

I: Project Delivery and Selection

By William A. Kitch

How do major projects actually get designed, created, and delivered to the client or user? How are the designers and the fabricators or builders selected? What is the role of the design professional in this process? In order to answer the last question we must first address the preceding two questions. The way the project delivery is structured defines the playing field on which the design professional will play. The selection process lays down the rules of the game. Without understanding the playing field and the rules of the game, you will be a spectator in the stands rather than a player on the field.

The goal of this article is provide structure and language to describe the different ways projects are delivered and designers and constructors are selected. In truth there are a myriad of methods for both delivery and selection and many different terms used to label the various methods. In this article we will develop a simple but useful model for delivery and selection. We will also build a common language for describing the methods. As you start your professional career, you will run into different models and different terms for project delivery and selection; but if we do a good job in this article, you will have a solid base to understand all the variations and flavors that currently exist in practice.

1.1. Project Phases

Whatever the project, a bridge, a home, a video game console, or a golf course, the project begins with an idea or a need perceived by the user. It is a long road

from the user's first perception of a need, to the delivery of the final project.

Delivering major projects is a process that can take years or even decades. There are many steps in the process and many different persons involved. Nobody ever woke up in the morning and said "Hey, I think I'd like to build a 27,000 square foot warehouse today," and then went and hired a contractor to build the warehouse.

Most users are not design professionals and are therefore not able to determine the best way to meet the need they have identified. The users' initial statement of need is often very simple:

- We need to reduce congestion on the 10 freeway between the 57 and the 605.
- We need a warehouse that will meet our business demands for the next 15 years.
- I want a larger house.

It is not possible to go from identification of a need directly to building a solution unless the need is so simple and common that solutions already exist and can be bought off the shelf. If you have a very simple need such as storage for a lawnmower, then you can buy a prefabricated storage shed and erect it in your backyard. However, for needs even slightly more complex than this, there are several steps between identifying the need and building the solution.

For any significant project it is not possible to go directly from need to solution. What, then, is the first step after identification of a need? Many people would answer design. This may sound like a reasonable

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approach; identify your need, design a solution, and then you're ready to build the solution. However, this is usually a recipe for an expensive solution that doesn't really meet the user's need.

To understand why one cannot jump directly from a need to design, imagine you are an architectural & engineering designer and a user comes to you and says "We need a warehouse that will meet our business demands for the next 15 years." Would you immediately start designing the structure? Would your staff start sizing the beams and columns, designing the façade, and lay out the parking lot? No! And why not? Because you still don't have the input needed to start designing. You don't know how big the warehouse needs to be. You don't know if it needs office space and if so how much. You don't know the user's aesthetic requirements. Will they be happy with a tilt-up structure or do they want something more architecturally pleasing? Do they want to pay for a facility that will last for 75 years or are they happy to use it for 20 years and move on when it needs major repair or refurbishment? How many trucks will need to be loaded at one time? How much parking is needed?

To put it another way, the designer cannot start designing until she has the specific requirements for the design. In this example, the required square footage, amount of truck traffic, material to be stored, aesthetic requirements, and expected life span are all required before design can start. So there is a step between identifying the need and starting design. We will call that step planning.

We can now define the four phases that every project will go through: Planning, Design, Construction, and Use (or Occupancy). Traditionally, in the construction industry these phases have been accomplished in a simple linear process as shown in Figure 1.1a.

1.1.1. Planning

The initial phase of project delivery is the planning phase. The objectives of this phase are to turn the user's identified need into a clearly defined set of requirements, develop a program cost estimate, and identify funding resources.

The first two objectives, requirements definition and program cost estimation, normally require the

services of engineers. Continuing with our warehouse example, the requirements definition would start by gathering data about the project. The designer would need to determine the square footage required for the warehouse. This information would come from the business records of the company and industry estimate of the amount of storage space required for the material being stored. The user's operations requirements would dictate the number of loading docks required, as well as the required parking spaces. A preliminary site investigation may be required to determine whether the structure can be built on a shallow foundation or if it will require a deep foundation. The goal at this point is to gather all information needed to develop a general scope for the project and identify the major cost items.

