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RISK MANAGEMENT IN DESIGN/BUILD

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ABSTRACT

The design/build delivery method has emerged as an innovative method for delivering private and public works projects. Despite an increase of its use, design/build is not a "cure-for-all" method that will solve all problems for the parties involved in the design and construction process. While design/build theoretically eliminates the adversarial relationships between the parties, reduces project duration, claims, and cost overruns; it is not a risk-free method. Opponents advocate that design/build merely rearranges the players and associated risks in the construction process. The design/build method carries some of the conventional risks, as well as, a new set of risks related to using new model Contract Agreements, selection process, and teaming up engineers and contractors in a joint venture.

This paper will identify risks associated with the design/build delivery method from the Owner, Architect/Engineer, and Contractors perspectives.

KEYWORDS

Design/build, Risk, Project, Construction, Management

1. INTRODUCTION

What is risk? The AACE International Risk Management Committee in their Professional Practice Guide to Risk defines "risk as the same as uncertainty" (i.e., risk = threats + opportunities), or "risk is the net impact of uncertainty" (AACEI 2000). The American Heritage dictionary defines risk as, "the possibility of suffering harm or loss", "the danger or probability of loss to an insurer", and it defines Risk Management as the "techniques used to minimize and prevent accidental loss to a business". The Project Management Institute (PMI), in its "Guide to the Project Management Body of Knowledge-PMBOK ®, defines Risk Management as a "systematic process of identifying, analyzing and responding to project risk." PMI identifies six components of risk management as follow: Risk Management Planning, Risk Identification, Quantitative Risk Analysis, Qualitative Risk Analysis, Risk Response Planning, and Risk Monitoring and Control.

Perhaps some of the best discussions about risk appeared in a series of lectures by Arthur Casagrande in Boston, during 1965. Casagrande, a soil engineer, in a lecture titled "Calculated Risks in Earth and Foundation Engineering" addressed risk in general and calculated risk in specifics. He jokingly wrote "calculated risks" is a term often used for risks that nobody knows how to calculate. He added, "instead the term usually means intuitive assessment" (Casagrande, 1965). His writing and lectures on risk preceded many of the modern risk management theories and practices.

2. RISK IN CONSTRUCTION

The construction of a project is a complex, dynamic undertaking. Every project is unique, and utilizes different materials. The players are numerous, and the market is constantly shifting. As a result, the construction of a project is, at best, a "fragmented" process in a "fragmented" environment. Typically a project is conceived by an owner, designed by architects and engineers, impacted by building officials, approved by regulatory agencies, constructed by general contractors and subcontractors, and maintained and operated by end users. Every step of this process is laden with risks. As parties perform their contractual duties, they try to reallocate risks to the next party. In the construction industry, the chief element of risk arises from the fact that many of the variables that influence and determine the final cost and duration of a project, are usually not known prior to construction.

Owners, contractors and engineers rely on legal contract documents to define, mitigate, allocate, and transfer their risks in the process. These contract documents define the legal requirements of the contract, and the roles and responsibilities of all players. Normally, these documents are developed separately by various organizations. Generally, from a risk point view, they serve to protect the interest of the party that drafted them.

3. THE DESIGN/BUILD METHOD

The design/build method is a project delivery technique whereby an owner contracts with a single entity (design-builder) to deliver the project (See Figure 1). This procurement method integrates the design and construction functions into a single source. The perceived advantages of design/build are (Friedman, 1984):

- The selection of a design/builder is based on qualification and definitive performance criteria,
- The contractor is involved early in the design phase,
- The design and construction phases are shortened,
- There is a single source of responsibility,
- Eliminates the adversarial relationships between contractors and A/E's.

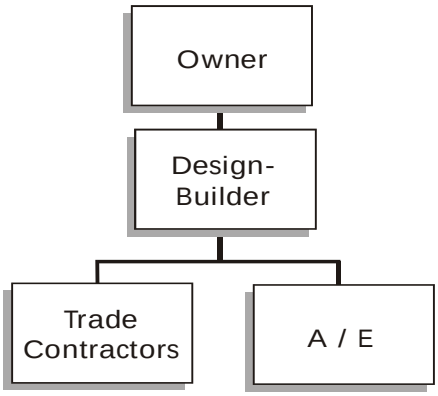

Figure 1: Design-Builder

The perceived disadvantages of design/build are (ACEC/FICE, 1991):

- Single source of responsibility,
- Material quality, substitution of lower quality material,
- Quality of inspection,
- Owner is not in control,
- Time for development of project aesthetics.

