Public Construction Contracting: Choosing the Right Project-Delivery Method

Valerie Rose Riecke

Any construction project that misses its deadline and is millions of dollars over budget receives unwanted attention. It receives even more attention if it is funded by taxpayers' money. Public owners (state agencies, counties and towns, universities and community colleges, and hospitals) often seek new ways to make construction projects adhere to both deadlines and budgets. Many experts believe that the key to the success of a construction project is the process by which it is organized and managed, or the "project delivery method." Recently the choices among methods have expanded. Proponents of each method claim that theirs is the best choice to save money, reduce time, improve quality, and decrease administrative burden.

Historically, North Carolina's laws restricted public owners to using a project delivery method called design-bid-build using separate-prime bidding (explained later).[1] In 2001 the North Carolina General Assembly added two options for project delivery: design-bid-build using single-prime bidding and construction manager at risk.[2] The North Carolina statutes also include a special provision that allows the State Building Commission to approve alternative contracting techniques.[3] The most commonly approved method is design-build. Now, with four methods available and various opinions bombarding the industry, public owners are wondering which one best suits their projects.

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This article offers guidance to public officials in assessing the different project delivery methods. Construction industry professionals interested in public-sector work also will find the article of interest. The study reported in the article is not a quantitative study that determines which method is the most cost-effective and least expensive. Many quantitative studies claim to have determined the most effective approach, but a precise, comparative analysis is impossible.[4] My analysis moves the industry one step closer to understanding the implications of each method.

As UNC was about to embark upon a massive capital program in excess of $4.2 billion, it was clear that a greater number of construction delivery options were necessary for success. The North Carolina General Assembly's approval late in 2001 to add construction manager at risk and single-prime bidding to the long-used multiple-prime bidding was a watershed event.

—Kevin MacNaughton, special assistant for capital projects, UNC at Chapel Hill

Research Design and Methodology

Opinions on the relative merits and risks of each method vary. To account for the differing opinions, I sought input from experts representing all construction industry disciplines. I first studied the published literature on the four project delivery methods, identifying the advantages and the disadvantages of each using four construction-contracting industry goals as evaluation criteria: (1) controlling project costs, (2) meeting or accelerating the schedule, (3) ensuring a quality product, and (4) decreasing the administrative burden.[5]

To apply the findings of the literature review, I distributed a questionnaire to construction industry experts. They included academicians, architects, engineers, construction managers, general contractors, legislators, local and state officials in North Carolina, and prime contractors. I chose them using referral sampling: I surveyed experts who were initially interested and available to participate, and they referred me to additional experts. In total, I incorporated fifteen responses into the study.[6]

Definitions of Project Delivery Methods

Many variations of project delivery methods exist in the construction industry. Because of this, there are no standard definitions.[7] Therefore it is important to understand how these methods are being applied in North Carolina. The descriptions that follow use the North Carolina General Statues as a basis and add information from the literature review and experts' comments. (For graphic representations of the methods, see Figures 1–4.) Words that appear in boldface are defined in the glossary (see page 26).

Design-bid-build using separate- (or multiple-) prime bidding. This project delivery method has four sequential phases: selection, design, bid, and construction. The selection phase entails hiring the **designers**, who are chosen on the basis of qualifications.[8]

Once the designers are selected, design begins. It has three phases: (a) schematic design, during which the basic appearance and the plan are developed; (b) design development, during which the functional and aesthetic aspects of the project and the building systems that satisfy them are defined; and (c) construction documents, during which the details of assembly and construction technology are finalized.