Once the general scope is determined (square footage of warehouse, office, parking requirements) the designer can develop options for the user. Options may include different sites, different sizes, or different quality of facilities. For each option, a program cost must be developed.

The program cost is essentially a budgetary cost. It is generally based on historic construction cost data and broad measures of the project scope such as square feet of warehouse space, square feet of pavement, or linear feet of sidewalk. The purpose of the program cost is to provide enough financial information to allow the owner to evaluate alternatives and to budget funds for the project. Program level cost estimates should include total project costs, including construction management, permitting, and other non-construction costs. Generally, program costs are satisfactory if they are within 20 to 30 percent of the final project costs.

Once options have been developed with program costs, the user is able to make a business decision about the best approach to meeting the identified need. In our warehouse example, the user may end up having to choose between two sites. The first may be close to her current location, thus providing low operational costs, but may provide a limited area with no expansion capability. The alternative site may be further away with lower construction costs and expansion capability, but have increased operational costs due to the distance from her current operations. For both options the designer should provide the scope and

cost data needed for the user to evaluate and select between the options.

The planning phase is complete when the user has identified a general scope of the project, defined the design requirements, determined the overall expected project costs, and identified potential funding sources.

There are many roles for design professionals to play during the planning phase. Designers and planners are needed to translate the user's need into specific design requirements, to develop cost estimates, and to evaluate the alternatives. Some users, such as large utility companies, or state departments of transportation, may have the in-house engineering capability to complete the planning function. Other users, such as retail sales companies or small municipalities, may have to contract for the needed engineering and planning services.

1.1.2. Design

When the project scope and the design requirements are set, project design can start. The objective of the design phase is to develop the plans and specifications needed to build the project. The level of design detail needed will depend on the project delivery method. The traditional linear system shown in Figure 1.1a generally requires a complete set of detailed plans and specifications. The complete plans and specs as well as a construction cost estimate are needed before proceeding to the construction phase.

In the fast track process, shown in Figure 1.1b, it is often possible to reduce the level of detail required during design. This can provide a significant cost savings to the users. The differences between the linear and fast track processes will be discussed further in Section 1.2.

The design phase is, perhaps, the area most often associated with design professionals. This certainly is the phase of the project requiring the most extensive use of design skills and personnel. The breadth of design skills needed will vary greatly with type of project. An industrial project, such as our warehouse example, will require relatively few architectural skills and mostly engineering skills. The design of an upscale office park, in contrast, may require much more architectural design. Subdivision design makes extensive use of urban planners, civil and transportation engineers, and little architectural design.

1.1.3. Construction

The vast majority of work done during construction is the actual craft and trade work required to physically complete the project. However there is significant use of design professionals in this phase. The project designers will complete all of the design engineering work needed to prepare the final plans and specifications. However, there is still much design work needed beyond what is included in the plans and specifications. For example, temporary structures required only