Design/build is not a new project delivery method. The design/build method (i.e. turnkey, performance contracts, etc.) has been effectively used for delivering projects in the international (Oil & Gas, chemical, hydroelectric, etc.), and domestic industrial (manufacturing, paper & pulp, etc.) markets for many years. The rapid rise in the use of design/build

was fueled by the recent passage of the "Federal Reform And Acquisition Act" (FARA) in 1996, as well as legislation in several key states allowing qualification-based selection (QBS) for selecting design/build teams, as well as, architects and engineers. These laws have opened the door for the formal and legal acceptance of the design/build project delivery method in the public works sector.

4. SOURCES OF RISKS IN DESIGN/BUILD

Risks in design/build can be classified into three major categories:

1. Risks related to the new model Contract Agreements,
2. Risks related to the selection methods of the design/builder,
3. Traditional risks.

New model contract agreements always carry a new set of risks. They contain new legal language and procedures that define and allocate risks and liabilities to the respective parties. Perhaps, two of the main reasons why new model forms of agreements are considered risky are: (1) because of unfamiliarity of users with the new legal languages and background, and (2) most importantly, because these agreements have not been tested enough the court system. Generally new model forms of agreements are received with caution by attorneys and practitioners due to lack of historical court cases to predict on how the courts will act on new and future cases governed by these agreements.

The selection method of a design/builder is another source of risk. Unlike the competitive bidding method, the selection procedures of the successful design/builder in Public Works are complicated and risky. Selection of a design/builder can be based mainly on a price, on qualification, or a combination of price and qualification criteria (Molenaar et al, 2001). These main selection criteria, combined with different ranking methods, weighting systems, political agenda and subjectivity of the selection committee members, will result in a major source of potential risk.

Traditional risks are those attributed to the marketplace. These include union and labor strikes, material shortages, productivity variation, substitution of lowers quality products, and force majeure. These risks will exist regardless of the project delivery methods.

5. RISK IN DESIGN/BUILD

The construction of projects is a risky proposition. Historically, contractors were trained to assume risks so that they can make profits. However, architects and engineers have been trained to avoid risks at all cost. This represents a fundamental difference in philosophy and approach toward risk between contractors and A/E. How would these two entities reconcile their differences toward risk in the design/build process? This situation gets more complicated as Public Works owners enter the picture with their ultra-conservative approach to risk. Public Works owners and managers are often under pressure to lower costs and reduce operational expenses. They must control rising costs, and they must be able to tell their Commissioners that project X, will cost Y dollars, and will be open by date Z. There is very little room for risk-taking in their positions, especially when public funding and financing is controlled in a political environment.

In construction, there are certain risks which contractors are accustomed to accepting. There are also traditional risks that owners have successfully assumed or passed down to A/E and contractors, and there are risks that A/E firms have avoided. In the design/build arena, all of these risks must be re-evaluated, and others must be considered. The following risks must be addressed in design/build:

- Proposal Risk,
- Price Risk,
- Schedule Risk,
- Performance Risk,
- Contractual Risks (Contract Documents),
- Surety/Liability Risks.

5.1 Proposal Risk

The selection method of the successful design/build team is one of the most intensive, challenging, and risky propositions for all parties. Design-builder selection can be based solely on qualification, solely on price, or on a combination of price and qualification (Molenaar et al, 1999). The most commonly used selection method in Public Works is the Two-Step method, which separates the technical proposal form the price of the project. It involves short listing, and selection of the design-builders based on the team's qualification, quality of the proposal, and/or combination of low price/proposal.

In design/build, the owner typically prepares the Design Criteria Package (DCP), which serves to formulate the owner's desires, and to provide Design/Build teams with basic information and design parameters to develop a proposal. The quality of the proposal, and the competitiveness of the price, is often determined by the level of design that is completed prior to submitting the proposal. The level of design required for the proposal stage in Public Works, typically ranges from 20- 40 percent, with 30 percent as an average (see Figure 2). This level of design would require considerable investment in manpower and resources, and is considered very risky. It would make little or no sense for a design/build team to risk this investment if the potential for return were limited to their usual margins. Because of the potential high cost associated with preparing and marketing the proposal, contractors normally share this cost with design firms. Some States Departments of Transportation (DOTs) have recognized this up-front financial risk, and have allowed for a stipend in the selection process. However, the stipend normally is fixed, and covers only a percentage the "direct cost" of labor used for the development of the 30 percent design and the proposal.