Figure 1. **Design-Bid-Build Using Separate-Prime Bidding**

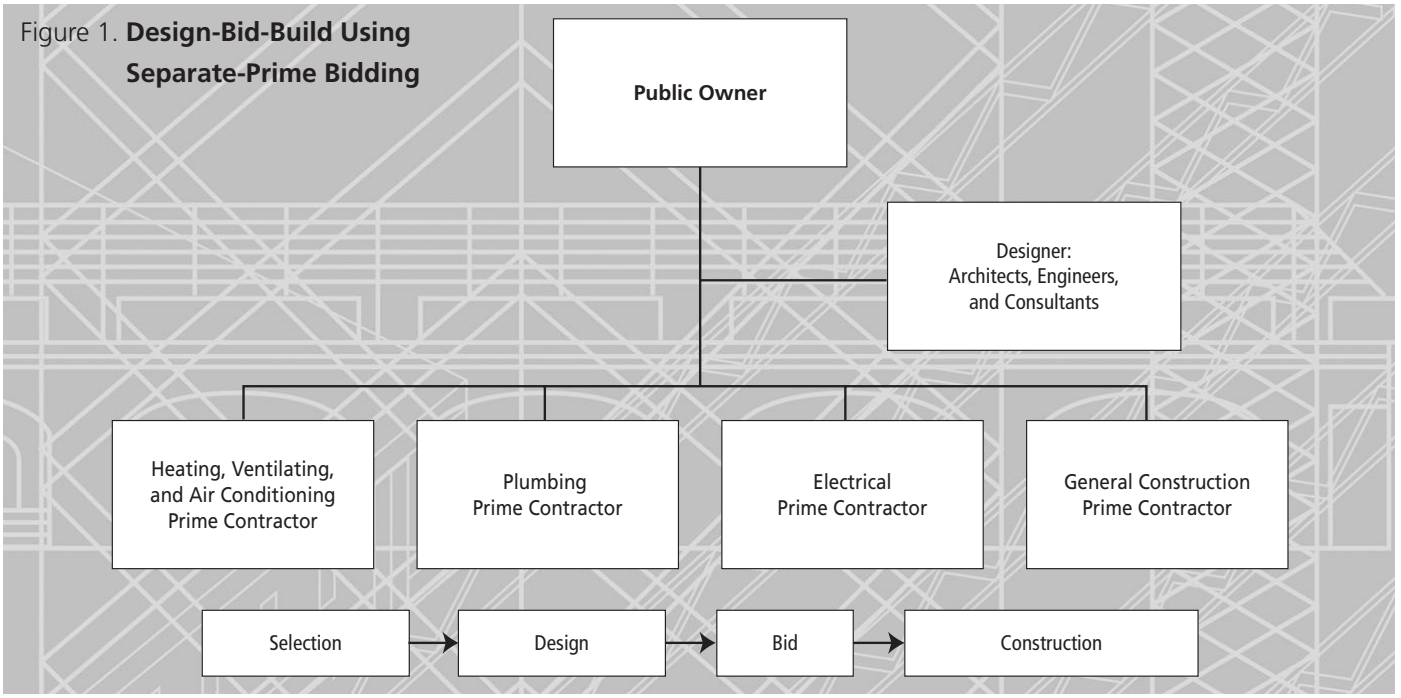


Figure 2. **Design-Bid-Build Using Single-Prime Bidding**

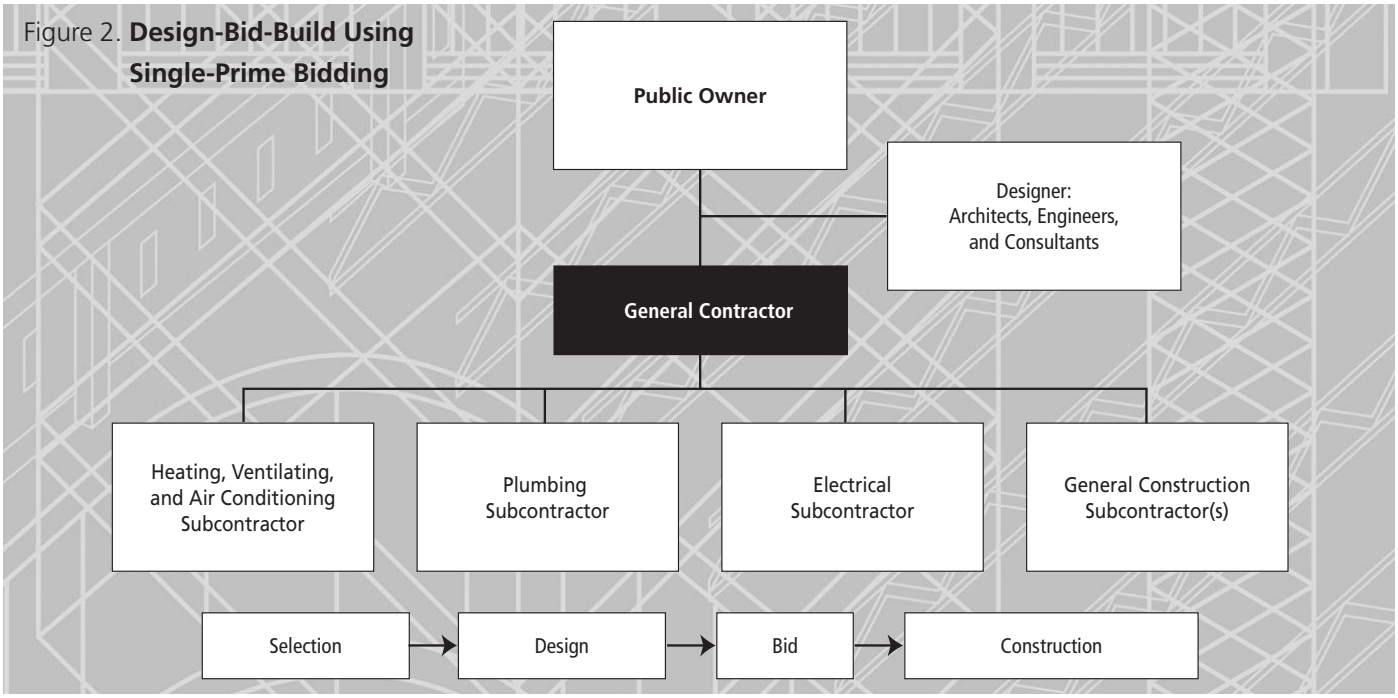
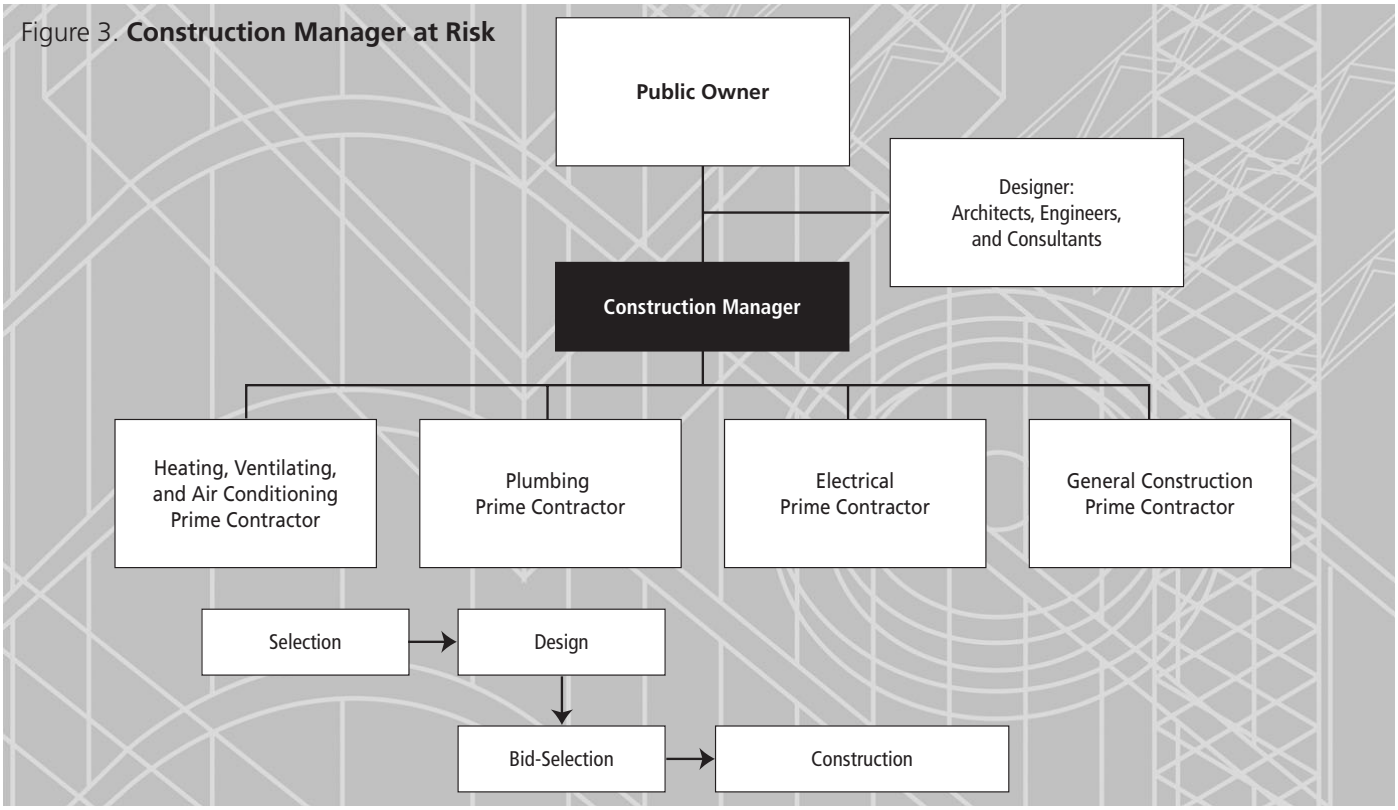


