following organizational chart shows the typical contractual relationships:

```
  OWNER
    
  DES/BLD  FINANCE
          |      |
    ARCH/ENG  SUBS
```

The design-build method provides one source for the owner to deal with, and hold accountable, on all project issues, as with the "master builder" architect of previous centuries. Teamwork is encouraged between the designer and contractor,
allowing complete pre-construction integration between the designer and contractor, and eliminating the shifting of blame. As one architect said "There's no competition to prove who's the idiot this week - the architect or the contractor" (Architectural Record 7/1982). The team can propose a whole approach to a project, involving both design and construction.

Project duration can be decreased by the elimination of a separate contractor selection process (such as a bidding period), and often, by using a fastrack construction schedule. The importance of the potential time savings of design-build is evident in cases such as the State of Massachusetts, who has recently used the process for several large prisons, justifying the use by the expected time savings of over thirty months. Change order claims to the owner, due to omissions in the plans, are eliminated. The only change orders are typically for change of scope, differing site conditions, or changes after the plans have been approved.

The design-build method, however, gives the owner less direct control over the design by reducing their ability to make changes during design. Some argue it also eliminates the owner's fiduciary relationship with the design professional as their advisor and protector. Ensuring the owner's protection is a combination of owner sophistication
and team integrity. The owner must have construction expertise to prepare the request for proposals (or negotiate a price, if not competitive), evaluate the proposals, and monitor the project to be sure that the agreed-to quality and quantity are provided.

"A successful design-build project requires 'a sophisticated client with the ability to judge what they're getting' in order for the concept to work"

Richard F. Albosta
Chairman, CEO, Ebasco Services Inc.
(ENR 5/24/90)

Occasionally an independent design professional and/or a construction manager is hired by the owner to help with these tasks. The overall time commitment to the project by the owner is often less than the traditional method, but the sophistication required is high.

If an owner wants to pick a team purely on qualifications, and contract with them on a reimbursable basis, the process involves only a review of their qualifications and availability, and often an agreement on a guaranteed maximum price. This method, however, provides less competition, and if no GMP is used, the owner has little price control; and a questionable design-build team has the incentive to over-design. It is used when the owner has great trust in the
team's integrity and the project is monitored with careful open book accounting, and almost always with a GMP.

The more competitive approach is for the owner, often working with a separate design professional, to do the initial programing and schematic design, and provide them as a basis for several teams to make proposals that include a lump sum or guaranteed maximum price, a developed design, and a project schedule. These proposals provide for price competition and also allow for design innovation, thus introducing a design element into the selection, and rewarding the team for innovation. Other award methods, as will be discussed in chapter six, can be used to incorporate such things as qualifications into the selection process.

In the request for proposals, the owner must carefully specify its expectations to the prospective design-build teams, so the selected team can produce the detail design and construction as expected, for the agreed to price. This is a critical element of a successful design-build project. If expectations are not laid out in a clear and verifiable fashion, the project will be filled with disputes. The main concern of most owners is how to get what they want. Some owners have referenced specific existing projects as examples of quality level and design features, to help clarify their expectations.
When preparing the request for proposals, the owner must decide how much specification to include, and how much specification to require back in the teams' proposals. The amount of specification provided by the owner must balance the need to convey exactly what they expect while allowing the team flexibility to propose innovative ideas. If the owner provides too much specification, they have reduced the effectiveness of design-build, stifled innovation, and have approached preparing full-working documents. No correct levels of detail exist. The owner and consultant must evaluate each project individually.

When evaluating the proposals, an owner must consider the entire life-cycle costs of the project, not just the initial capital cost (proposed price). This is important, since a team could propose a facility for a low price, but one that would require extensive staffing or maintenance to operate. This issue can best be addressed in the owner's specifications supplied in the request for proposals.

One problem with requesting competitive design-build proposals is that these proposals are expensive to prepare (estimated to average 0.5% of expected construction costs (Minden, pg 102)), often costing several hundreds of thousands of dollars each for a large project ($50 - $100 million projects). This discourages participation and places distorted prices on the projects (to make up for other lost
Many owners have partially remedied this problem by paying an honorarium for adequate proposals, whether they are selected or not. These do not cover the total cost of preparing the proposals, but do lessen the impact and risk for the firms. Many owners consider the honorarium worth the cost to produce several design alternatives for their project, and feel in the end they still have gained more value.

A typical design-build project would have the following segments:

1. Preliminary work including scoping, programing, schematic design, and performance specifications is conducted by the owner and consultant
2. Requests for qualifications are sent to interested design-build teams
3. Owner selects several teams to compete
4. Requests for proposals are issued to the teams
   Proposals from the teams are to include developed designs, schedule, and price, all based on owner specifications
5. Selection of team based on scoring formula for proposals
6. Final design of the project by the team, with interaction with, and intermediate approvals from, the owner; this may be done in phases if fastracking is allowed
7. Construction of the project by the team, based on approved plans

8. Acceptance and use by the owner

It is possible to have separate contracts for the design and construction portions of the process so that the owner has the option to stop the process after design, either to discharge an unsatisfactory team or stop the project entirely, yet still have complete documents. Obviously, this is difficult if fast-tracking is used. In the public sector it also is common to use a separate design professional, from any of the prospective teams, to prepare the preliminary work (programming and schematic design). Even if the project is negotiated, this will help obtain an unbiased scope for the project.

It is very difficult to determine if design-build saves the owner money. Some say that the increased efficiency and innovation of the designer-contractor teamwork, the potential shorter project duration, the elimination of the separate contractor bidding process, and the reduction of design redundancy of bid documents and shop drawings reduces the cost. Others argue that the owner's cost in preliminary work, the cost of proposals to the teams, honorarium costs, and the lack of fierce competition all contribute to increasing the cost of design-build.
Lump-sum contracts are common with simple design-build projects, allowing a rare combination of a fixed price and a fastrack schedule; while reimbursable contracts with a guaranteed maximum price are more common on complicated projects. A fixed price, design-build contract for a highly complex project is possible, but must be carefully awarded by the owner to avoid problems.

Typical internal structures of design-build teams are generally characterized by one of the following (Consulting Engineer 5/19/84):

1. Contractor is the lead participant, who then engages a separate design professional. An owner must be careful in this situation that the design commitment is strong, and not totally dominated by the contractor.

2. Construction manager is the lead participant, who subcontracts the design and construction tasks (same as "design construction manager" in section 4.3.1).

3. Contractor and design professional form a joint venture. This structure can work well, as long as the two participants establish common goals, philosophies, and corporate cultures.

4. Contractor has design professionals in-house. This is the most common approach, with most of the top fifty
design-build firms structured this way. It allows highly efficient in-house communication, common goals, a non-ad-hoc environment, and stability after the project is finished. It does, however, limit the flexibility of the contractor in diversity of design specialties.

5. Design professional is the lead participant, who then subcontracts for construction, either with a general contractor or directly with sub-contractors, as a construction manager. The owner must be careful that this method does not become dominated by the designers, resulting in impractical and excessive designs. Also of concern is the financial and management abilities of many design firms to lead a design-build process.

Regardless of these internal variations, the owner contracts with one entity. In all of these examples, the contractor can use its own construction forces, but normally subcontracts most of the work to trade contractors.

The participation of the design professional on design-build teams has been controversial in former years. Architects and engineers employed by design-build firms were often denied membership in their respective professional societies. The American Institute of Architects adopted a code of ethics in 1909 that forbade architects from engaging in building
construction (see Section 1.3 for more on this issue). The architect was held in a position of advisor to the owner in overseeing the contractor, and removed from the commercial issues of the project. Many saw participation in the commercial issues of design-build as a "contamination" of the design profession.

While the code of ethics was abandoned in the early 1980's, many architects still consider design-build a potential conflict of interest, and will not participate. Their concern stems from the perceived removal of the architect from a professional position advising the owner, to a more commercial role concerned more about the contractor and profit than the owner and the public. Many design-build firms prefer to think just the opposite - that they have brought the construction side of the project to the owner-oriented, professional perspective of the architect.

Another concern of some design professionals is that their services may be indirectly bid against other competitors in a design-build competition. Bidding of design services is frowned upon by various professional societies and outlawed on federal projects by the Brooks Law. This issue is often resolved by using a DBT selection process that combines qualifications, design proposal, and price.
Design-build had traditionally been used in this country on private projects of two forms - simple projects where the design intent could easily be conveyed (such as warehouses and standard houses); and process-oriented projects (such as chemical plants) where performance specifications were more important than design details. Use was also common on packaged and proprietary products, such as pre-engineered steel buildings and water treatment facilities. And design-build has existed for years on portions of larger projects, such as pump stations for sewer projects.

Today, however, many types of projects, both public and private, are being attempted with this method, including schools, prisons, hotels, hospitals, and sewers. The growing use of design-build on public projects is of interest since it often allows a proposal system, combining qualifications and price, not just the standard low-bid process. Design-build is more common in Europe and South America, where it is viewed as a simpler and quicker alternative, and where complex bidding laws don't limit its use.

One interesting note is that the common shop drawing process actually is a design-build process nested in other methods. Full-blown design-build simply expands on this by giving the general intent for the whole project, and allowing the "contractor" to work out the appropriate details.
For a detailed analysis of design-build and case studies of its use on several large public projects, see *Design-Build in the Public Sector: A Case Study of the Commonwealth of Massachusetts Division of Capital Planning and Operations (DCPO) Design-Build Projects for Three Correctional Facilities*; Minden, Steven D., S.M. Thesis, MIT, 1986.

4.5.2 Responsibilities

**Control:** The project controls rest mainly with the design-build team, similar to a general contractor. All designer-contractor-subcontractor coordination is the responsibility of the design-build team. Complete control of the site normally rests with the team. The owner interacts with the team extensively during design to ensure compliance with the design intent, and during construction to ensure that the approved plans are being followed. An on-site owner's representative is common for large projects. The owner may require certain milestones on the schedule to be met to ensure that they are on time. If the project is conducted on a reimbursable basis, the owner must carefully monitor the project to control costs.

The team is normally responsible for meeting permit and hiring requirements, however the owner should request proof of both. The owner should also request full sets of design
documents and as-built drawings as part of the permanent project records.

**Payments:** The owner is responsible for periodic, probably monthly, progress payments to the team for work completed to that date. This requires that the owner have both the means to pay for the work and procedures set up to verify the payments that the team is requesting. The owner must verify both that the amount of work is in place and that it meets the quality required. The contract should stipulate the amount of retainage (money held back by the owner as warrantee), payment schedules, and other money transfer details. The owner is responsible for obtaining any financing required.