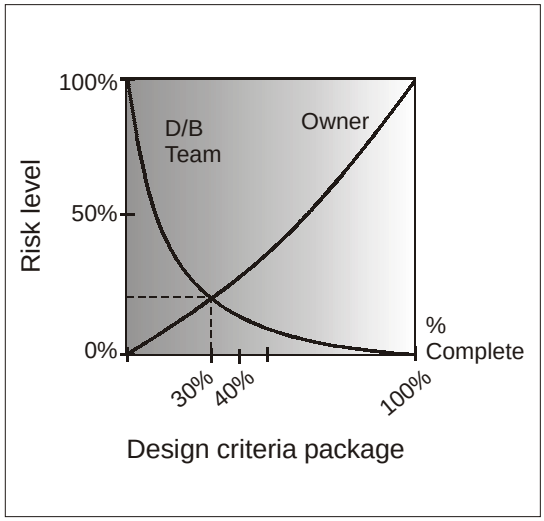

Figure 2: Proposal Risk

Proposal risk can be analyzed in quantitative and qualitative measures. The results of these analyses should be ranked and weighted against the probability of winning the project. This is similar to probability analyses and Monte Carlo Simulations used to determine bidding strategy in the competitive bidding method.

5.2 Price Risk

Contractors are accustomed to accepting price risk. This risk is present in all areas such as, quantities, labor rates, materials pricing, equipment rates, labor productivity, etc. In competitive bidding, the lowest bid is based on quantity surveys and estimates tabulated from the 100 percent complete design documents (bid set). Any variation in scope and quantities entitles the contractor to an adjustment. In the design/build method this is not the case. The design-builder is required to provide complete project pricing based on a 30 percent complete set of drawings, oftentimes, with little or no information available about soil and subsurface conditions. The price quoted in the proposal should be competitive to warrant selection, and should be realistic to cover the cost of construction with a desired margin for profit. This price commits the design-builder to the construction of the project, if selected. Unless there is a change in the scope by the owner, there will be no adjustment to the contract price. The price risk also includes hidden components such as, change in technology risks, and owner-finished-equipment (OFE) risks.

This risk can also be quantified and analyzed. One might argue that the design/build team can mitigate pricing risks by the selection of lower quality, cheaper materials to offset any quantity variations. The D/B team can also control price risk by providing efficient design and innovative solutions to engineering problems.

5.3 Schedule Risk

The construction of a design-bid-build project is defined by a master schedule (CPM, PERT). This schedule is developed by the contractor, based on 100 percent complete design drawings. It serves as a legal instrument for claims and change orders. Any variation in scope and circumstances (delays, changes, interference, etc.) entitles contractors and owners alike to an equitable adjustment.

In the design/build process, the team is required to provide a schedule, and to be committed to that schedule, at the 30 percent design completion level. This represents a tremendous risk because many of the design variables, materials, processes, and technologies, as well as, construction ways, means, and methods, may not have been selected or determined as yet. Of all risks, schedule risk is perhaps the most critical one. Barring a change in scope by the owner, a design/build team may still be subject to penalties such as liquidated damages if the schedule presented in the proposal is not met, and may lose the legal rights for delays claims, and extended overhead claims.

5.4 Performance Risk

Performance risks include risks associated with the design and performance of the construction contract. During the competitive bidding, the Architect/Engineer performs the design, and as a result, assumes all risks related to materials and design performance. The owner assumes the risk of providing a complete biddable and contractible set of drawings (warranty of constructability). Under the design/build method, the owner is responsible for developing the Design Criteria Package (DCP), which defines the project and performance requirements. As a results, the owner assumes the risk of clearly defining his/her requirements is early in the process. Any changes in scope, or in design requirements after that initial stage, would be construed as change orders. The Design/Build team assumes the risks associated with designing and building the project. These include engineering risks, system performance risks, warranty and guarantee risks, in additional to the price risk and schedule risk.

Risks related to warranties and guaranties have also shifted from the owner to the design-builder in design/build. Under the competitive bidding, the contractor typically provides a short tern warranty (1-3 years) that cover construction defects. This is not the case under design/build where the design-builder selects the materials and processes. Because owners are not involved with materials/systems selection, there is a trend toward requiring longer warranties and guaranties (7-15 years) from the design-builders to offset the risk of installing lower quality, cheaper materials. In fact, there are discussions among some state DOT's to require a 20-30 year warranty on bridge projects, when the DOT does not provide construction engineering and inspection (CEI). Obtaining a long-term warranty and guaranties is neither simple, nor cheap. Most often, it will require the design-builder to post a bond with a surety company to secure the long term warranty. This will results in additional financial and surety risks to the design/build team.