Figure 3. **Construction Manager at Risk**



During design the public owner creates the **project requirements**, also known as the **project program**. Also, the designers develop the **design documents** on the basis of those requirements.

Next, the designers create **bid packages** for the following trades: heating, ventilating, and air conditioning; plumbing; electrical work; and general construction (any work not included in the other three categories). Then bidding begins on the construction project. Bids are received from prospective **prime contractors** and awarded to the lowest, most responsible bidders. At the end of the bid phase, contracts are executed with each of the prime contractors.

In the final phase, construction takes place. Under this method, it occurs after the design documents are complete, and the pubic owner contracts separately with the designers and the prime contractors.

Design-bid-build using single-prime bidding. This project delivery method also has four sequential phases: selection, design, bid, and construction. Activities

in the selection and design phases are largely the same as in separate-prime bidding. The exception is that the designers create one bid package from the design documents, as opposed to multiple packages.

After one bid package is developed, construction bidding begins. Bids are received from general contractors and awarded to the lowest, most responsible bidder. At the end of the bid phase, one contract is executed.

Construction is the project's final stage. It takes place after the design documents are complete. The public owner contracts separately with the designers and the general contractor, and the general contractor holds contracts with subcontractors.

Construction manager at risk (construction management).[9] As with the design-bid-build methods, there are four phases of project delivery: selection (of a designer), design, bid-selection (of a construction manager), and construction. First, the public owner develops the project program and then requests **proposals** from prospective designers.[10] As with other methods, the public owner awards the contract on the basis of qualifications.

The designer then develops design documents. During this process the public owner requests proposals from prospective construction managers.[11] The construction manager is selected on the basis of qualifications.

Once the construction manager is selected, the contract has two phases of execution. In the preconstruction phase, the construction manager works with the public owner and the designers until the design documents are about 80 percent complete. Then the contract is renegotiated to include a **guaranteed maximum price** for the construction.[12]

After the guaranteed maximum price has been set, the construction manager may begin construction, even though the design documents are not complete. If construction begins early, the construction manager creates multiple bid packages from the incomplete design documents and opens bidding.[13] Contracts are awarded to the lowest, most responsible bidders, and construction takes place.

Under this method, construction begins before the design documents are complete. Also, the public owner contracts with the designers and the construction manager, and the construction manager contracts with the prime contractors and the subcontractors.