**Safety:** The design-build team normally assumes responsibility for all site safety issues, similar to a general contractor. The role of the design professional in site safety is up to the team, since they are one entity. The owner's role is minimal and should be clearly detailed in the contract.

**Bonds:** The traditional bonds in construction - Bid, Performance, Payment, and Maintenance - are all applicable for use with a design-build team, all being held by the team. As mentioned earlier, bonds are often not required by private owners when dealing with a reputable, stable
contractor. A separate but related matter is the common use of performance warranties issued by the team when proposing the project, to convince the owner that the team will create a certain value.

**Insurance:** The insurance structure for a project with a design-build team is normally similar to one with a general contractor (see Section 4.2.2 for a list of common insurance policies for a project). The project property insurance, such as an all-risk builders risk policy, is usually held by the team, but can be held by the owner. The owner, the design-build team, and the trade contractors all must obtain adequate liability insurance, as recommended by an insurance expert.

In the past, some independent architects involved in design-build have been concerned about the status of their professional liability insurance (Architecture 10/1986). Their concern was that insurance companies would be reluctant to insure them for fear of assuming a portion of the contractor's liability. While most have been able to get insurance, their policies typically include exclusionary language stating that coverage does not extend to any "equity interest" they may have in the design-build entity. Contractors who employ design professionals must add professional liability to their insurance coverage. The
coverage of the team, including the architect, should be carefully reviewed with an insurance expert.

4.5.3 Design-Build Team working for a Fixed Price – Advantages and Disadvantages

In order to obtain a fixed lump-sum price for a design-build project, the preliminary work by the owner to schematically design and specify the performance of the project must by very complete, clear, and verifiable. The team will review these documents and agree to perform the entire project for a fixed sum of money. Having a design-build team working for a fixed price has the following advantages:

**Advantages:**

1. The total cost and schedule is known before the start of design and construction. This allows early decision making and financing, such as market issues of bonds.

2. Teamwork between the designer and contractor during design and construction is enhanced. Pre-construction planning advice from the contractor is available, and will create opportunities for cost-saving innovations when preparing their proposal.

3. The owner has no liability for change orders, unless the scope or site conditions change.

4. The owner has to deal with only one entity responsible for the entire project, with minimal
involvement in coordination between the designer and contractor.

5. The owner is able to delegate total site responsibility, including safety, to one entity.

6. The method can allow for a fastrack schedule, which saves time through overlapping of design and construction. The shorter duration project can save the owner money in financing costs, fixed project costs, and lost income from the project.

7. A separate selection process for the contractor, after design, is eliminated, potentially saving both time and money.

The disadvantages for the owner using a design-build team for a fixed price are as follows:

**Disadvantages:**

1. Making design changes (either in scope or in approved design) is often expensive and difficult for the owner. When pricing a change, the team often tries to regain profit lost to the rigid fixed price. This leaves the owner in a bad negotiating position with few competitive market forces to help them.

2. The owner has lost some flexibility in, and control over the detail design process.

3. The owner has lost the design professional's fiduciary relationship to advise the owner and provide checks and balances on the contractor.
4. The owner must be knowledgeable about design and construction to establish the initial parameters, review proposals, and monitor the process. The help of an independent consultant is frequently needed.

5. Often, an honorarium is paid to the proposing teams to offset the high cost of preparing the proposals.

6. The owner is entirely dependent on one entity for the success of the project. Performance expectations may not be met if the team falters.

4.5.4 Design-Build Team working for a Reimbursable Price – Advantages and Disadvantages

Retaining a design-build team for a reimbursable price has many of the same characteristics as above, with several very important exceptions. The following list highlights only those advantages and disadvantages that are different from above.

Advantages:

1. The reimbursable nature of the contract makes changes in design easier to handle, if the subcontract for that portion of the work has not yet been awarded, since they are simply paid for at cost.

2. The owner has the option to choose a team based only on qualifications, and eliminate the costly, complex, and lengthy proposal process. The schematic design,
normally done during the proposal process, is done by the team working with the owner.

Disadvantages:

1. Less price accountability, and possibly less efficiency, exists. If purely cost-plus, the design-build team has less incentive to limit cost, which may result in over-design and/or contractor inefficiency. The owner must play a very active role to monitor costs. The possibility of future work and damage to the firm's reputation will help to balance this in the private sector. A GMP is normally used to greatly reduce this risk of financial inefficiency, yet still provide flexibility.

2. The total price may not be known until the end. The contract should be switched to a GMP or lump sum at some point, but the competitive forces may not be as strong on the team at that point. If the contractor provides competition for the owner by bidding sub-contractors, they are approaching the role of a construction manager.

4.5.5 Design-Build Team – Conclusion

Design -build allows a project to be created in its entirety by one team. The resulting teamwork can eliminate many of the coordination and relationship problems that plague
construction. The owner has to deal with only one team, one budget, and one schedule, streamlining their control process. The method allows the team to propose an entire innovative approach to the project, based on both their design and construction experience.

An owner also, however, has placed total project responsibility with one entity. They no longer have the checks and balances of an independent designer, and an owner using design-build must thoroughly understand the process and know exactly what they want.

The award method should always consider the qualification of the team, not just low price, since design services are involved, and if competitive proposals are used, the owner must consider the life-cycle cost of the designs.

A pure cost-plus contract should never be used with design-build, since the team is both designing and constructing the project, whereas a GMP is often used, provided a credible price can be arrived at. A lump sum contract is the most straightforward way of dealing with the intangibles, provided the owner is able to provide adequate and final specifications.
4.6 Turnkey Team

4.6.1 Definition

A turnkey team is a single business entity that performs the design, construction, and construction financing of a project. One lump-sum payment is made by the owner at project completion (when the contractor turns over the "key"). The team can be one company or a partnership of firms, where, for example, separate design, construction, and development firms join forces.

The following organizational chart shows the typical contractual relationship:

```
  OWNER
    \   /  \
  TURNKEY
    \   /  \
     ARCH/ENG  SUBS  CONS FINANCE
```

Turnkey offers the owner the same advantages and disadvantages of design-build, as described in the last section, with the additional feature of lump-sum payment at
completion. Having the turnkey team responsible for the
construction financing is advantageous, if they can obtain
financing faster or cheaper than the owner, and/or as a
method of maximizing the value of the project for an
established budget, such as with a cap award method.

There are many reasons a turnkey team may be able to get
short-term financing more efficiently than the owner. Some
eamples are:

1. The team may be able to obtain capital at a lower
cost. For example the client may currently have a bad
bond rating, or the team may be a large company able
to borrow money on its own, including issuing of
bonds, for a lower rate.

2. Some lenders and institutional investors will not
loan for construction, only for completed products
(ENR 6/21/1984). This is seen in a real estate
market, for example, that is over-built. The lenders
are hesitant to loan for new construction because of
the risk, and to encourage absorption of the surplus,
but normally will agree to long-term financing if the
project is complete and credible.

3. A public or private owner will not have a sum of
money available until a later date, from the sale of
a piece of land, for example. The owner must be
careful, however, that using the turnkey team as a
lender, in essence, is cheaper than outright borrowing.

4. A limit on expenditures by the owner is in place for a given fiscal period.

Some public owners have used the turnkey method to take advantage of the expertise and infrastructure of existing private developers. HUD, for example, contracted with private developers to supply low income housing units, because, at the time, their existing organization was more efficient at land acquisition, gaining approvals, financing, design, and construction (Minden 1986, 129).

"Three years after starting a major project, private developers are finished and deciding where to invest next. Look at a public project after three years and its supporters and critics will still be debating its merits"

Matthys Leve

"The Problem with Public Projects"

(Civil Engineering 3/1987)

The turnkey method can also be used to help the owner maximize the value of the project by setting a cap, or fixed maximum price, and allowing the proposing teams to bid the project with the most value against the maximum price (see section 6.3). In this method, the owner provides a lump-sum price, base building specifications, and a list of add-on
options and quality upgrades. The teams propose a total project, including the base building and as many options and upgrades as possible, still within the same price. This is, in effect, bidding the building for a set price, as opposed to the normal method of price for a set building.

The owner normally works with a consultant to establish a base building and cost estimate that are compatible, and a list of options and quality upgrades in the order of preference. This method can also be used for design-build, but it is simpler to execute with turnkey, since the price is all-inclusive, including financing costs.

The turnkey method can create strong incentive for the team to finish the project on time, as specified, since the team must carry the financing costs until the project is accepted by the owner (Minden).

When using a turnkey method, it is not uncommon for the owner to have to deed the project property to the turnkey team. This is to facilitate gaining financing for the project, since the lenders will have rights to the entire project, not just the improvements. In most cases, this temporarily releases the owner from property taxes and site liability, but the cost will obviously be included in the proposal from the team.
Most turnkey projects are contracted for a fixed price, awarded either competitively or negotiated with a single source. A reimbursable contract can be used as long as the team can obtain flexible financing, and the owner can control costs, as discussed in the design-build section.

4.6.2 Responsibilities

**Control:** The project controls rest mainly with the turnkey team, similar to a general contractor. All designer-contractor-subcontractor coordination is the responsibility of the turnkey team. Complete control of the site normally rests with the team. The owner interacts with the team extensively during design to ensure compliance with the design intent, and during construction to ensure that the approved plans are being followed. An on-site owner's representative is common for large projects. The owner may require certain milestones on the schedule to be met, to be sure that they are on time. If the project is conducted on a reimbursable basis, the owner must carefully monitor the project to control costs.

The team is normally responsible for meeting permit and hiring requirements, however, the owner should request proof of both. The owner should also request full sets of design documents and as-built drawings as part of the permanent project records.
**Payments:** In a true turnkey arrangement, no payment is made until the project is complete. In this case, the owner has no responsibility for payments until that time. The turnkey team has full responsibility for paying all design professionals, contractors, suppliers, financing costs, and any other project costs. Some turnkey projects of long duration provide for several large payments at major stages in the project, such as yearly or at the completion of sections. In all cases, the owner is responsible for obtaining any long-term financing required to pay the lump-sum payments.

**Safety:** The turnkey team normally assumes responsibility for all site safety issues, similar to a general contractor. The role of the design professional in site safety is up to the team since they are one entity. The owner's role is minimal and should be clearly detailed in the contract.