5.5 Contractual Risks (Contract Documents)

These are the inherited risks built into the Contract Documents. The design/build method has shifted the roles and responsibilities of all parties, and has re-shuffled the risks associated with the construction process. This will require a new Risk Management strategy from all participants. To accommodate the shift in risk and responsibilities, several organizations have developed a new set of model Contracts Documents for use with design/build. The following is a list of most commonly used ones in the United and States and overseas for procuring design/build projects:

- The Design / Build Institute of America (DBIA) Standard Forms 520, 525, 530, and 535,
- American Institute of Architects (AIA) Standard Form 191,
- The Engineer Joint Contract documents Committee (EJCDC) Standard Forms 1910- 40,
- The Associated General Contracts (AGC) Standards Form 410,
- Federation Internationale des Ingenieurs-Conseils (FIDIC), orange or silver books (1986), or the new 1999 editions.

There have been several studies that compared risk allocation, liabilities, claims, and entitlements of the various parties using the above forms of agreements in design/build. A common conclusion among practitioners and claims consultants is that design/build does not eliminate claims. Zack (2000) examined the potential for construction claims in design/build using the DBIA Contract Documents. He concluded, "Almost all forms of claims can still occur in design/build projects". He added "In fact, claims including constructive changes, different site condition, acceleration, termination, untimely review of payments requests, error and omissions, etc., can still be made by all participants in design/build."

Verderjagt (1999) compared six contract areas under various Form of Agreements to determine the transfer of risk to the design-builder under the D/B method. The areas studied are listed below, and a summary of his finding is shown in Table 1.

1. Warranty of fitness and suitability (Owner to D/B),
2. Warranty of construct ability (Owner to D/B),
3. Force majeure (Owner to D/B),
4. Different Site Condition (Owner to D/B),
5. Obtaining permits (Owner to D/B),
6. Professional Liability (Designer to D/B).

Table 1: Shift to Design-Builder

	DBIA	NSPE/ ECJCD	AIA	AGC
Warranty of Design Fitness	++	+	++	0
Warranty of constructability	++	+	++	0
Force Majeure	0	+	0	-
DSC's	0	++	+	-
Permitting	+		+	-
PLI	+	+	+	+-

+ = Increase, - = Decrease, 0 = Neutral

5.6 Surety and Liability Risks

Some of the most important elements of risks in design/build are risks related to surety, bonding, and professional liability. Historically, there was a clear separation in types and limits of insurance policies issued to contractors and engineers. Architect and Engineers covered their exposure to risks with professional liability insurance (error and omission). On the other hand, contractors posted performance and payment bonds to cover their risks during the construction of the project. The design/build delivery system has muddied this delicate separation in risk and insurance, and forced the insurance and surety communities to develop new products that will meet the requirements of all parties. Owners, in particular, are advised to read carefully insurance policies and bonds in the design/build method, to determine the extend to which both the design and construction functions are properly covered by these new products.

Under the competitive bidding method, a performance bond is issued by a surety on behalf of the contractor, and essentially promises the owner, that if the contractor fails to perform his obligation under the contract, the surety will undertake to complete the project. Performance bonds are financial instruments with serious risk ramifications, and they are issued only after the surety has evaluated and understand the risk associated with the project. In their evaluation, surety companies examine the contractor's financial standing, cash flows, assets, defaults, past performances, etc. to determine his/her "bonding capacity" and issue the bond. The surety community have expressed serious concerns about guaranteeing the performance of both design and construction functions when the contractor undertakes both design and construction obligations in design/build. Understandably, surety companies are concerned about undertaking what amounts to errors and omissions risks that are unfamiliar to them. In a similar manner, professional liability carriers are concerned about guaranteeing construction performance and workmanship.

This discussion brings back the debate as to who should lead a design/build team. From a surety and insurance point of view, the answer is clear. The party who has got the most to lose, should lead the team. Clearly that would be contractors. Contractors have more cash on hand to operate their companies, and they have tangible assets such as equipment, tools, and buildings that can be liquidated quickly. These assets, combined with a potent bonding capacity, make contractors better equipped to handle risks. In contrast, Architects/Engineers have little or nothing to lose on a design/build project. They have no cash on hand, their operation is normally financed with short term loans to cover payroll and expenses until they get paid. Moreover, A/E consultants do not have any tangible assets that can be liquidated, and to that effect, their bonding capacity is practically negligent.