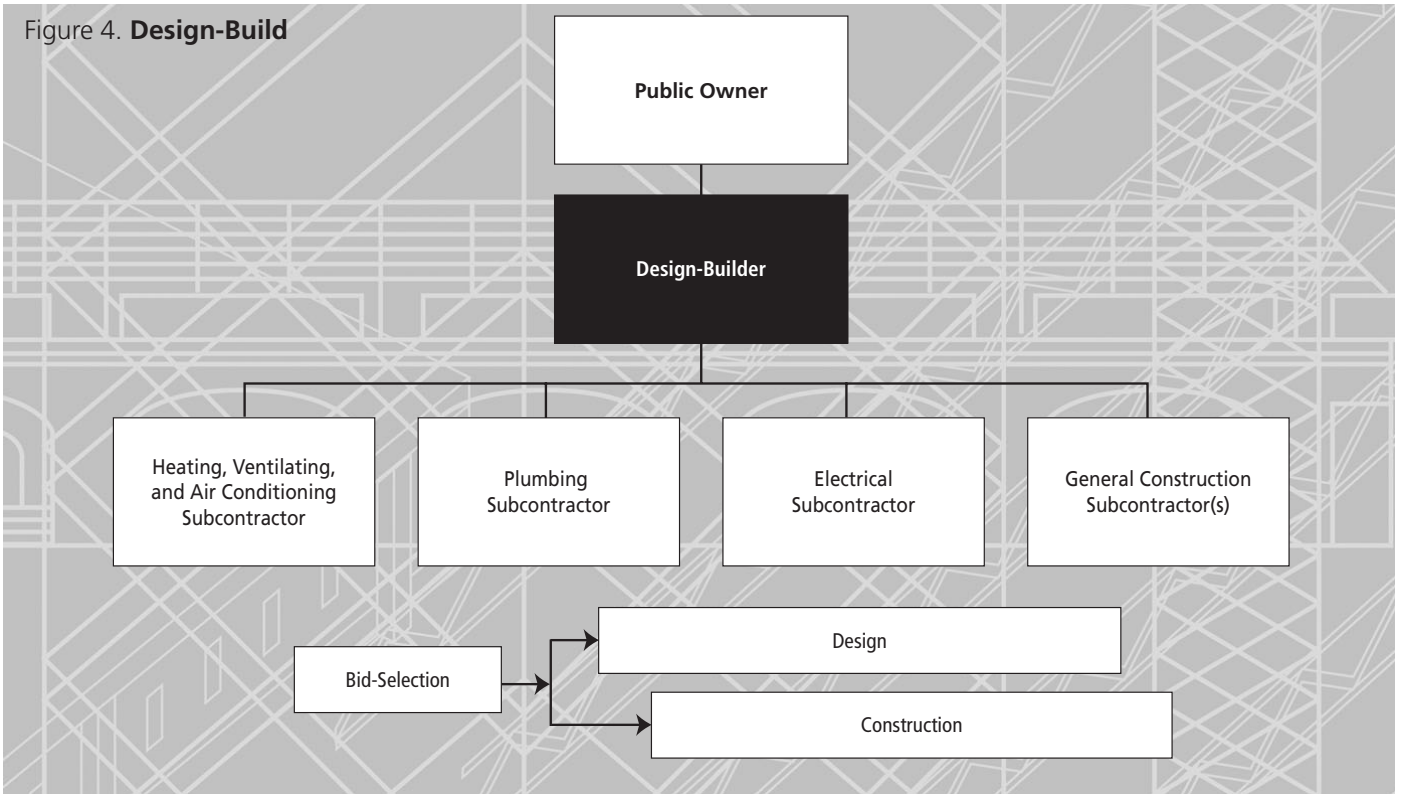
Design-build. Unlike the design-bid-build and construction-manager-at-risk methods, this method has only three phases: bid-selection, design, and construction. The public owner first prepares a detailed project program and then requests proposals to attract a design-builder. The design-builder is either a single company or a partnership of two or more companies. Several companies are selected on the basis of their qualifications.

The design-builders then develop detailed proposals, which include design documents and a cost for construction. A proposal is selected on the basis of the lowest, most responsible bid.[14] As with the construction-manager-at-risk method, the design-builder may begin construction after being hired. Under this method, construction begins before

Employing single-prime bidding on less complex projects has ensured a single source of responsibility. Many institutions have found that the prequalification of these hard-bid contractors is worth the effort on most jobs.

—Kevin MacNaughton

Figure 4. **Design-Build**



Glossary

Bid package: A group of documents issued to contractors who are bidding on a construction project. The documents include information on the bidding process and the design documents (see below); also called "bidding documents" or "invitation to bid (ITB) package."

Change order: A revision in the contract documents after the execution of the contract. A change order is an order to change the work to be performed under a contract. It is usually given by the public owner to a general or prime contractor (see column 3) or by a general or prime contractor to a subcontractor.

Cost estimating: Calculation of the approximate direct and indirect costs of the project.

Design documents: The construction documents and the project specifications. The construction documents are drawings that describe the construction requirements. The project specifications are detailed written instructions, which explain each phase of work to be done. For example, the drawings will show the size and the location of a duct, and the specifications will define the manufacturer of the duct and the construction technique to install it.

Designer: Architects; landscape architects; civil, structural, mechanical, plumbing, and electrical engineers; technical consultants; and specifications writers.

Guaranteed maximum price: An amount stipulated in a construction contract as the maximum sum payable by the public owner to the construction manager for the work specified.

Long lead time: The extended period required to manufacture certain materials. Long lead times may create scheduling delays if the items involved are needed before they are manufactured.

Phased construction: Overlapping of design and construction, also called "fast tracking." The construction schedule is compressed by overlapping some activities that otherwise would be performed sequentially. Phased construction increases project delivery speed because construction can start before the design documents are complete. An example is to start site work and construction of the foundation before the interior is completely designed.

Prime contractor: A company responsible for all facets of construction or renovation of a building, in its particular trade: (a) heating, ventilating, and air conditioning; (b) plumbing; (c) electrical work; or (d) general construction (any work not included in the other three categories). The prime contractor employs a subcontractor or subcontractors to perform some or all of the work associated with its specialization.

Project costs: The direct and indirect costs associated with the execution of a project.

Project program, project requirements: A general project description, including project objectives, functional uses, occupancy requirements, and budget and time considerations and limitations.

Proposal: The document submitted by a bidder to a public owner for design and/or construction of a project; also called "bid."

Underbid: To submit a bid that is less than the cost to perform the work.

Value engineering: The process of analyzing the direct cost versus the value of alternative materials, equipment, and systems.

the design documents are complete. The public owner contracts only with a design-builder.

Findings

The study found that opinions vary greatly on the relative merits and risks of each method. The findings are presented in the following sections according to the evaluation criteria identified earlier.

Controlling Project Costs

Although many studies claim to have determined the most cost-effective or the least-expensive project delivery method, as noted earlier, the task is impossible. So, for each method the questionnaire asked if **project costs** were always met and usually reduced, typically met and rarely reduced, or rarely met and never reduced. I deemed the most effective method to be the one cited by the highest percentage as always meeting and usually reducing project costs.

Overwhelmingly, experts indicated that the construction-manager-at-risk method is the most effective. (For a graphic presentation of the results, see Figure 5.)

Seventy-three percent of the experts responded that costs are always met and usually reduced because the construction manager assumes the financial risk associated with any profit or loss.[15] If the budget is exceeded, the construction manager must work without charge to arrive at the guaranteed maximum price.