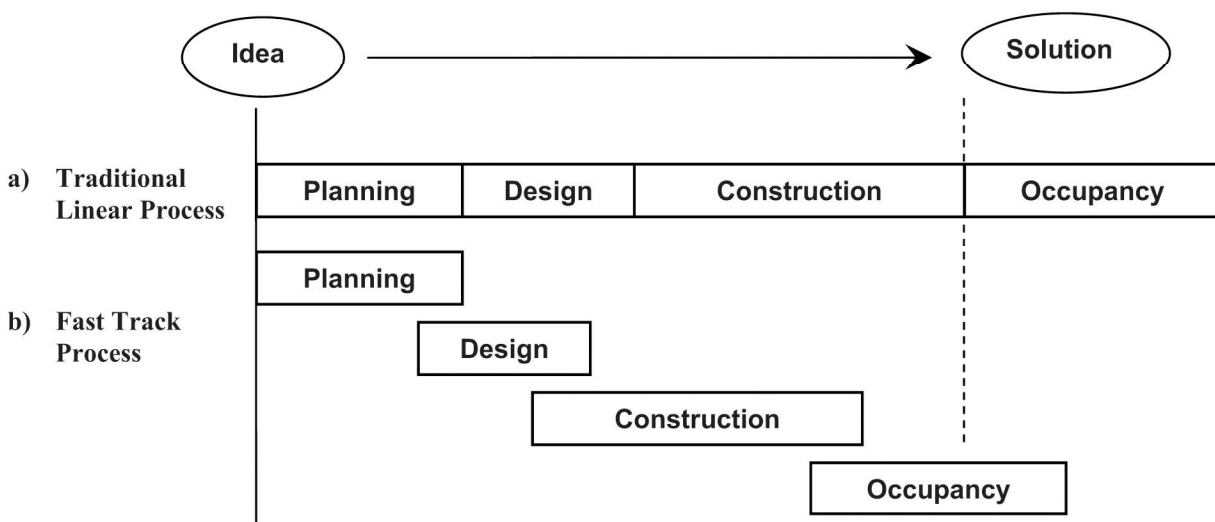


Figure 1.1: Project Phasing

for construction such as false work or shoring must be designed. Construction contractors often require design services to prepare alternative specifications or to develop specific construction techniques.

There is extensive communication between the designer and constructor during this phase. It is common for the designer to have a resident engineer on site at the construction project. The role of this resident engineer is to communicate between the construction contractor and the designer. The resident engineer provides the designer and owner information about the progress of construction and provides the construction contractor with interpretations of the plans and specifications from the designer.

Another function required during the construction phase is construction management. This role is often filled by an engineer.

1.1.4. Occupancy

While some may think there is little role for the engineer during the occupancy phase this is not true. The amount of engineering services needed during occupancy will vary significantly with the type of project, but in nearly all cases there is a significant role for engineering. Facility or maintenance engineering is required during the life of most projects in order to keep the project or facility in good operating order and to minimize the life cycle costs of owning the facility. This is true of roads, bridges, utility systems, and buildings. During the initial occupancy there is a lot of communication amongst the designer, the constructor, and the facility or maintenance engineer. The maintenance staff may require training to properly operate mechanical and electrical systems. Preventative maintenance programs must be developed often with the input of the designers. There will often be discrepancies between the design specifications and the operational capabilities. It normally requires engineering analysis to determine if the discrepancies are due to design deficiencies or construction problems.

It is useful to distinguish among the planning, design, construction, and occupancy phase, but it is often difficult to draw clear boundaries between them. Properly completing each phase requires a mix

of skills, but engineering and design skills are required in all phases of project delivery.

1.2. Project Delivery Methods

As discussed earlier, the project delivery process requires many different skills including finance, costing, designing, engineering and planning. Each phase of the process has distinct goals and requires a special mix of skills. In all cases it requires a team or teams of people to complete a project. How these teams are selected, organized, and managed has significant impacts on how the project will proceed. We will use the term “delivery method” to describe the combination of contract organization and contractor selection that creates the organization of teams responsible for planning, designing, constructing, and delivering a project.

There are two critical variables that determine the type of delivery method. These are the contract structure (number of contracts) and the process used to select designers and constructors. By evaluating these two variables we are able to classify the most common delivery methods.

1.2.1. Contract Structure

Usually, the user or project owner will have to contract for both the design and construction services needed to complete a project. In some cases an owner may have in-house design resources. For example, Caltrans has extensive design capability and performs design services for many (but not all) of their projects with in-house resources.

In most cases the owner is contracting for both design and construction services. There are two basic ways to organize the contracts. In the traditional method, the owner lets two separate contracts: one for design services and one for project construction. This contract structure is shown in Figure 1.2a. The designer completes the design and provides complete plans and specs for the project. This structure gives the owner the most control over the design process but provides the least amount of collaboration between the designer and the constructor.

In the design-build process, the owner lets a single contract for both design and construction services.