6. A/E DIFFERENT ROLES - DIFFERENT RISKS

There are several roles that a design firm can play in the design/build process. An A/E may work for an owner developing the design criteria package, and possibly continuing in supervisory role during construction. An A/E may also be a part of the design/build team working with a contractor. In the later arrangement, an A/E may lead the team, of may work as a sub-consultant to a contractor. Each role is different and it caries different sets of risks.

A/E working for the owner developing the design criteria package, assume the same traditional risks that consultants have under in the competitive bidding method. These risks include, error and omission risks, and professional liability risks. The risk of an A/E may increase if he/she takes on a supervisory role over the construction process, to protect the owner's interests. In this expanded role, an A/E takes on additional risks related to untimely review of submittals and pay request, interference, and probably site safety during construction. In this capacity an A/E may also affect the construction schedule, and that may entitle the design-builder to an adjustment and change order.

A/E risks and liabilities will expand greatly if an A/E leads the design/build. In this role, an A/E is exposed to more general liability risks, faulty workmanship risks, licensing risks, surety risks, and insurance risks. Leading a D/B team, an A/E assumes additional construction and contractual risks such as delays, economic loss, negligence, warranties and guaranties.

An A/E acting as sub-consultant to a contractor, also faces a new set of risks. Contractors leading a D/B team, control all financial aspects of the project such as, cost, fees, and contracts incentives. In this role, contractors will pressure the A/E to cut costs in order to win the project. Cost cutting will results in shorter design time, selection of lower quality materials, and lower designs standards. All of these have risk ramification on the A/E's general liability insurance, especially if a contractor wants to be added on to the A/E professional policy.

The basic shift in risk and liability has caused some friction between A/E consultants and contractors as to whom should lead the design/build team. A/E consultants believe that they should lead because the design/build process is simply "engineered construction". On the other hand, contractors believe that they are better equipped to handle risk, and to them, Design/Build is a good "construction engineering".

7. OWNERS' RISKS

Despite the common belief, the design/build method does not transfer all risks from the owner to the design-builder. Owners must still perform some necessary up-front work to develop the design criteria package, or scope. This will encompass defining design parameters, acquiring right-of-ways, performing land and boundary surveys, and performing geotechnical investigations. To what level of details does the owner develop the package? Is it to 10 %, 20%, 50% completion of design? It is obvious that the larger the percentage, the more risks the owner assumes. The owner must strike a comfortable balance between details, risks, and creativity. The greater the detail provided in the scope the less risk is transferred to the design-builder creatively and financially. An owner may also elect to hire a third party consultant to oversee the construction process. This involvement in the construction phase may bring the owner additional risks related to work stoppage, site safety, and untimely review of submittals and payment requests.

8. TANGIBLE vs. INTANGIBLE RISKS

Most of the foregoing discussion has been about tangible risks that owners, contractors, and A/E consultants must endure. Do these cover all risks associated with the design/build process?

There are certain intangible risks of which all parties must be aware. The decision to participate in a design/build project must be based on evaluating tangible, as well as, intangible risks. Architects and Engineers rely on their reputation and technical expertise to market their services to clients. They abide by professional ethics and "standard duty of care" to provide clients quality services and products. These intangible qualities/assets are very valuable to their practice, and their earning may depend on it. It would take one or several bad design/build experiences to ruin these reputations, and turn away clients. That is why an A/E must choose carefully their design/build projects, and the contractors with whom they team. For a Public Works owner, a negative design/build experience may force the agency to rethink its contract procurement methods, and may force it to return to the conventional competitive bidding method. Contractors already do not like teaming up with engineers in design/build. A bad design/build experience would not necessarily turn them away from future design/build projects. However, when contractors encounter several bad design/build projects to the extent of affecting their bonding capacity, they would re-evaluate their participation.

9. CONCLUSION

The design/build method does not eliminate risk from the construction process. It merely re-arranges the participants and their roles in the process, and it reallocates risks among the parties. Architects, engineers, contractors and owners, must evaluate their risks, and must react to mitigate their exposure to risk. Everyone must realize that the potential for construction claims still exist in using design/build of projects. To that effect, they must understand the legal relationships, protections, and limitations offered in any model contract documents and Form of Agreements used.

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