Experts also ranked this method high because the construction manager is involved in all project phases. There are more opportunities for **value engineering** and **cost estimating.**

Even though this method ranked highest, experts said that public owners may have difficulty enforcing the contract. The guaranteed maximum price is based on incomplete design documents and is a defined price for an undefined product.

The design-build method also is effective in controlling project costs, although not as effective as the construction-manager-at-risk method. Forty-seven percent of experts responded that costs are always met and usually reduced. Additionally, 53 percent responded that costs typically are met. Experts ranked this method high because there are not as many **change orders** or as many claims stemming from errors and omissions in the design documents. The

designers and the "constructors" (the general contractors or the prime contractors) are under one contract. Further, as with the construction-manager-at-risk method, a project using this approach benefits from increased value engineering and cost estimating during design.

Nevertheless, public owners should be aware of the increased financial risks of using this method. Because the fixed price is based on the design documents developed during the bid phase, changes in the project program are likely to occur. Any such changes can be costly once construction is under way.

Although not as effective as the others, the two design-bid-build methods also were effective in controlling project costs. Thirteen percent of experts reported that costs are always met and usually reduced using either design-bid-build method. Also, 67 percent responded that costs typically are met when using the single-prime bidding method, and 27 percent responded that they typically are met when using the separate-prime bidding method.

With these methods the public owner benefits from the designers' expertise and advice. It also benefits from separating the designers from the contractor(s). The separation creates a system of checks and balances. Unlike the case with the other two methods, the public owner can make changes in the project program at a moderate cost during the design phase because construction has not begun.

Overall, however, the design-bid-build methods together ranked low and the separate-prime bidding method ranked last, with 60 percent of experts responding that costs are rarely met. One expert attributed the low rankings to the contract-selection process. Because the contract is awarded to the lowest, most responsible bidder, contractors tend to **underbid** when they know that the project has problems. The problems will create change orders later. Also, because the chance for change orders increases in proportion to the number of contracts made on a project, public owners potentially could have four change orders from a design error when they are using separate-prime bidding, as opposed to one when they are using single-prime bidding.

We have used construction manager at risk with great success. We built our new Justice Center under this method, and we just awarded bids for several large water department projects under a construction-manager-at-risk contract. In both instances the bids came in under projection. The Justice Center project came in on time and on budget—unheard of in government construction projects—and we saved over half a million dollars on the water department bids. So the finance officer, David Clawson, and I are big fans of this contracting method.

—Norma Mills, attorney, Dare County, North Carolina

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Meeting the Project Schedule

The questionnaire asked, for each method, whether the project schedule is always met and usually accelerated, typically met but rarely accelerated, or rarely met and never accelerated. According to the experts, the design-build method is the most effective in meeting or accelerating the project schedule. Sixty-four percent of experts responded that schedules are always met and usually accelerated, and 36 percent reported that schedules are typically met. (For a graphic presentation of the results, see Figure 6.)

Experts responded favorably to this method because **phased construction** can occur. Using this approach, the design-builder can avoid scheduling delays by identifying **long lead times** early.

Even though this method ranked highest in the study, one expert remarked that public owners with committees may encounter problems. In some cases, committees with multiple stakeholders may prolong the decision making. Phased construction relies on speedy decisions from the public owner.

The construction-manager-at-risk method also is effective in meeting or accelerating the schedule. Fifty-three percent of experts responded that the schedule is always met and usually accelerated, and 47 percent responded that the schedule is typically met.

As with the design-build method, phased construction explains the high ranking. However, design-build reaps the benefits of phased construction earlier in the process than construction manager at risk. Also as with design-build, public owners must gain input from the stakeholders more quickly and earlier in the design process to reap the time savings of the phased construction.

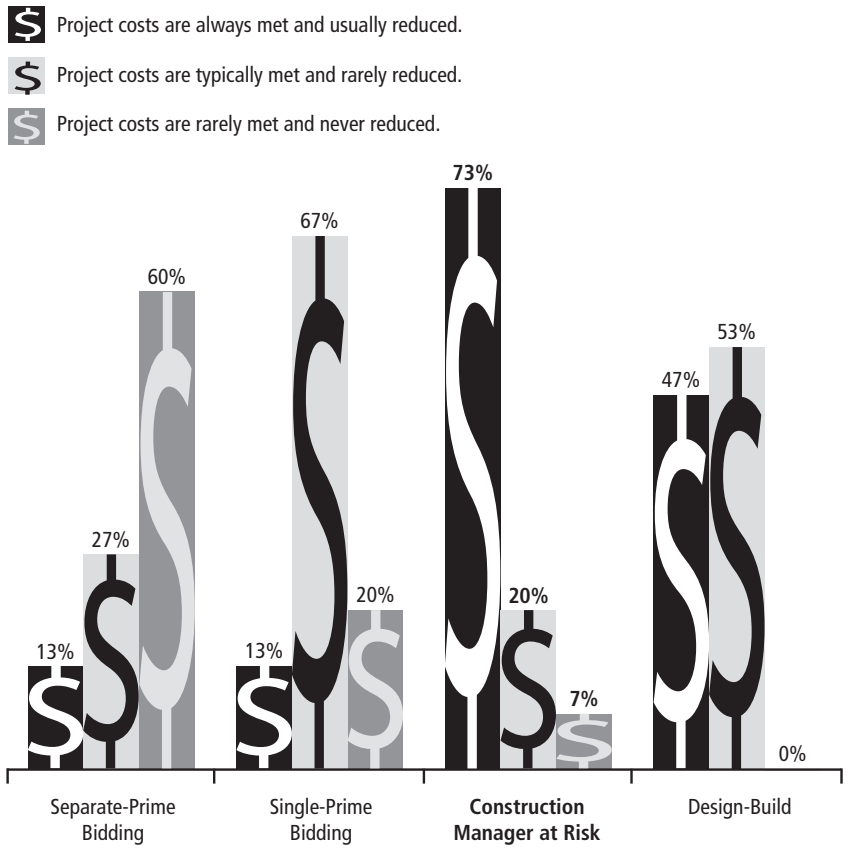
The two design-bid-build methods also were effective in meeting and accelerating the schedule, although less so than the other methods. Sixty percent of experts responded that the schedule typically is met using the single-prime bidding method, and 33 percent of experts responded the same for the separate-prime bidding method.