**Bonds:** The traditional bonds in construction - Bid, Performance, Payment, and Maintenance - are all applicable for use with a turnkey team, but may be modified from the standard bond format, considering the contractor-supplied financing. For example, the payment bond need only be in place at the time of payment. Many bonds may be nested within the team, for example between the team and sub-contractors.
**Insurance:** The insurance structure for a project with a turnkey team is normally similar to that with a general contractor (see Section 4.2.2 for a list of common insurance policies for a project). The project property insurance, such as an all-risk builders risk policy, is most often held by the team, but can be held by the owner. As discussed in the design-build section, the design professional must have adequate professional liability coverage for working on such a project, whether they are in the employ of a contractor or an independent consulting firm. The owner, the turnkey team, and the trade contractors all must obtain adequate liability insurance, as recommended by an insurance expert.

4.6.3 Turnkey Team working for a Fixed Price - Advantages and Disadvantages

The advantages and disadvantages of a turnkey team working for a fixed price are very similar to a design-build team, with several additions specific to the turnkey method. Having a turnkey team working for a fixed price has the following advantages:

**Advantages:**

1. The total cost and schedule is known before the start of design and construction.

2. Teamwork between the designer and contractor during design and construction is enhanced. Pre-construction
planning advice from the contractor is available, and will create opportunities for cost-saving innovations when preparing their proposal.

3. The owner has no liability for change orders, unless the scope or site conditions change.

4. The owner has to deal with only one entity responsible for the entire project, with minimal involvement in coordination between the designer and contractor, and no payment responsibilities during construction.

5. The owner is able to delegate total site responsibility, including safety, to one entity.

6. The method can allow for a fastrack schedule, which saves time through overlapping of design and construction. The shorter duration project can save the owner money in financing costs (even though the team finances the project in the short term), fixed project costs, and lost income from the project.

7. A separate selection process for the contractor, after design, is eliminated, potentially saving both time and money.

8. The owner can delegate the short-term financing responsibility, which can result in lower financing costs, a faster process for obtaining financing, and allow owners to take advantage of efficient existing developers.
9. The fixed price including financing can be used to maximize the project value by the use of a cap, and can be used as an incentive for performance, since the team must carry the financing costs until the project is accepted.

The disadvantages for the owner using a turnkey team for a fixed price are as follows:

**Disadvantages:**

1. Making design changes (either in scope or in approved design) is often expensive and difficult for the owner. When pricing a change, the team often tries to regain profit lost to the rigid fixed price. This leaves the owner in a bad negotiating position with few competitive market forces to help them.

2. The owner has lost some flexibility in, and control over the detail design process.

3. The owner has lost the design professional's fiduciary relationship to advise the owner and provide checks and balances on the contractor.

4. The owner must be knowledgeable about design and construction to establish the initial parameters, review proposals, and monitor the process. The help of an independent consultant is frequently needed.

5. Often, an honorarium is paid to the proposing teams to offset the high cost of preparing the proposals.
6. The owner is entirely dependant on one entity for the success of the project. Performance expectations may not be met if the team falters.

4.6.4 Turnkey Team working for a Reimbursable Price –
Advantages and Disadvantages

Retaining a turnkey team for a purely reimbursable price is very uncommon, but is presented here for reference. It has many of the same characteristics as above, with several very important exceptions. The following list highlights only those advantages and disadvantages that are different from above.

**Advantages:**

1. The reimbursable nature of the contract makes changes in design easier to handle if the subcontract for that portion of the work has not yet been awarded, since they are simply paid for at cost.

2. The owner has the option to choose a team based only on qualifications and eliminate the costly, complex, and lengthy proposal process. The schematic design normally done during the proposal process is done by the team working with the owner.

**Disadvantages:**

1. Less price accountability, and possibly less efficiency, exists. If purely cost-plus, the turnkey
team has less incentive to limit cost, which may result in over-design and/or contractor inefficiency. The owner must play a very active role to monitor costs. The possibility of future work, damage to the firm's reputation, and the cost of carrying the financing will help to balance this. A GMP is normally used to greatly reduce this risk of financial inefficiency, yet still provide flexibility.

2. The total price may not be known until the end. The contract should be switched to a GMP or lump sum at some point, but the competitive forces may not be as strong on the team at that point. If the contractor provides competition for the owner by bidding sub-contractors, they are approaching the role of a construction manager.

4.6.5 Turnkey Team - Conclusion

Turnkey provides the owner with all the same process teamwork advantages as design-build, as well as the ability to delegate all financing responsibility until the project is complete. This added feature can both reduce the owner's administrative responsibilities and possibly increase the project value. The increase in value is possible if the team can more efficiently obtain short-term financing, and/or the
award method is arranged to use the all-in-cost method to compare proposed projects, as in a cap method.

A pure cost-plus contract should never be used for a turnkey project. A lump-sum is better able to establish some accountability, as will be discussed in chapter five.

In addition to the cautions listed in the design-build section involving the combining of the design and construction functions, a turnkey owner must be sure that the contractor financing is actually creating more value, not just a convenience. Projects should use the turnkey method only where this value can be gained.
4.7 Build-Operate-Transfer Team - Privatization

4.7.1 Definition

A build-operate-transfer (BOT) team is a single business entity that performs the design, construction, construction and long-term financing, and temporary operation of a project. Its most common form is called privatization, involving private companies providing projects for public owners, such as highways and prisons. At the end of the operation period, which can be many years, the project is transferred to the owner. The team can be one firm, or a partnership of firms where, for example, separate design, construction, and investment firms join forces.

The following organizational chart shows the typical contractual relationship:

```
  OWNER
    |
    v
  BOT
    |
    v
ARCH/ENG  SUBS  C&L FIN  OPERATE
```
Build-operate-transfer offers the owner the same advantages and disadvantages as turnkey, as described in the last section, with the additional feature of payment to the contractor in the form of long-term operational revenues, not disbursements (payment) from the owner.

This arrangement is normally used to allow private investors to implement public sector infrastructure projects for a state (a "state" could be a country, state, county, city, town, etc.). Developing countries desire to use the method for the following reasons (Selwan 1990, 20):

1. Provides the needed project, and a period of professional operation, to both service the need, and to boost the economy.

2. The project does not require public financing, which helps a government that is at its debt limit; or it frees up money for other projects such as social or educational programs.

3. Introduces new technologies and management techniques to the state, and trains its residents.

However, these developing countries have experienced limited success with BOT because of risk factors that will be discussed later.

The method can also be advantageous for developed countries, to reduce the state's financial involvement in a given
project. This is often needed since most governments are finding it difficult to finance maintenance of the ever-growing infrastructure inventory, as well as new infrastructure needs. From the owner's point of view, the project is the debtor, not the owner, i.e. the revenues from the project pay the debt, not the owner (Selwan 1990, 15). Many governments also find that BOT teams can develop and operate projects more efficiently than a public bureaucracy, resulting in faster completion, quality operation, and sometimes lower costs to the end consumer.

Under a BOT arrangement, the team agrees to build a specified project at no cost to the owner, and, in return, the team receives the operating revenues for a set number of years, such as highway tolls or electricity sales, to pay off the debt and yield a profit for the investors. The negotiation of the length of the operating period is a critical element of the deal. Most operating periods run for between ten and twenty-five years, but some are much longer, such as the Channel Project between France and England, in which the private developers have the right to operate for fifty-five years. Assuming the project is profitable, the team will want as long an operation period as possible. The risk is, of course, that if the project does not turn out to be profitable, a long period could cause large losses.
Another main negotiation point is what, if any, guarantees the owner will provide to reduce the risk of the contractor. The owner (state) normally will not give "main level" guarantees, such as a set yield on the project for investors. They do, however, often give "second level" guarantees, such as (Selwan 1990, 20):

1. Some protection from political risks (war, government decisions, expropriation) that affect the yield. The amount of protection is a major negotiation issue and has stopped many proposed BOT plans.
2. A guarantee of future exchange rates and transfer rights for currency.
3. Details of transfer of the facility at the end of the operation period.
4. Minimum revenues in the event of commercial problems that are out of the control of the team, such as a drastic drop in demand for electricity from a power plant project. This is not the same as guaranteeing a minimum revenue, regardless of how the facility is managed or how the economy fluctuates. The revenue level guaranteed is normally well below a break-even point.

As mentioned, one of the main negotiation issues for projects in unstable developing countries is the amount of political risk the team must assume. Outside agencies or the home country of the team have often had to assume some of
the risk in the risk-sharing equation to make a project viable. Insurance is available to cover the team from political risk (Selwan 1990, 71), but the more risk it covers, the higher the price, and the less the payoff.

An example of home country involvement is the three-tier export credit guarantee set up in 1988 by Britain's Export Credit Guarantee Department. It provided certain guarantees against risks, depending on the characteristics of the team, project, and host country. The three tiers were (ENR 6/30/88):

1. 100% reimbursement of payments delayed more than three months by standard political risks, defined as war, rebellion, government decisions, cancellation of U.K. export licences, and expropriation.

2. Additional backing to cover for the failure of the host country to honor certain specific agreements, under any circumstances.

3. Additional coverage to guarantee 60% of the expected revenues of the project, under any circumstances.

Very few projects, however, have met the strict requirements to qualify for even the first guarantee. While backing of this type is a large step, it is still is not enough incentive for many teams to accept projects in developing countries, limiting the effectiveness of BOT in those countries.
The BOT team is normally made up of a joint venture of a "promoter", who instigates and coordinates the process, a contractor (usually design-builder), an operator, investors, and lenders. Equity is typically thirty percent, with the following breakdown (Selwar 1990, 41):

- Promoter: 5%
- Contractor and Operator: 10%
- Investor: 15%

Projects can be awarded by negotiation with one team, but are more commonly awarded by competitive proposals. If the project is awarded competitively, the owner must prepare an extensive preliminary study to specify what is expected from the project. This work is normally done by a consultant, and is of similar content to that used for turnkey proposals. The requirements of the team proposals are all unique to the given project, but at a minimum include design schemes, operation period, a detailed report on the team makeup, and an analysis of the financial feasibility of the proposal. The owner must be sure to stipulate the condition that the facility must be in at the time of transfer.

Several recent examples of major international projects that have been done with a BOT team are the Channel Project and the Hong Kong Eastern Harbor Crossing. Many smaller projects are also being conducted with this method, such as prisons, turnpikes, and schools.