This contract structure is shown in Figure 1.2b. This structure provides for the best collaboration between designer and constructor and has the potential for reducing both total time and cost of the project. However, this method gives the owner the least control over the process.

1.2.2. Selection Methods

There are many different methods for selecting design and construction services. However, most of these methods can be classified into one of three categories: low bid, best value, and qualification based selection.

1.2.2.1. Low Bid

The distinguishing characteristic of the low bid selection process is that selection is based strictly on price. There are different ways to specify the price. The price may be lump sum, a single price for all services, or it may be based on unit pricing. In unit pricing, rather than specifying the total cost of a project, the price is divided into areas and payment for each area is based on the unit prices. For example, base course placement may be priced in cubic feet of in-place compacted base course; painting may be priced in square feet of walls painted. Regardless of how the price is structured, this selection process is based solely on price.

1.2.2.2. Best Value

The distinguishing characteristics of the best value process are that the selection is made using both costs

and some measure of the qualifications or quality of services provided by the bidder. Since it is not possible to put a monetary value on the qualifications of the bidders, this method uses some sort of weighting system to evaluate both qualifications and price. The weight systems used vary greatly.

Although there is no standard weighting system, a typical best value method is called the two step or two envelope method. In this method bidders provide separate qualifications and cost proposals. The qualifications are evaluated first by the owner and each competing firm is given a score based on the firm's qualifications. Next the cost proposals are evaluated. The owner then uses the cost proposal and the qualification rating to determine which firm is the best value to the owner. Conceptually, this method gives the owner the ability to pay more for a higher quality firm. However, because it isn't possible to put an exact cost on a given level of quality, it is difficult to determine and defend the trade off between cost and quality.

1.2.2.3. Qualifications Based Selection (QBS)

The distinguishing characteristic of the QBS process is that cost is not a selection criterion. In this process the selection is based solely on the bidders' qualifications. The price is negotiated after the selection is made. The process follows these general steps:

1. Owner defines general scope of work and publishes a request for qualifications.

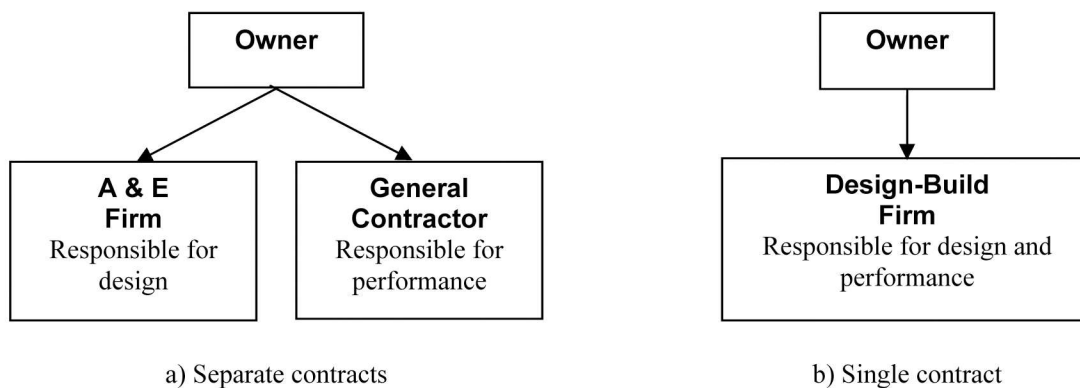


Figure 1.2: Contract Structures

2. Interested firms prepare proposals listing their qualifications, similar projects completed, and approach to the proposed project.
3. Owner evaluates qualifications submitted and selects the most qualified firm.
4. Owner and selected firm jointly define scope and cost of project. This is where the price/cost trade-offs are made.
5. Once cost and scope are agreed upon, a contract for the project is signed.
6. If owner and selected firm are unable to agree upon cost and scope, owner moves on to next best qualified bidder and attempts to negotiate cost and scope.

1.3. Defining Costs

What does a project cost? The answer to this question depends a lot on how you ask the question and to whom? In order to be able to compare apples with apples, we must have a common definition of costs. We will use the following definition from the Georgia State Financing and Investment Commission (1991).