The main benefit to the public owner is the systematic checks and balances created by separating the designer and the contractor(s). The designers scrutinize construction operations, while the contractors carefully review construction administration by the designers.

Even though several experts favored these methods, they ranked low overall. Twenty-seven percent of experts responded that the schedule is rarely met using single-prime bidding, and 60 percent responded the same for separate-prime bidding.

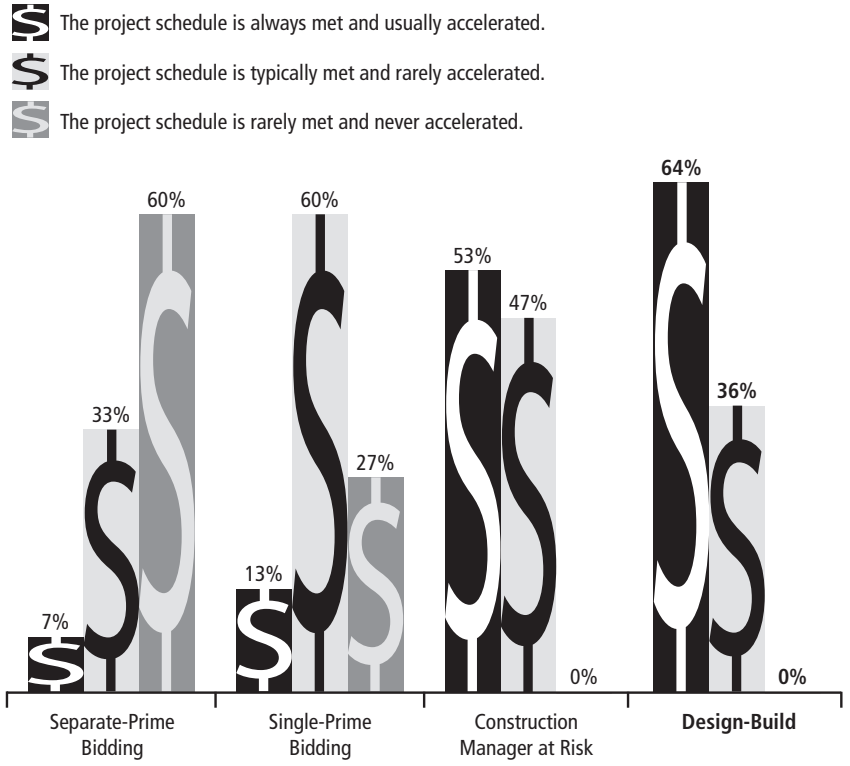
Experts suggested that public owners be aware that stakeholders take the initial decision deadlines less seriously because changes can be made later. Another challenge with these methods is that checks and balances can create a

Figure 5. **Controlling Project Costs**



Note: The method in bold type is the most effective in controlling project costs.

Figure 6. **Meeting the Project Schedule**



Note: The method in bold type is the most effective in meeting the project schedule.

strained relationship and hinder coordination. This is especially important in separate-prime bidding because the designer may work with four prime contractors.

By all accounts the multiple-prime delivery system for this campus was a total disaster, and we have absolutely no intention of using this system for future construction projects. The majority of our future projects costing more than $15,000,000 will be candidates for construction manager at risk. The balance will in all likelihood be bid and awarded on the single-prime basis.

—Clyde D. Robbins, director of design and construction, Appalachian State University

Ensuring a Quality Project

The definition of what makes a quality project varies in the construction industry. Because of this, the questionnaire asked whether the functional and aesthetic goals of a project are met, rather than asking if the methods ensure a quality project.

There was little distinction among the methods. Forty percent of experts responded that functional and aesthetic goals are always met using single-prime bidding, construction manager at risk, or design-build. Twenty-seven percent thought that using separate-prime bidding is best. (For a graphic presentation of the results, see Figure 7.) Overall, experts indicated that public owners have the greatest chance for a quality project using construction manager at risk.

Under construction manager at risk, public owners benefit from having input from construction personnel during design. This also is a characteristic of design-build. However, a conflict of interest can occur under design-build. Unlike the case with construction manager at risk, with design-build, the designer is no longer an independent adviser. When using this method, public owners should be aware that the design-builder is likely to cut corners because it both interprets design needs and may seek the lowest cost alternative.

Like the case with construction manager at risk, under the design-bid-build methods, the designer is an independent adviser. (That is, under these methods the owner holds separate contracts with the designer and the construction manager, so they are not contractually responsible to the prime or general contractors.) Because of this and the expanded design phase, several experts indicated that a quality product is more common when using these methods. The designers are not under a deadline to produce high-quality design documents. All experts agree that having good design documents ensures a quality product.

When asked about the risks of these methods, experts again cited the contract-selection process. One explained that even well-qualified firms may be forced to shortchange the public owner on quality of supervisory staff in order to submit a bid low enough to win. Public owners should be aware of this risk and the probability that short-changing will multiply as more contractors become involved.

Dare County found through experience that the single-prime process provided only a guaranteed minimum price for our new Justice Center and that the only incentive for maintaining a schedule was a punitive one in the form of liquidated damages. After much research and discussion and since it was before the passage of Senate Bill 914, the county obtained local legislation to allow alternative methods for the project. The county ultimately decided upon a design plus construction-manager-at-risk approach. [The county had the design done before it solicited for a construction manager.] We were able to obtain a guaranteed maximum price for the project, to include incentives for schedule improvements and for savings of the budgeted contingency, and to obtain a quality product knowing that both the architect and the contractor were on the same team and had the same boss.