4.7.2 Responsibilities

**Control:** The project controls rest mainly with the BOT team, similar to a turnkey team. All designer-contractor-subcontractor coordination is the responsibility of the BOT team. Complete control of the site normally rests with the team. The owner interacts with the team extensively during detail design to ensure compliance with the design intent, and during construction to ensure that the approved plans are being followed. An on-site owner's representative is common for large projects. The owner may require certain milestones to be met on the schedule to be sure that they are on time. However, the team has an incentive to finish as soon as possible so they can start collecting revenues, and to build a quality facility because they must operate and maintain it for a number of years.

The team is normally responsible for meeting permit and hiring requirements, however the owner should request proof of both. The owner should also request full sets of design
documents and as-built drawings as part of the permanent project records.

**Payments:** In most BOT arrangements, no payment is made to the team by the owner. The BOT team has full responsibility for paying all design professionals, contractors, suppliers, financing costs, and any other project costs, both during construction and the operation period.

**Safety:** The BOT team normally assumes responsibility for all site safety issues, similar to a general contractor. The role of the design professional in site safety is up to the team since they are one entity. The owner's role is minimal and should be clearly detailed in the contract.

**Bonds:** The type of bonds between the owner and the team used on a BOT project are unique to the project. Some owners may require performance bonds of the team. The team will require the normal construction bonds of contractors working on the project.

**Insurance:** The project property insurance, such as an all-risk builders risk policy, is held by the team. As discussed in the design-build section, the design-professional must have adequate professional liability coverage for working on such a project, whether they are in the employ of a contractor or an independent consulting firm. The BOT team
and the trade contractors all must obtain adequate liability insurance, as recommended by an insurance expert.

Insurance against political risk and such issues are beyond the scope of this thesis, but must be thoroughly investigated by the team and the owner.

4.7.3 Build-Operate-Transfer Team - Advantages and Disadvantages

The advantages and disadvantages of a build-operate-transfer team are very similar to a turnkey team, with several additions specific to the BOT method. Using the build-operate-transfer method has the following advantages:

**Advantages:**

1. The financial arrangement and schedule is known before the start of design and construction.

2. Teamwork between the designer, contractor, and operator during design and construction is enhanced. Pre-construction planning advice from the contractor can be available.

3. The owner has no liability for change orders.

4. The owner has to deal with only one entity, with minimal involvement in coordination between the designer, contractor, and operator, and no payment responsibilities.
5. The owner is able to delegate total site responsibility, including safety, to one entity.

6. The owner is able to delegate total operation responsibility to one entity, ensuring professional operation for a period of time.

7. The method can allow for a fastrack schedule, which saves time through overlapping of design and construction. The team has an incentive to finish as soon as possible so they can start collecting revenues sooner.

8. A separate selection process for the contractor and arrangements for operation are eliminated, potentially saving both time and money.

9. The owner can delegate the financing responsibility which can result in a faster process for obtaining financing, help an owner that is at its debt limit, free up money for other projects, and allow owners to take advantage of efficient existing developers.

10. Introduces new technologies and management techniques to a region, and trains its residents.

The disadvantages for the owner using a build-operate-transfer team are as follows:

**Disadvantages:**

1. Making design changes (either in scope or in approved design) is often difficult for the owner.
2. The owner has lost some flexibility in, and control over, design details and the design process. However, it is likely that a quality design will result since the team must operate and receive revenue from the project for an extended period.

3. The owner has lost the design professional's fiduciary relationship to advise the owner and provide checks and balances on the contractor. However, this is less important than on a project the owner would take over immediately.

4. The owner must be knowledgeable about design and construction to establish the initial parameters, review proposals, and monitor the process. The help of an independent consultant is often needed, and it may still be difficult to achieve the desired quality and schedule results.

5. The owner is entirely dependant on one entity for the success of the project. Performance expectations may not be met if the team falters. Selection of a reputable team is essential.

4.7.4 Build-Operate-Transfer Team - Privatization -

Conclusion

Privatization is a rapidly growing method for public owners to obtain needed infrastructure projects at no direct cost to them. All of the process efficiencies gained in design-
build are realized here, as well as the financial advantages. The skills of existing private developers can be brought to bear on often-slow public infrastructure projects. Also, many areas are exposed to new technologies, and jobs are created, both which stimulate economies. Many governments see BOT as a great economic benefit since its project-revenue payment form makes many large projects more acceptable to cautious tax payers.

The main risk for owners is to be sure they don't "give away the store" with the BOT agreement. A BOT deal is only good for an owner if it produces a project that otherwise is unfeasible, or if it produces that project (including operation) more efficiently than the owner could.

As the use of BOT matures, governments must fine-tune the guarantee system to solidify many potential projects in unstable developing countries. Once, and if, this happens, huge new areas of development will be opened up.
5

Contract Types

5.1 Overview

5.1.1 General

The contract, as defined in this thesis, is the agreement of how the owner will pay the contractor for work performed. This chapter expands on the two main groups of contracts discussed in the last chapter - a fixed price, such as a lump-sum, unit prices, or a cap; and reimbursable, such as cost-plus or a fixed fee. An important and common hybrid between the two is called a guaranteed maximum price, which reimburses the contractor only up to a certain point, then makes the contractor liable for any costs over that amount. All of the variations will be discussed in this chapter, and specific recommendations made.

A fixed price contract sets a certain price for the work, normally before it is started. Any costs over that amount are absorbed by the contractor. If costs are under that amount, the contractor keeps the savings. In a reimbursable contract the contractor is reimbursed for all expenses for
material, labor, and other direct costs, and paid a fee that includes overhead and profit. There are two levels of reimbursable contracts - in one type the contractor is reimbursed for actual wages and material costs, in the other type they are reimbursed for labor and materials that are competitively bid as subcontracts.

The decision by an owner of what type of contract to use should revolve around risk allocation. There are many risks involved in construction, however, the risk we are most concerned with when choosing the contract type is financial risk, the risk of cost overruns. Optimizing the cost of a project will depend on properly assessing the risks, allocating the risks, and ensuring that each party properly manages the risks allocated to them.

5.1.2 Assessing the Risk

The owner must carefully look at the proposed project and assess the following characteristics:

1. Complexity of the project. The more complex the project, the harder it will be to predetermine an accurate fixed price, and the more important teamwork will be during design and construction.

2. Completeness and/or adequacy of the documents. Complete documents allow for formulation of accurate fixed prices, with less contingency, where incomplete
documents with fixed prices invite contingencies and disputes.

3. Likelihood of changes from indecision, external issues, or unknown site conditions. Changes in a fixed price are usually difficult, while changes in a reimbursable contract are easier.

4. Priority of cost, time, and quality. A high priority on time or quality can lead to a reimbursable contract, while price priority can lead to a fixed price.

At the same time the owner is assessing the project's characteristics, they must also look internally at their own ability to handle the different demands of the various contract types. For example, a cost-plus contract with a percentage fee requires a very knowledgeable owner to audit the process and guard against waste.

The owner must be careful, however, to not use an inappropriate contract type simply to match their capabilities to the project characteristics. If the two are not compatible, the owner should either alter their capabilities, such as temporarily hiring project managers, or alter the project characteristics, such as further completing the documents.
5.1.3 Allocating the Risk

The financial risk of the project, how much the project will actually cost, can be shifted all to the owner or all to the contractor, in an extreme case, or a more desirable combination of the two.

"A balancing of the risk should be sought between the owner and his contractor or designer in order to utilize the incentive value of bearing risk while minimizing a contingency charged for accepting the risk"

(Levitt, Ashley, and Logcher 1980)

This is an important but often overlooked concept. Many owners put as much financial risk as possible on the contractor, as in a fixed price contract, as an incentive for productivity. What they do not take into consideration is that some risks may be less expensively borne by the owner.

A company's ability to efficiently handle risk is based on their power to control the risk, their possible reward for controlling the risk, and their financial position to assume risk. These principles can best be explained by a construction example. Assume a contractor is being hired to construct an urban office building. Because of the existing building and time constraints, limited geotechnical
information is available. It is unclear if the foundation will bear on natural ground, structured fill, or piles, and if piles are used, what length they will have to be. The owner's assessment of the project determines a relatively simple foundation is needed from the bearing level up, and that complete documents have been done, excluding the bearing issue. If the entire foundation is contracted for a lump sum, the contractor will likely put in a large contingency for the unknown cost of creating a bearing surface for the foundation. Most contractors are not well capitalized, and thus are risk averse. In this case, they also have little control over what they may find under the building, only control over how efficiently the required work will be done.

Instead of requiring the contractor to make an educated guess of the eventual bearing requirements, and paying them a conservative contingency to take the risk, the owner could assume some of the risk. The actual concrete foundation and the main excavation that are defined could be contracted for a lump sum. The owner could then request a unit price proposal for the other two possibilities, piles and structural fill, thus giving the contractor the incentive to maximize labor productivity while the owner maintains the risk of what the total cost will be. The owner will end up paying exactly what the work costs, with no contingency.
5.1.4 Managing the Risk

Once the owner and contractor have agreed what risk each will bear, and established the contract, they both must prepare to manage that risk to minimize cost liability. For example, if the owner feels comfortable contracting on a cost-plus basis, they must set up a knowledgeable organization to carefully monitor and audit the project. Each expenditure by the contractor must meet pre-established tests of need and auditability (The Business Roundtable 1982). In other words, the items must prove warranted and be able to be accurately measured for payment, before they are approved.

Labor productivity is the hardest risk to control, and, if at all possible, should be the responsibility of the contractor, since they are best able to directly control it. This is automatically done with fixed price contracts, and can be done on reimbursable contracts by requiring bidding of sub-contracts.

Incentives built into contracts to motivate the contractor can play a very important part in productivity. While they are beyond the scope of this thesis, the reader is encouraged to investigate the many incentive programs being used, their applicability to various projects, and their effectiveness.
The remainder of this chapter describes the most common variations of contracts, and outlines their advantages and disadvantages.

5.2 Lump Sum Contracts

5.2.1 Definition

In a lump sum contract, the contractor agrees to perform the stipulated work for a fixed sum of money (Clough 1981, 27). The lump-sum commonly includes all labor, materials, project overhead, company overhead, and profit. The sum can be determined by competitive bidding or negotiation.

A lump sum contract is normally used on projects that are relatively simple, have been completely designed and defined, are unlikely to change, and do not require a fastrack schedule.

5.2.2 Advantages of Lump Sum Contracts

1. Competitive bidding can be used, resulting in a low price.

2. The owner does not have to monitor and approve each expenditure.
3. The total cost is known at the start of construction, and the risk of completing the work for that cost rests with the contractor.