The total construction cost (TCC) is the sum of

- Construction Cost of Work: Material and labor required to build the project
- General Conditions: Non material and labor costs such as permitting, leases for site offices and staging areas etc.
- Contractor's Fee: Contractor's profit

The design fees are the total cost paid for the design of the project.

The total design and construction cost (TDCC) is the sum of

- Total construction costs
- Design fees

Total Project Cost (TPC) is the sum of

- Total construction costs (TCC)
- Design fees
- Balance of project costs: Costs such as construction management fees, cost of capital, owner's in-house management costs, etc.

When comparing costs it is critical to understand if a particular cost quote is the TCC, TDCC, or TPC.

Ultimately, the cost that should concern the owner is the total cost of ownership (TCO) of a facility. This cost is the sum of the TPC plus all the operations and maintenance (O&M) costs incurred over the life of the facility. O&M costs far exceed TPC. O&M costs often make up 80% or more of the TCO.

The O&M can be strongly impacted by the design. It is often true that one can decrease the TCO by spending more on the TPC. For example making a building more efficient may increase TPC but savings in O&M costs will far outweigh the increased TPC and reduce the TCO. Unfortunately TCO is often not considered in the project delivery selection process.

1.4. Defining Delivery Methods

Using the variables of contract structure and selection method we can define six different project delivery methods. Table 1.1 identifies the various delivery methods based on the number of contracts and selection process. Each delivery method will be discussed in further detail.

1.4.1. Design-Bid-Build

Defining Characteristics: Separate contracts for designer and builder. Builder selected solely on cost.

Other Typical Characteristics: The designer generally completes 100% design before the build contract is let. Communication between designer and builder is through the owner.

The design-bid-build process is shown in Figure 1.3. The delivery method provides for the least interaction between the designer and the builder. It is not amenable to fast tracking. It does provide for the highest level of cost competition for the construction phase since cost is the only selection criteria. This method can be very successful for the owner for projects with a well-defined scope that use well established construction methods, and do not require or benefit from new or innovative processes.

Table 1.1: Project Delivery Methods

Selection Process	Contract Structure	
	Two Contracts Designer & Builder	One Contract Designer-Builder
Low Bid	Design-Bid-Build	Design/Build Low bid
Best Value	CM/GC Best Value	Design/Build Best Value
Qualifications Based Selection	CM/GC QBS	Design/Build QBS

1.4.2. Construction Manager/General Contractor with Best Value Selection (CM/GC Best Value)

Defining Characteristics: Separate contracts for designer and builder. Builder selected on qualifications and TCC.

Other Typical Characteristics: Designer generally completes a preliminary design before build contract is let. Fast tracking is often used. Collaboration between designer and builder determines final design and cost.

The CM/GC process is shown in Figure 1.4. The delivery method generally provides for more interaction between the designer and the builder because the design is not complete when the builder is selected and the owner needs to build a collaborative process with the designer and builder to determine final cost and scope. This process is amenable to fast tracking but still requires separate procurement time for both the design and construction contracts. The cost portion of the evaluation in this process is usually a guaranteed maximum TCC based on the preliminary design. The final TCC is determined during the design and negotiation process. In order to be able to accurately compare costs, the preliminary design must be complete enough that potential construction bidders can develop meaningful TCC estimates.

1.4.3. Construction Manager/General Contractor with Qualifications Based Selection (CM/GC QBS)

Defining Characteristics: Separate contracts for designer and builder. Builder selected solely on qualifications.

Other Typical Characteristics: Designer generally completes a preliminary design before build contract is let. Fast tracking is often used. Collaboration between designer and builder determines final design and cost.

The process is the same as the CM/CG Best Value method (Figure 1.4.). The main difference between the two methods is that this method does not require a cost proposal from potential builders since the QBS process is based solely on qualifications. This means that the preliminary design only needs to have a general scope of the project. The final project scope and cost will be negotiated after selecting the builder.