—David Clawson, CPA, finance director, Dare County

Reducing the Administrative Burden

Experts were asked whether the public owner is less involved, moderately involved, or highly involved in the design, bidding, and construction phases. Responses indicated that design-build called for the least involvement, thus providing the greatest reduction of administrative burden. It was followed by construction manager at risk. Design-bid-build using single-prime bidding ranked a close third, and separate-prime bidding ranked last.

In general, the results indicate that the administrative burden increases with the number of contracts. The design-build method benefits the public owner by involving only one contract. There is only one line of communication for the owner. With construction manager at risk and single-prime bidding, the public owner holds two contracts, and with separate-prime bidding, five. Each contract involves developing a bidding package, issuing it, receiving proposals, evaluating them, negotiating the contract, and overseeing its implementation.

Even though the design-bid-build methods ranked low, experts stated that they are easy to understand and public owners have worked with them for some time. Many experts said that there is confusion in the industry because the construction-manager-at-risk and design-build methods are relatively new and are used differently. For example, with construction manager at risk, opinions differ about when proposals should be requested for the construction manager.

Some public owners request proposals for the designers and the construction manager at the same time, while others request proposals for the construction manager after schematic design. Because these methods are relatively new, experts suggested that public owners consider using the design-bid-build methods until more experience is shared in the public contracting industry.

Regardless of method used, owners' involvement depends on how much time they dedicate to a project. Experts think that public owners should carefully judge their involvement and capacity level so that they do not lose control of the project.

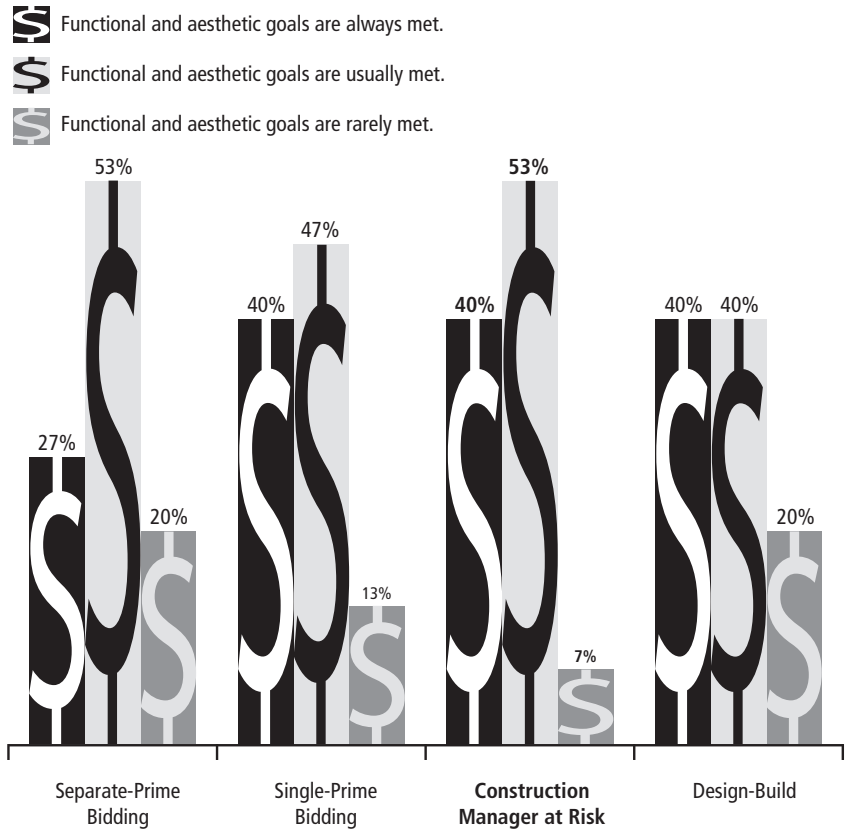
Further Considerations

Overall, the study reveals that experts think the construction-manager-at-risk and design-build methods control project costs, reduce time, improve quality, and decrease administrative burden more than the design-bid-build methods. However, public owners should recognize that additional factors will influence their decision in choosing the best method: whether or not they are developing a project program; whether or not they are working with multiple stakeholders; and whether or not they are using in-house design and construction staff.

First, experts agree that the key to a successful project is a comprehensive project program. Some project delivery methods offer greater assistance than others during this process. Public owners should consider the design-bid-build methods if they do not develop a project program because the design period allows for more time. Because the construction-manager-at-risk and design-build methods have shorter design phases, public owners must ensure that a program is developed early using construction manager at risk and is well developed for design-build. For example, with design-build, development includes classifying detailed building components early on.[16]

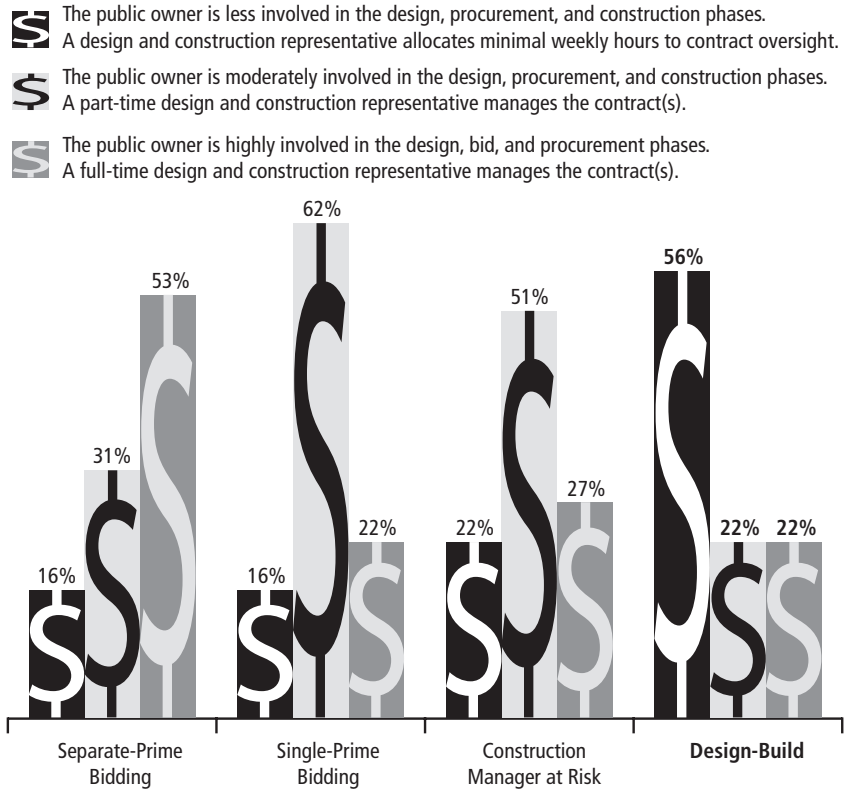
Next, stakeholder involvement may force public owners to choose one of the two design-bid-build methods. The longer design period of these approaches allows interest groups representing