5.2.3 Disadvantages of Lump Sum Contracts

1. The contractor may include a large contingency to cover the risk of completing the job for the agreed-to sum.

2. Changes, after the contract has been signed, are often expensive and difficult for the owner. This is especially a problem if the documents are insufficient, and claims result.

3. The contractor may default on the contract if a major error was made in the bid, causing delays and expense for the owner.

4. The documents must be complete before the price is agreed to, eliminating both a fastrack schedule and pre-construction advice from the contractor.

5.3 Unit Price Contracts

5.3.1 Definition

In a unit price contract, the contractor agrees to be paid a set cost per unit of each item, such as per-cubic-yard of excavation. The actual amount paid is based on the actual measured units constructed on the project, times the unit
price agreed to. The unit cost for each item commonly includes all labor, materials, project overhead, company overhead, and profit. Sometimes overhead items are paid as separate items. The unit prices can be established either through competitive bidding or negotiation.

A controversial unit price bidding practice exists called unbalancing bids. Unbalancing a unit price bid means that some items are intentionally bid at more or less than actual value. Unit price bids may be unbalanced for two reasons—to take advantage of presumed quantity errors by the owner, or to get a disproportionate amount of the money earlier to increase the present value of the project and cover early project costs. Quantity errors could be capitalized, for example, by overpricing an item that has been underestimated by the owner, or underpricing an item that has been overestimated, thus reducing the overall bid. Payment can be obtained early by overpricing tasks done early and underpricing later ones, thus not affecting the overall bid.

Owners can protect themselves by preparing sufficient quantity estimates, by allowing separate payment for early items such as mobilization, and by carefully reviewing all proposed unit prices.
Unit prices are used on relatively simple items, such as piles or excavation, where only approximate quantities are known but the work involved is well defined.

5.3.2 Advantages of Unit Price Contracts

1. Competitive bidding can be used, resulting in lower prices.
2. The owner only has to measure the quantity to determine payment.
3. Some flexibility in making changes exists, within the limits of the contract.
4. An approximate total price is known before the start of construction.

5.3.3 Disadvantages of Unit Price Contracts

1. The owner must carefully measure quantities on site.
2. Unbalancing of bids may cause some expense to the owner from disproportionate cash flows.
3. The documents must be complete before the price is agreed to, eliminating both a fastrack schedule and pre-construction advice from the contractor.

5.4 Cost-Plus Contracts

5.4.1 Definition
In a cost-plus contract, the purist form of reimbursable contracts, the contractor is reimbursed the cost of doing the work, including labor, materials, and project overhead, plus a fee, including company overhead and profit. The fee can be a fixed sum, a percentage of the cost, or a formula incorporating both. A fixed fee will be discussed in Section 5.7.

The merits of a reimbursable contract are controversial. Many owners are scared of this type of contract, and view it as a potential "run away train". Their concerns are not totally unwarranted. Some of the common concerns for owners are (Fellow and Butler, ASCE):

1. The cost of the project is not guaranteed before construction
2. There is small incentive for the contractor to put his best, most productive people on the job
3. There may be a natural tendency for the owner to make changes
4. More and higher quality involvement by the owner will be necessary
5. There is a tendency for the contractor's personnel to drag out the job
6. The potential exists that the procurement agent will not obtain the best prices
7. The contractor could charge exorbitant fees for equipment, tools, and the home office personnel
8. The owner's and contractor's cost control systems are not as effective as they need to be for this type of contract.

The good side of a cost plus contract is the great flexibility it provides the owner for such things as fastracking, changes, and pre-construction advice from the contractor; and since the owner has assumed all the financial risks, the contractor will not charge a contingency. Also the costly claims process is eliminated.

Cost-plus is often used for emergency repairs, when urgency prohibits complete design or a formal bidding process.

The keys to successful use of a cost-plus contract are sophisticated, tough project management by the owner, and an honest, reputable contractor with whom the owner's team can work well. The owner must constantly monitor the project and be involved in all procurement. Development of strong teamwork is essential. Often the subcontracts are competitively bid, which reduces the owner's risks of poor productivity and excessive charges. Cost-plus is only recommended in emergencies, when an owner has full confidence they can control costs, or when cost is not important.

5.4.2 Advantages of Cost-Plus Contracts

1. A fastrack schedule can be used
2. Pre-construction advice from the contractor is available

3. Changes by the owner are easily accommodated

4. Teamwork can replace the adversarial relationship often found in a lump-sum contract

5. If properly managed by a sophisticated owner, cost can be reduced by the elimination of contingencies, claims, and the bidding process

5.4.3 Disadvantages of Cost-Plus Contracts

1. The total cost is not known before the start of construction which can cause financing and other problems

2. The owner must be sophisticated and heavily involved to guard against overcharging, dragging out, and uncompetitive purchasing

3. Competition may by reduced by the elimination of lump sum bidding; this can be mitigated by bidding sub-contracts

5.5 Guaranteed Maximum Price Contracts (GMP)

5.5.1 Definition

In a guaranteed maximum price, the contractor is reimbursed the cost of doing the work, including labor, materials, and project overhead, plus a fee, including company overhead and
profit, up to a prearranged maximum price. Once that price is reached, the contractor must finish the job at no additional cost to the owner. If the job is finished under the maximum price, there is often a sharing of the cost difference between the owner and the contractor as an incentive to the contractor to reduce costs.

This is an important and common hybrid between the rigidity of a fixed price contract and the open-ended nature of a reimbursable contract. It provides the owner with the flexibility of a reimbursable contract but puts a ceiling on the total price. It has the potential of making the contractor a team player without giving them carte blanche (Macomber 1989). This contract type will also allow an owner to more easily obtain financing than the open ended forms of reimbursable contracts, such as cost-plus or fixed fee.

A main concern for many owners is how to establish the guaranteed maximum price. It is often set by negotiation, with the owner working from an independent estimate. However, the GMP is sometimes not set until after the project is started, further reducing the owner's negotiating position. The GMP can be established by competitive proposals, but this diminishes the advantages of a GMP over a lump-sum bid. The GMP normally will be higher than a competitively awarded lump sum since the contractor's profit is capped, and because it is normally established from
incomplete documents (sixty percent documents are common), which creates a contingency.

5.5.2 Advantages of Guaranteed Maximum Price Contracts

1. The maximum price is known at the start of construction
2. A fasttrack schedule can be used
3. Pre-construction advice from the contractor is available
4. Changes by the owner are easily accommodated, as long as they do not alter the scope
5. Teamwork can replace the adversarial relationship often found in a lump-sum contract
6. If properly managed by a sophisticated owner, cost can be reduced by the elimination of contingencies, claims, and the bidding processes

5.5.3 Disadvantages of Guaranteed Maximum Price Contracts

1. The owner must be sophisticated and heavily involved to guard against overcharging, dragging out, and uncompetitive purchasing
2. Competition may be reduced by the elimination of lump-sum bidding; this can be mitigated by bidding sub-contracts
3. It may be difficult to establish a reasonable GMP
5.6 Fixed Fee Contracts

5.6.1 Definition

In a fixed fee contract, the contractor is paid a lump sum fee, including company overhead and profit, but is reimbursed for labor, materials, and project overhead. In this common variation of a reimbursable contract the owner has the flexibility of a cost-plus contract without giving the contractor an incentive to increase costs. The reimbursable costs are sometimes paid directly by the owner, such as in a CM arrangement.

5.6.2 Advantages of a Fixed Fee Contract

1. A fastrack schedule can be used
2. Pre-construction advice from the contractor is available
3. Changes by the owner are easily accommodated, as long as the scope is not dramatically altered
4. Teamwork can replace the adversarial relationship often found in a lump-sum contract
5. If properly managed by a sophisticated owner, cost can be reduced by the elimination of contingencies, claims, and the bidding process
6. The contractor's overhead and profit is fixed, reducing incentives to increase the cost of the
project and removing risk and uncertainty for both parties

5.6.3 Disadvantages of Fixed Fee Contracts

1. The total cost is not known before the start of construction, which can cause financing and other problems

2. The owner must be sophisticated and heavily involved to guard against overcharging, dragging out, and uncompetitive purchasing (the fixed fee, however, provides more contractor assistance in these matters than a pure cost-plus contract, since the contractor has no incentive to overcharge, and a financial incentive to finish as soon as possible, because their fee is fixed)

5.7 Build-Operate-Transfer Contracts

All build-operate-transfer contracts are unique to the specific project, and cannot be generically explained here. Their main financial features are:

- The length of the contractor's operation period
- What parameters will be placed on operation charges to the end users
- What guarantees the owner will provide
- What are the terms of the transfer, such as condition of the facility and any payment
See Section 4.7 for a detailed description of the build-operate-transfer process.

5.8 Contract Types - Conclusion

An owner must choose a contract that most efficiently allocates the financial risk of the project, and then properly manage the risk they assume. Pushing all the risk to a contractor with a lump-sum contract is only recommended if the project is very well defined. The other extreme, a pure cost-plus contract, is almost never recommended except for emergencies, when the owner is confident of their ability to control costs, or when price does not matter.

The common alternative - a guaranteed maximum price - can be very useful as a reimbursable contract with an upper limit, but is false security if the GMP is unrealistic. If it is too low, lump-sum adversarial relations may develop. If it is too high, the owner is not guaranteed a reasonable price.
6

Award Method

6.1 Overview

Choosing the appropriate contract award method is the final step for the owner. The award method, as defined in this thesis, is the method used to select the contractor and/or the price, such as competitive bidding or negotiation. The price can be the total price or just the contractor's fee, depending on the contract type. The award method is very important because of the "one-off" or unique nature of most construction projects, i.e. there is no list price for what a project should cost (Slatter, London). The owner must use market forces and expertise to obtain the desired value at the most reasonable price.

The two extremes of award methods are lump-sum competitive bidding (open to anyone), and single-source negotiation, with many variations in between. The most common variations are bidding with pre-qualification of contractors, multiple-parameter bidding, and competitive negotiations - all will be explained later.
For many owners, especially public agencies, bidding is seen as an efficient way to reach the market price, and eliminate the possibility of favoritism and corruption. Price is often the only factor in this commodity perspective of construction. In this process, the project is carefully specified so the bidders can propose comparable prices for the same product. Some problems can arise, however, if an incapable contractor is chosen who either can't perform the work, or does not work well on the owner's team; or if the project is too complex or dynamic to be clearly specified. These problems can be further exacerbated by the low margins that are forced on contractors by the bidding process. An adversarial relationship may result.