Note that in both of the CM/GC delivery methods any cost savings realized in the design and scope development phase go to the owner. While this potentially provides the owner with a great deal of value it does not incentivize the builder into taking risks that could have potential cost savings since the builder would not benefit from those savings.

1.4.4. Design-Build Low Bid

Defining Characteristic: A single contract for both design and construction. Selection based solely on TDCC.

Other Typical Characteristics: Generally includes some sort of fast track organization. Pricing usually based on a guaranteed maximum TDCC.

The design-build process streamlines the total project timeline by eliminating one contract procurement since both the design and construction services are combined in a single contract, as shown in Figure 1.5. It also maximizes collaboration between designer and builder since they are on the same team, under a single manager. The low bid selection process maximizes cost competition among bidders. However

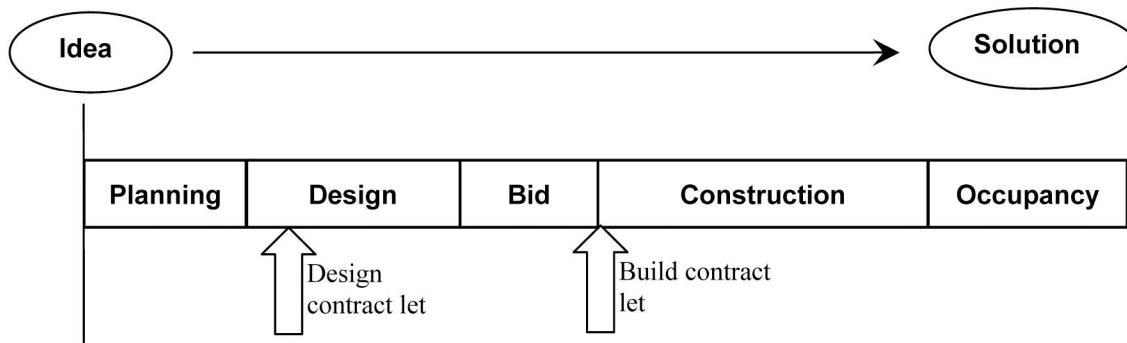


Figure 1.3: Design-Bid-Build Process

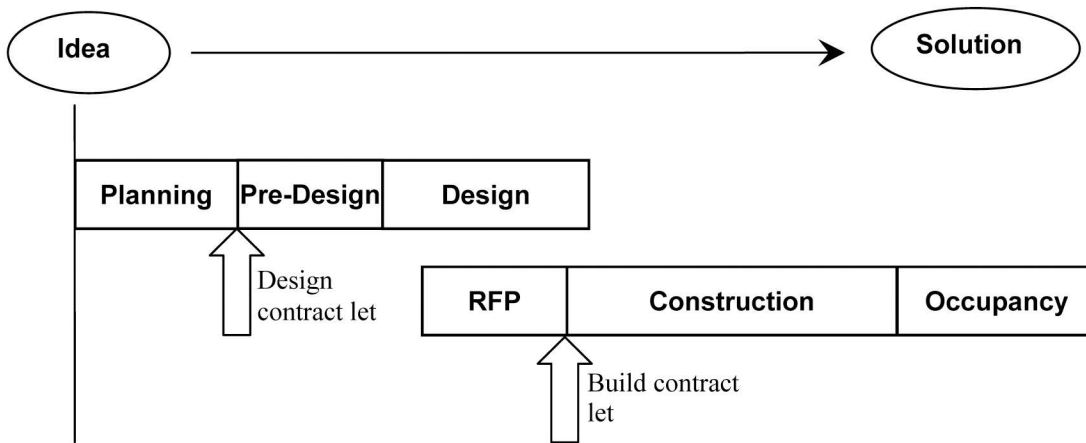


Figure 1.4: CM/GC Process

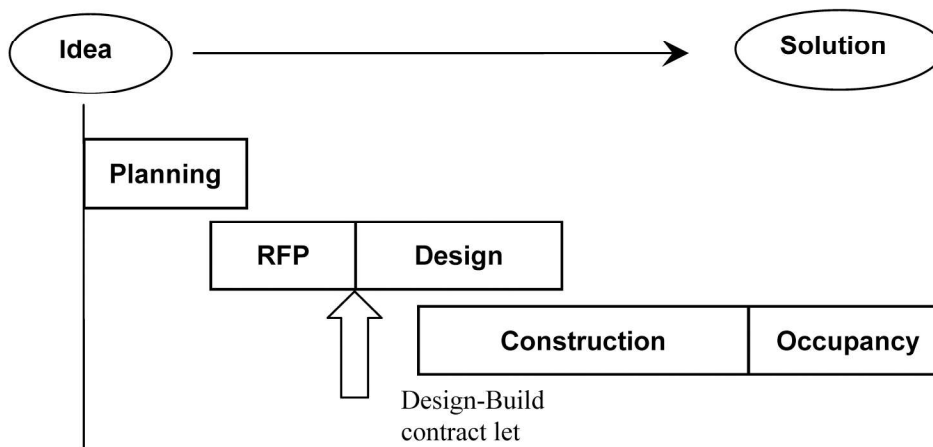


Figure 1.5: Design-Build Process

all of the savings a contractor might realize with an innovative design-build idea are kept by the contractor. The low bid selection method does not allow the owner to make cost-schedule-scope trade-offs since the selection is based solely on cost.

1.4.5. Design-Build Best Value

Defining Characteristics: A single contract for both design and construction. Selection based on both qualifications and TDCC.

Other Typical Characteristics: Generally includes some sort of fast track organization. Pricing usually based on a guaranteed maximum TDCC.

The process is the same as other design-build delivery methods, see Figure 1.5. Like other design-build methods, it maximizes collaboration between designer and builder. The best-value selection process allows the owner some control of the cost-scope trade-off, since all bidders will generally have to provide their design-build approach in the qualifications part of the proposal.

1.4.6. Design-Build QBS

Defining Characteristics: A single contract for both design and construction. Selection based solely on qualifications.

Other Typical Characteristics: Generally includes some sort of fast track organization.