Figure 7. **Ensuring a Quality Project**



Note: The method in bold type is the most effective in meeting the functional and aesthetic goals of a project.

Figure 8. **Reducing the Administrative Burden**



Note: The method in bold type is the most effective in reducing the administrative burden.

several public agencies and the general public more time to discuss options. The phased construction approach used in the design-build and construction-manager-at-risk methods relies on speedy decisions by the public owner.

Finally, public owners that have no in-house design and construction staff and whose staffs have heavy workloads or no training with the construction-manager-at-risk or design-build methods should consider the design-bid-build methods until the public construction industry has more experience with these approaches.

staff is less experienced. Because of this, public owners may find that the design-bid-build methods, especially the single-prime bidding method, will continue to be useful in many situations.

Notes

1. The federal government has separate procedures for project delivery. The laws of North Carolina do not apply to Army Corps of Engineers projects, federal buildings, or federal military bases in North Carolina.
2. N.C. GEN. STAT. art. 8, Public Contracts, § 143-128 [hereinafter G.S.].
3. G.S. 143-135.26(9).

Appalachian State University has to date initiated three projects using the construction-manager-at-risk delivery system: the Library and Information Commons ($47,586,800), the Rankin Science Addition and Renovation ($11,157,000), and the Athletic Facilities Addition and Renovation ($16,000,000). The library project is proceeding in excellent fashion—on budget and ahead of schedule. The construction-manager-at-risk method for the Rankin project did not meet our expectations and was not continued beyond the preconstruction phase. The project was subsequently bid and awarded using the single-prime delivery system, which to date is proceeding satisfactorily.

—Clyde D. Robbins

Conclusion

Changes always are taking place in the construction industry. New tools are available to manage projects, and new building techniques are being used. Each new approach spawns claims that it will save money, reduce time, improve quality, and decrease administrative burden. To protect themselves from misleading claims, public owners should stay abreast of new laws and information.

This study has shown that experts consider the construction-manager-at-risk and design-build methods to be the best for controlling costs, reducing construction time, improving quality, and decreasing the administrative burden. However, public owners may not realize the benefits of these methods if their project program is not well developed, many stakeholders are involved in decision making, and their

4. To make a comparison, one would have to replicate a project exactly under each project delivery method. This would mean using the same design, staff, site, and time frame simultaneously.
5. The goals were developed during the literature review.
6. Confidentiality was assured to the experts during this research.
7. Representatives from the American Institute of Architects, the Associated General Contractors of America, Design Build Institute of America, and Construction Managers Association of America are currently collaborating on developing industry-wide definitions documenting the variations for each method.
8. The public owner develops the selection criteria. They may include the public owner's previous experience with the firms, and the firms' financial capability, staff qualifications, history of litigations and disputes, and references from past clients. Bids are solicited using a request for proposals (RFP) or a request for qualifications (RFQ).
9. The term "at risk" refers to the construction manager's assuming high risk, for example, for the performance and the financial stability of subcontractors and vendors, fluctuations in prices of materials, adherence to schedule, and weather changes. The high risk also is linked to a guaranteed maximum price, which is explained later in the article.
10. In some cases the public owner attempts to attract a company that has the ability to perform both design and construction management. If that happens, then instead of requesting proposals for a second time, it renegotiates a guaranteed maximum price with the company later in the design process.
11. Several experts noted that the selection process takes place when the schematic-design phase of design is complete.
12. The public owner determines the point in the design phase when the guaranteed maximum price is to be negotiated. Several experts indicated that the guaranteed maximum price is negotiated toward or at the end of the construction-documents phase.
13. As with design-bid-build with separate-prime bidding, bid packages may be prepared for heating, ventilating, and air conditioning; plumbing; electrical work; and general construction.
14. After the design-builders develop the proposals, the public owner critiques each one. Then each design-builder responds with design changes that make all the proposals technically equivalent, adjusting the price accordingly. The public owner evaluates the revised proposals and makes the award on the basis of the lowest price. A lowest-price award is made because the public owner's critique created equivalent designs.
15. Experts revealed that savings produced during the execution of the contract revert to the public owner. In some cases the public owner and the construction manager share the savings. This is known as a "shared savings program." When the direct project costs, including profit and overhead, are less than the guaranteed maximum price, the construction manager and the public owner share the difference on the basis of some stipulated percentage. Experts said that the shared savings program provides an additional incentive to the construction manager to control project costs.
16. An example of such a component is a building's air handling units. The term "air handling unit" refers to equipment that is designed to move conditioned air. It contains fans, filters, and heating or cooling coils. Units can be classified as either a central system or a unitary system. Unitary equipment can be classified as a rooftop unit, a unitary package unit, a unitary split system, or a compound room unit.