Negotiating a contract can produce a better relationship, but, if only one company is involved, it is very difficult to determine the market price for the work. The owner may get the contractor and relationship they want, but might pay too much for the project.

At issue here are the different perceptions of construction services as either a commodity or a service. In reality, construction involves both. Many parts of a project, such as materials and some labor, are commodities available on the open market; while some attributes offered by the contractor, such as technical expertise and management abilities, are of value as services, and are less able to be
bought on a price-only basis. When awarding a contract, many owners try to attach a value to intangible services such as cooperation, responsiveness, and sophistication of the contractor, and consider that in proposals. A key to successful award methods is isolating the two types of products - commodities and services - and awarding each in an appropriate way - commodities should be awarded with bidding, and services should be awarded with multi-parameter bidding or negotiation. A given project may actually have many different award methods nested within it. Most subcontracts are awarded with some sort of bidding, while the overall organization could be picked by any of the award methods.

One important point is that sophisticated contractor services are valuable to the owner only if they need them. A simple house project, for example, that requires few contractor services, is completely designed, and carefully monitored, is a commodity (provided a pool of qualified home builders are available).

When the project is less definable and/or professional services are needed, such as in many design-build projects, alterations may have to be made to the bidding process that add other parameters. These others parameters, as will be described, allow the owner to consider such things as schedule, contractor’s qualifications, contractor's work
load, and contractor's reputation, in addition to just the price.

This chapter describes the most popular multiple parameter bidding alternatives, but as the reader can imagine, there are many more possible combinations of characteristics and ranking formulas to evaluate proposals.

While it is beyond the scope of this thesis, the reader should be aware of the many restrictions placed on award methods by various government agencies. These include such things as minority and small business hiring quotas, a minimum percentage of work that must by done by the contractor's own forces, prevailing wage rules, and local resident hiring quotas. These can overrule an otherwise logical selection of an award method.

6.2 Competitive Bidding

6.2.1 Definition

In the pure competitive bidding award method a contractor is selected in market competition, by the lowest price proposal. In this form, price is the only consideration. For fixed price bidding, the owner or design professional creates complete bidding documents, including plans, specifications, and contract details that are issued to
interested contractors. Fixed price bids are submitted and compared, all based on identical requirements. If the bids are only to establish the fee, a scope of work and project details are issued and fixed-fee proposals are submitted.

Competitive bidding is popular as a way to take advantage of market forces, and to eliminate favoritism and corruption. Some dispute the effectiveness of the second assumption, pointing to events such as the 1979 Justice Department probe of bidding on public projects that landed one-hundred and sixty contractors in jail for bid rigging (Bid Rigging, ASCE). However, on average, most agree that bidding is an effective, unbiased method of choosing a contractor.

Studies have shown that an increase in the number of bidders on a project reduces the margin that most contractors will place on a bid (Carr 1983). An owner should be cautioned, however, about having too many bidders participate, in an attempt to save money. This can scare away solid contractors who are unwilling to shave their margin to a highly risky level, and can result in an unrealistically low bid that may eventually cause major problems and default.

One common way to reduce the number of bidders to a manageable number, and to ensure the owner of getting an acceptable contractor, is the process of contractor pre-qualification. This process has many forms, but it basically
evaluates the experience, capabilities (financial, physical, and technical), workload, and track record of contractors, and only allows qualified firms to bid. This both ensures the owner of a qualified contractor and saves an unacceptable contractor from wasted bidding expense. Quantifying these characteristics and including them in the bidding evaluation process is called multi-parameter bidding, and will be covered later in this section.

Bidding is a very expensive process for both the owner and the contractor. The owner must make "bullet proof" documents to avoid future claims, and the contractor must prepare detailed cost estimates for bids, of which many are unsuccessful. Owners must not abuse the contractor's need for work by frivolously requesting bids simply to keep another contractor "honest", or to help the owner estimate the market cost of a project, without intentions of awarding the project. These practices will make it difficult for that owner to get reasonable bids in the future, and raise the overhead cost of construction for everyone. An alternative method of determining the market cost of a project is to hire a trusted contractor to estimate it.

When using competitive bidding to select a contractor, the owner must realize that they are going to get a no-frills contractor who will do only what is clearly specified in the documents. When a contractor structures their company to be
a low-cost competitive bidder, they must eliminate any waste and frills that are not specifically helpful in obtaining work, and completing the work within the budget.

A common complaint about bidding is that it stifles innovation and research in the industry because contractors cannot afford to invest in it, and are not rewarded for innovation unless it results in immediate cost savings.

6.2.2 Advantages of Competitive Bidding

1. The method produces market competition to establish the price

2. The owner knows the total cost or fee at the start

3. The method helps to eliminate favoritism and corruption, and allows many contractors to participate

6.2.3 Disadvantages of Competitive Bidding

1. In its pure form, with price as the only judging criteria, bidding can occasionally result in an incapable or undesirable contractor

2. The owner must produce complete bidding documents in order to avoid claims for changes of work, which eliminates fastracking, is expensive, and time consuming

3. An adversarial relationship may result from the zero-sum-game and low-markup nature of bidding
6.3 A Cap

6.3.1 Definition

The cap method is a variation of a competitive bid. In this process, a fixed price is set by the owner, and contractors propose a level of quality and options for a project against that fixed price. The owner establishes a base building design and a list of options and quality upgrades in their order of preference. The contractors propose a total project, including the base building and as many options and upgrades as possible, all for the owner's established "cap" price. This is, in effect, bidding the building for a set price, as opposed to the normal method of a price for a set building. After the contract is awarded, it is identical to a competitively bid lump-sum.

6.3.2 Advantages of the Cap Method

1. The method produces market competition to establish the most value for the project for the fixed price
2. The owner sets, and knows, the total cost at the start
3. The method helps to eliminate favoritism and corruption, and allows many contractors to participate
6.3.3 Disadvantages of the Cap Method

1. In its pure form, with price ultimately the only judging criteria, a cap can occasionally result in an incapable or undesirable contractor

2. The owner must produce complete bidding documents in order to avoid claims for changes of work, which eliminates fastracking, is expensive, and time consuming

3. An adversarial relationship may result from the zero-sum-game and low-markup nature of bidding

6.4 Negotiation

6.4.1 Definition

In a negotiated award process, the price and/or contractor are selected by negotiation between the owner and either several contractors or one contractor. The negotiation can include other important variables such as schedule. It is assumed that the qualifications of the contractor are acceptable since they were selected to negotiate.

If only one contractor is selected for negotiation, in a non-competitive process, they and the owner work to reach a price or fee. The owner is normally working off an independent estimate of the price, or industry standards for a fee. If several firms are selected for competitive
negotiation, each firm is asked to submit a price or fee, and often a schedule. The owner then negotiates back and forth among the competitors to realize the best price, schedule, and contractor combination. The exact methods of how the negotiation is conducted can not be easily summarized here, since negotiation is more an art than a science.

An important aspect of negotiating a construction contract is the opportunity to discover ways to create value for both parties through such exercises as a constructibility analysis and value engineering. This can advantage both parties much more than just a head to head, zero-sum-game, price negotiation. Often, while difficult to measure, the innovation of a contractor in reducing construction costs can offset the reduction in competitive forces.

Negotiation is seen by owners as appropriate if (1) no competition exists for the contractor, (2) urgent requirements prohibit bidding, (3) other considerations, such as qualifications or public policy outweigh the need to bid, or (4) the opportunity exists to substantially improve the project value through interaction (U.S.A.F Univ. 1985).

6.4.2 Advantages of Negotiation

1. The owner is able to pick the contractor of their choice
2. A less adversarial relationship is likely, as a result of the two-way negotiation, the possibility of future negotiated work with the owner, and the normally higher margins

3. Constructibility, value engineering, and other value-creating advice can be given by the contractor during the negotiation, and points of confusion can also be resolved, thus reducing any contingency

4. Time and money can be saved by elimination of a formal bidding process

6.4.3 Disadvantages of Negotiation

1. The owner has fewer competitive forces working for them to drive down the price and establish the market value of the work; the negotiation skills of the owner are very important

2. Some public owners may not be able to use the method because it may be seen as encouraging favoritism and/or corruption

6.5 Qualification and Price Bidding

6.5.1 Definition

In the qualification and price proposal type of multiple-parameter bid method, the contractor is competitively selected based on qualifications and price. The process is
often quantified with a ranking formula. Multiple parameter bids are different than negotiations in that a fixed bid and qualifications are evaluated together as the bid. This can allow public and private owners to credibly select a uniquely qualified contractor who may not have the lowest bid.

The weight of the qualifications may be calculated in a formula, as normally required for public agencies; or less formally considered, as done by many private owners - i.e. they may accept a higher bid from a more qualified contractor, but do not have an exact formula for determining the selection.

An example of how this can work is the awarding of a contract for a tunnel in Baltimore to the highest of three bidders, because they possessed extensive tunnel experience of a similar nature. A formula was established that put more weight on experience than price (ENR: 4/6/78).

The qualifications category can include a combination of factors, such as experience, capability (physical, financial, and technical), workload, and track record. This method obviously is most valuable when the project is such that it requires some special qualifications.

6.5.2 Advantages of Qualification and Price Bidding
1. The owner is able to consider both the price, as established by the competitive forces, and the qualification of the contractor; this should produce an acceptable contractor at a reasonable price.

2. The owner knows the total cost or fee at the start.

3. The method helps to eliminate favoritism and corruption, provided the qualification evaluation process is objective, and can allow many contractors to participate.

6.5.3 Disadvantages of Qualification and Price Bidding

1. The owner must produce complete bidding documents in order to avoid claims for changes of work, which eliminates fastracking, is expensive, and time consuming.

2. An adversarial relationship may result from the zero-sum-game and low markup nature of bidding.

3. The owner must develop a credible method of evaluating the proposals, and spend time doing the evaluation.

6.6 Time and Price Bidding

6.6.1 Definition

In the time and price proposal type of multiple-parameter bid method, the contractor is competitively selected based
on the schedule and price. The schedule can play a part in
the award by being ranked by the owner in an evaluation
formula, such as in the previous section, or by being
quantitatively included in the actual bid.