The process is the same as other design-build delivery methods, see Figure 1.5. Like other design-build methods, it maximizes collaboration between designer and builder. The QBS selection process allows the owner maximum control of the cost/scope trade-off since that negotiation occurs after selection of the design-build contractor. This delivery method requires the greatest sophistication on the part of the owner to both select and negotiate with the design-builder. Many owners use separate contracts with design professionals to aid in the selection process.

1.5. Selecting the Best Project Delivery Method

None of the project delivery methods is inherently better than another. The selection of a project delivery method will depend on a number of variables including: policies of owner's organization, in-house engineering capabilities, project timeline, and funding availability, just to name a few. What is important is for owners, designers and builders to understand the different characteristics of each method so that the project delivery method can be carefully matched to a specific project.

1.6. The Design Professional's Role in Different Project Delivery Methods

Design-bid-build has been the traditional method of project delivery and most design professionals are familiar and comfortable with this method. In this process the design professional has played one of two roles: the project manager for the owner (either on the owner's staff or under separate contract) or as the contract designer. As the contract designer, operating under a design only contract, design professionals have been used to working directly with the owner with little direct interaction with builders. The design-build models are quickly changing this relationship. In most design-build contracts the prime contract is the builder, and the designer is generally a subcontractor to, or minor partner of, the builder. This new relationship has proved difficult for many design professionals.

Some designers complain about the loss of authority that comes from working for the builder rather than the owner. When a designer works for the builder, the designer's primary responsibility is to the builder not the owner. Many designers struggle to balance the responsibility to produce a low cost design for the builder while meeting their professional standard of care. Whatever role the design professional plays, it is critical that the designer clearly understands the nature of the relationship that is being undertaken before that designer agrees to take on the work.

There is no reason for designers to avoid working under design-build delivery systems rather than the traditional design-bid-build systems they are familiar with. The designer simply needs to understand their role in the delivery system, and how to best apply

their professional skills and standards to the project at hand.

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