If the schedule is included in the actual bid, a value-per-
day of the finished project is established by the owner, and
the bids submitted are the summation of the actual
construction bid plus the proposed duration times the value
per day (Herbsman and Ellis 1991). The project is awarded to
the lowest "bid". This encourages a shorter duration
project, thus rewarding an innovative, efficient, low-price
contractor. This method also eliminates liquidated damages
because the owner can simply subtract the daily value from
the amount owed to the contractor.

The weakness of this method is that the owner must have an
accurate way to calculate the per-day value of the finished
project for the method to hold up in court against delay
claims or challenges to the bids.

Another interesting variation of time and price bidding is
where the owner requests a payment schedule with the bids.
The owner then awards the contract to the project with the
lowest present value, not just the lowest bid. This allows
the owner to know the actual lowest total cost, compare
projects of different proposed durations, and encourages the
contractor to reduce project costs by deferring non-critical activities (Selinger 1983). (This last point is debatable since inflation figured into the bid will likely cancel any savings).

6.6.2 Advantages of Time and Price Bidding

1. The owner is able to consider both the construction price, as established by the competitive forces, and the duration of the project in comparing bids; this encourages shorter durations, and rewards innovative, efficient, low-cost contractors

2. The owner knows the total cost or fee, and schedule, at the start

3. The method helps to eliminate favoritism and corruption, and allows many contractors to participate

6.6.3 Disadvantages of Time and Price Bidding

1. The owner must produce complete bidding documents in order to avoid claims for changes of work, which eliminates fasttracking, is expensive, and time consuming

2. An adversarial relationship may result from the zero-sum-game and low-markup nature of bidding

3. The owner must establish a credible per-day value of the finished project if time-price bids are used
6.7 Qualifications, Time, and Price Bidding

6.7.1 Definition

In the qualifications, time, and price proposal type of multiple-parameter bid method, the contractor is competitively selected based on their qualifications, proposed schedule, and price. As described in the last several sections, a formula is normally set up by the owner to quantify the three characteristics to allow an objective comparison of firms, schedules, and bids. Each variable in the formula is weighted to reflect the importance of that characteristic to the particular project.

6.7.2 Advantages of Qualifications, Time, and Price Bidding

1. The owner is able to consider the price, as established by the competitive forces, the proposed schedule, and the qualification of the contractor; this should produce an acceptable contractor and a reasonable balance between the schedule and price - the owner is able to weight the formula representative of their priorities

2. The owner knows the total cost or fee, and schedule, at the start

3. The method helps to eliminate favoritism and corruption, provided the qualification evaluation
process is objective, and can allow many contractors to participate

6.7.3 Disadvantages of Qualification and Price Bidding

1. The owner must produce complete bidding documents in order to avoid claims for changes of work, which eliminates fastracking, is expensive, and time consuming.

2. An adversarial relationship may result from the zero-sum-game and low-markup nature of bidding.

3. The owner must develop a credible method of evaluating the proposals, and spend time doing the evaluation.

6.8 Design and Price Bidding

6.8.1 Definition

In the design and price proposal type of multiple parameter bid method, the contractor is competitively selected based on their proposed design and price. This can be used for design-build, turnkey, and build-operate-transfer projects. The owner either establishes a formula to evaluate a proposed design and the price, weighted to reflect their priorities, or considers them less formally.
This requires the most difficult type of bid evaluation, since designs are not easily reduced to numeric ranking formulas that will stand up to challenges from other bidders. The owner, especially if it is a public agency, must take great pains to ensure an equitable evaluation process.

6.8.2 Advantages of Design and Price Bidding

1. The owner is able to consider both the price, as established by the competitive forces, and the proposed design; this should produce a desirable design and competitive price

2. The owner knows the total cost or fee at the start

3. The method helps to eliminate favoritism and corruption, provided the qualification evaluation process is objective, and can allow many contractors to participate

6.8.3 Disadvantages of Design and Price Bidding

1. The owner must produce a detailed request for proposals in order to avoid claims for changes of work, which is expensive and time consuming.

2. An adversarial relationship may result from the zero-sum-game and low markup nature of bidding

3. The owner must develop a credible method of evaluating the proposals, and spend time doing the evaluation
6.9 Award Methods - Conclusion

The unique nature of almost every construction project does not allow the owner to know an established market price for the project. Competitive market forces must be introduced through the award method to establish an efficient price for the owner. This is relatively easy when the entire project is a standard, well-defined commodity allowing competitive bidding between qualified contractors.

If the project is not defined or if the owner desires to include other parameters in the selection process, they must use multi-parameter bidding or negotiation. These methods allow owners to attach a value to the services and superior abilities of certain contractors, when they are needed. The difficult part is to attach the proper value to these characteristics.

The owner must decide what parts of a project are commodities and what, if any, are services, and award the parts accordingly. In modern construction, most subcontracts and materials are bid, regardless of the method used to select the overall contractor.
7

Compatibility of Methods to Projects and Owners

7.1 Overview

For each construction project undertaken, the owner must create a contracting method, which defines the scope of the project, the organization type used, the contract type, and the award method. The preceding chapters have defined the variations of each of the four components, and stated their relative advantages and disadvantages. This chapter will present a logical process for choosing an appropriate method based on the project and the owner's characteristics.

As mentioned in chapter one, choosing a contracting method is far from an exact science. There is no formula into which you plug project and owner variables to produce a contracting method. In many cases, there is not one single best method, but several that are appropriate. The selection process often takes a "process of elimination" approach, paring away obviously inappropriate methods until reasonable alternatives remain. (The analogy is made to choosing a golf club for a given shot - you know which are not appropriate, but several will work, one of which may be the best.) The
inexactness of the selection is complicated by the unique nature of each project, and the intangible nature of many of the judgement criteria, as described in the previous chapters. For example, a project viewed as large and complex by one owner may be insignificantly small to another. Obviously, the best resources for choosing methods is knowledge, experience and sound advice.

Before an owner can begin to choose a contracting method, they must gain an initial understanding of the project, such as a very rough cost range, schedule, and design parameters. A consultant may be needed to help the owner formulate this information in a programing and scoping exercise. This is not as much preliminary design as it is simply trying to put a finger on roughly what the project might involve.

Central to the selection process is choosing an appropriate organization and general contract-type combination, such as a general contractor working for a fixed price. This choice, in essence, determines the scope, organization, and contract-type (contract-types are defined as fixed or reimbursable - actual contract selection is discussed later), three of our four components. Once the organization and contract-type are chosen, the owner must fine-tune which specific contract is most appropriate, and decide which award method should be used, using the risk allocation and
commodity vs. service discussions, as presented in chapters five and six.

7.2 Organization and Contract Selection

7.2.1 General

The organizational selection process starts by eliminating types that obviously do not meet the needs of the project and the owner. Three types of characteristics, or drivers, must be assessed by the owner, and then used to eliminate inappropriate methods. These include project drivers, owner drivers, and market drivers (also see Minden 1986 for a similar list). As discussed in chapter one, the six organization types are further divided into general contract groups of fixed price or reimbursable price where appropriate, since evaluating each as a whole was found to be of little value.

7.2.2 Project Drivers

The project drivers to be assessed have been broken down as follows:

1. **Time Constraints:** The owner must decide if the project should be conducted over a normal, sequential schedule, or if a fastrack schedule is needed. This decision involves financial analysis of the possible cost of
fastracking vs the value of early completion, as well as the technical and regulatory feasibility of fastracking.

2. **Flexibility Needs:** The owner must decide how much flexibility for changes they are likely to need during the construction process. The need for changes stems from two sources - strategy and definabillity. If the owner is not the end user of the project they may have a strategy of allowing changes during construction, such as in a residential development, where buyers of condominiums are often allowed to customize the units as they are being built, thus requiring flexibility in the construction process.

   The ability of the owner and designer to define the project before construction is a function of its complexity, size, and the finality of the owner's design decisions. Many projects are too large or complex to be completely designed ahead of time, thus requiring flexibility in the process. Some owners are unable to make pre-construction documents final because of indecisiveness, permit requirements, and market fluctuations.

3. **Pre-construction Service Needs:** The owner must decide the value to the project of pre-construction services from the contractor. Depending on the complexity and
uniqueness of a project, pre-construction services can be more or less valuable. The owner must assess how important cost estimates, constructibility advice, and value engineering are to the project. Most owners have found that these services are almost always valuable, and strive to attain them when possible.

4. **Design Process Interaction:** The owner must assess how much interaction they want to have with the designers during the design of the project. This interaction is normally important to owners if the design is intended to be highly creative, the appearance is critical, and/or its ability to serve a function is essential.

With an independent designer, as used with a general contractor, a CM, or multiple primes, the owner has complete interaction and control over the design. With fixed price design-build, turnkey, and BOT contracts, where the design is included, owners have less control over the detail design. This may be unsatisfactory for an owner who, for example, wants to be very involved in a creative architectural design.

5. **Financial Constraints:** The owner must decide if the project can be more efficiently financed, either for the short term or long term, by the owner or contractor.
Once these drivers have been assessed, the owner can use the following summary chart to eliminate inappropriate methods, as a first "filter". Organizations are simply grouped into fixed or reimbursable price contracts. An owner must identify the rows that reflect the drivers (needs) of the project. Any organization that meets all of the required drivers could potentially be used, pending further analysis.

Obviously, if no organization satisfies the project drivers, a conflict of needs exists, and must be identified and modified by the owner.
<table>
<thead>
<tr>
<th>DRIVERS</th>
<th>GC-FP</th>
<th>GC-R</th>
<th>CM</th>
<th>MP</th>
<th>DB-FP</th>
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<td>Sequential Schedule</td>
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<td>No Pre-Con Adv Needed</td>
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<td>Design Interaction</td>
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Note: An organization is designated ("X") if it is able to satisfy the corresponding driver, however this results in some having both the positive and the negative driver marked. An obvious example of this is that a project that could accommodate a fastrack schedule could also use a sequential schedule.

Legend

GC = General Contractor     DB = Design-Build Team     FP = Fixed Price
CM = Construction Manager   T = Turnkey Team         R = Reimbursable Price
MP = Multiple Prime Contractors  BOT = Build-Operate-Transfer Team
7.2.3 Owner Drivers

The owner drivers can be used to further narrow the number of appropriate methods, if more than one is identified by the project drivers, and to also help with the contract and award selections. The owner drivers are more intangible than the project drivers and depend on more judgement by the owner. The owner drivers are as follows:

1. Construction Sophistication: How much does the owner know about construction, and how much advice will they need? If the owner is unsophisticated about construction, they are going to need someone, in a fiduciary relationship, such as an independent designer or a construction manager, to advise them. A graphical representation of the relative sophistication required by the owner is shown below.
2. **Current Capabilities:** How much staff can the owner commit to monitor the project? Staff can be assigned at three levels, each requiring increased involvement—administrative decisions, contractor monitoring, and on-site management. Different contracting methods will require different levels of involvement. This current capabilities assessment should also include any additional staff an owner may be willing to employ for the project. A graphical representation of the relative involvement required is shown below.

![Graphical Representation](image)

3. **Risk Aversion:** The amount of risk the owner is willing to bear is important in figuring the risk allotment to determine the contract type. The owner must establish an acceptable level of risk. A graphical representation of the relative financial risks is shown below.
Notes: 1. CM is assumed to be pure form i.e. no GMP
2. GC, DB, T, and BOT are all assumed to be fixed price

4. Restrictions on Methods: These could be things such as laws requiring public owners to bid all projects, or state laws against private owners using design-build.

5. Other External Factors: These are other issues, external to the project, that guide the owner in choosing a method; such as choosing a particular contractor for strategic or political reasons.

Once these drivers have been assessed, the owner must compare them to the characteristics of the remaining potential organizations to choose a good match with the drivers. Restrictions on the methods and other external factors should be considered first, and may dominate the
selection. If not, sophistication, capabilities, and risk aversion are all important.

An example of matching the current capabilities to an appropriate method is an owner with ample sophisticated staff may be advantaged by taking on many multiple prime contractors and acting as the CM, providing on-site management; while an owner with less available staff for the same project may be more interested in using a construction manager, leaving the owner with only administrative decisions. It is also important to remember that the current capabilities and sophistication are related, in that available staff is useful only if they know something about construction.

The risk aversion of the owners, and its use in efficiently allocating the risk, was discussed in detail in Chapter five. This discussion should be used to help the owner when choosing a contract.

7.2.4 Market Drivers

Market drivers allow the owner to understand the business environment in which the project is to be awarded, thus helping them to further define the appropriate organization and award method. They can also be used to determine how to most efficiently package the project, and when, if
necessary, is the best time to bid. The market drivers are as follows:

1. **Current State of the Market:** The owner must decide how competitive the market is at the time. This can affect how and when to best bid portions of the project, if bidding is used.

2. **Package Size of the Project:** The owner must decide how to package the project to maximize efficiency and gain the most from market competition. The owner must determine if the project is too large or too small to attract adequate competition for the given market. If necessary, small projects can be combined with others, and large projects can be broken down into smaller packages. Putting the project in an imperfect market will inflate the price above the theoretical market price.

3. **Availability of Appropriate Contractors:** The owner must be sure that appropriate contractors are available to work in the location of the project. For example, a design-build project will not work well in an area where very few contractors practice design-build and others are reluctant to enter the area.

All three of these drivers are based on judgement and experience of the owner and their consultants. No exact answers exist, but an owner should be able to get a general
feel for the market, and adjust the contract accordingly, even by a rather simple investigation of the market.

7.3 Award Method Selection

The award method should be picked based on which portions of the project can be treated as commodities and which as services, as discussed in Chapter Six. Once the award method is chosen, the market drivers can be used to indicate how to best package the project and when to bid it, if bidding is used. The availability of appropriate contractors, for example, can eliminate some potential methods and give the owner an indication of competition, even in a good bidding climate.

7.4 Selection of the Contractor and Design Professional

Although this thesis has not examined the selection process for the contractor and design professional, much has been written on the subject, and several cautions are worth including here.

It is important for owners to remember that the different types of contracting methods discussed in this thesis often require certain types of contractors and design professionals. For instance, the corporate culture of a firm and the experience of its staff may be focused on a specific
type of work, such as negotiated design-build, making them inefficient at other methods, such as lump-sum general contracting. And a highly competitive bidding firm, with a low-cost strategy, is not often staffed to deal with the coordination issues of design-build or turnkey.

It is important for an owner to determine that the contractor and design professional chosen for a project have the experience and corporate culture necessary to efficiently execute the proposed contracting method.

7.5 Trends in Contracting Methods

Surveys of owners and contractors show that the use of alternative methods of construction contracting is increasing. In the last decade, various industry organizations have created new documents and guidelines for many of the methods, and owners and contractors continue to gain experience with them.

The most popular alternative methods include construction management, design-build, and build-operate-transfer. Construction management has especially gained new recognition, partly because of its increased use, and partly because many firms who, for years, have offered similar services under the title of a general contractor for are now more accurately being categorized as construction managers.
(This must be separated from firms who simply use the CM label for advertising, but still operate in another form). Owners find that CM provides a professional, flexible contractor as a team player, while still having market competition for the majority of the project costs.

BOT use is increasing in the form of privatization of public infrastructure in developed countries, where economic stability is greater than in the developing countries where BOT was intended for use. Many governments are turning to privatization because they are unable to fund needed projects while maintaining the growing inventory of existing infrastructure, and funding other growing demands, such as social and educational programs. The use of BOT is expected to increase in developing countries if more guarantees are established, especially as a mechanism for many western companies to start doing projects in eastern block countries, as the countries needs become more apparent and relations improve. A new breed of large BOT contractors will develop to handle such large scale endeavors.

Design-build is also gaining acceptance with many owners as more sophisticated controls are developed and understood by many of the owners, and use on different types of projects has evolved. The method is being used more and more on building projects, instead of just on the traditional process plant applications.
An interesting new market for many of the alternative methods is public owners, who are more often allowing their use as they gain greater understanding of how to control the process and make awards more competitive, while still getting the desired outcome.

The use of specific award and contract variations seem to simply follow the fluctuations of the economy to take advantage of more or less competitive markets. Whenever someone makes a broad prediction, such as "bidding is losing popularity" it seems the economy and/or opinions change to disprove the prediction. This is because no contract type or award method is always better - many types are and should be used.

7.6 Future Research Possibilities

This thesis has opened up many areas of potential future research into the contracting process. Some suggestions are:

1. The role of incentive clauses in contracts.
2. An analysis of two very similar projects that were conducted by different contracting methods.
3. A further refinement of the selection process with the addition of quantitative judgement criteria such as dollars, months, acres, stories etc.
4. Development of a computer model for the cost of a project, allowing the owner to try different contracting methods and evaluate the predicted price, schedule, and quality.

5. A study of the political and economic considerations of large privatization projects and a forecast of future markets.

6. A large survey of which methods are used by owners for which types of projects.

7. An analysis of the effect of new computer software such as CAD and MIS on contracting methods.

7.7 Conclusion

This chapter, and thesis, attempt to give some direction to owners struggling with the decision of how to contract for the construction of a proposed project. An owner must first understand the various components of the contracting methods, the characteristics of the proposed project, and their own abilities. It has been shown that some methods are much more appropriate for some projects than others, and that an owner should not pick a method simply because it is convenient or recommended by the contractor. Use of the three groups of drivers, the risk-allocation analysis, and the commodity vs service analysis will guide the owner in choosing the correct method. A careful selection can result in cost savings and a much more harmonious construction.
process. A flow chart of the decision process is shown on the following page.

Owners and contractors are encouraged to investigate the various alternative methods. Many are gaining acceptance throughout the world and can soon open up new markets for owners and contractors experienced in their use. The traditional lump-sum, hard bid general contractor will likely never be eliminated, but it's popularity is starting to be viewed more as a cycle in the industry than the final solution to construction contracting. Owners are finding that other methods are able to supply a similar level of market competition without the rigidity of the traditional method.
Figure 3
Method Selection Flowchart

Identify Project Drivers

Eliminate Any Inappropriate Organizations with Figure 2

Identify Owner Drivers

Use Owner Drivers to Further Eliminate Inappropriate Organizations

Identify Market Drivers

Use Market Drivers to Further Eliminate Inappropriate Organizations

Use Risk Allocation Analysis and Drivers to Choose Contract Type

Use Commodity vs Service Analysis to Choose Contract Award Method

Use Owner’s and Consultant’s Judgement to Create Final Contracting Method from Remaining Alternatives
BIBLIOGRAPHY AND REFERENCES

Books


Articles and Papers in Journals and Periodicals


American City & County. (1987, June). "The Advantages of Multiple Contracting"

American City & County. (1981, June). "Why construction management?"

Architecture. (1986, October). "Design/Build Methods Mature"


Civil Engineering (ASCE). (1985, March). "Bid-Rigging: An Inside Story"


Civil Engineering (ASCE). (1984, June). "Construction Managers and their Liability to Third Parties"


Civil Engineering (ASCE). (1985, August) "Deletion of Work on Unit-Price Contracts"

Civil Engineering (ASCE). (1991, February). "FHWA to Experiment with Creative Bids"

Civil Engineering (ASCE). (1981, May). "Incentive contracts would greatly boost construction industry efficiency"

Civil Engineering (ASCE). (1991, January). "Rethinking the Competitive Bid"

Civil Engineering (ASCE). (1991, June). "Unit Pricing and Unbalancing Bids"

Civil Engineering (London). (1987, January/February). "Inherent danger in fee competition"

Consulting Engineer. (1984, May). "Design-Build Brings a Response"

Consulting Engineer. (1983, November). "Facing the Realities of Competitive Bidding"

Consulting Engineer. (1985, February). "Negotiated Procurement"


Consulting/Specifying Engineer. (1990, Mid-March). "Engineers at the Bar: Design/Build contracts"

Electric World. (1982, December). "Quality can be maintained on lump-sum construction"


Engineering News Record (ENR). (1988, June 30). "Build-operate-transfer may get credit backing"

Engineering News Record (ENR). (1989, June 15). "CM gains favor with owners: Contracts and scope vary, but flexibility remains the key"


Engineering News Record (ENR). (1982, Sept. 2). "Contractors report trend to more lump-sum contracts"

Engineering News Record (ENR). (1979, June 14). "Few pursue design-build, says AIA"

Engineering News Record (ENR). (1991, March 11). "GSA, at least, still has big plans"


Engineering News Record (ENR). (1985, November 7). "Negotiated contracting prompts legislative fight"


Engineering News Record (ENR). (1990, May 24). "Owners warming up to design-construct"


Heating/Piping/Air Conditioning. (1988, March). "How to work with design-build contractors"


Hydrocarbon Processing. (1989, April). "Fast-track contracting can save money and time"


Lund, Philip J. (***). "The Design/Build Alternative"


New England Real Estate Journal. (1989, March 3). "How much control do owners have over the building they create?"


**Reports**


**Theses**
