# THE IMPACT OF THE SELECTION OF CONSTRUCTION DELIVERY METHOD ON ACHIEVING BEST VALUE AND SUSTAINABLITY: THE EUROPEAN AND U.S. EXPERIENCES

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ABSTRACT: This paper provides a literature-driven review of the sustainable-construction movement in the United States and Europe and explores the state of authorized procurement methods in the United States and Europe. The current budget malaise in the United States and Europe demonstrates the importance of using the best methods for achieving the dual goals of sustainable construction with efficient expenditure of public funds. This paper focuses on two of the most-used construction delivery methods, design-bid-build and design-build to evaluate which method best achieves these goals. To accomplish this task, this paper explores the findings of several studies and published reports covering the topics of the sustainable construction movement and the best methods for achieving sustainable construction.

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## INTRODUCTION

Achieving sustainable construction is an increasingly sought-after goal in public procurement projects. As individual states expand green and sustainable procurement requirements, procurement professionals have sought the best methods by which to achieve the government's objectives. National governments in Europe and the United States also have increasingly adopted sustainable objectives in public procurement, as evidenced by the growth of green certification programs in Europe and the United States. The growing interest in sustainable construction, however, comes during a time of decreased government revenues and budget cuts across the political spectrum. Indeed, in the United States, "Federal agencies are being directed to achieve a 15 percent reduction in costs for managing contracts over the next year under a new component of the Obama administration's Campaign to Cut Government Waste" (Clark, 2011). Likewise, "[n]umerous federal agencies have been instructed by the administration and/or their respective department/agency leadership to re-baseline their spending to fiscal year 2008 levels" (Garrett & Beatty, 2011, p. 12). This means that "many government agencies, which have benefited by large increases in funding in fiscal years 2009 and 2010, are going to have to make significant cost reductions to operate at a much lower budget" (Garrett & Beatty, 2011, p. 12). One only has to observe the austerity cuts in several European nations to understand the budget crunch affecting Europe.

The challenge of lower budgets presents strategically-minded public procurement professionals an opportunity to help their clients optimize goals for value and sustainability. Thus, it is important for procurement professionals to use construction delivery methods best suited for the dual goals of achieving sustainability while allocating public funds wisely.

This paper aims to provide a literature-driven review of the sustainable-construction movement in the United States and Europe. This paper focuses on the two most-used construction delivery methods, design-bid-build and design-build, to evaluate which method best achieves the goals of best value, sustainable

construction. To accomplish this task, this paper explores the findings of several studies and published reports covering the topics of the sustainable construction movement, the best methods for achieving sustainable construction, and offers policy recommendations to expand successful procurement methods for sustainable construction.

## DISCUSSION

### THE SUSTAINABLE CONSTRUCTION MOVEMENT

Controlling the social, environmental, and economic costs of construction is essential for sustainable procurement and development. Indeed, "[b]uildings in the United States are responsible for 39% of CO2 emissions, 40% of energy consumption, 13% water consumption and 15% of GDP per year" (U.S. Green Building Council, 2011, "About USBGC," para. 3) (hereafter USGBC). Table 1 provides a visual demonstration of the impact that buildings alone have in the United States.

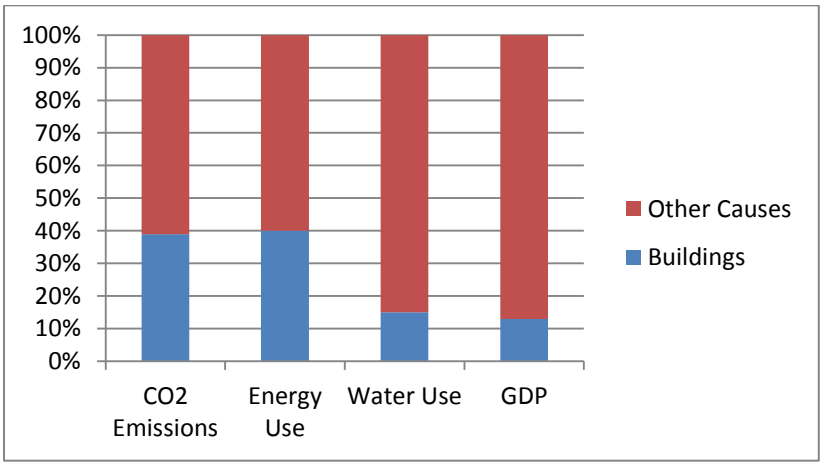


Table 1.

Some argue that "[g]reater building efficiency can meet 85% of future U.S. demand for energy, and a national commitment to green building has the potential to generate 2.5 million American jobs" (USGBC, 2011, "About USBGC," para. 3). European governments consider sustainable development so essential that "environmental protection requirements are to be integrated into the definitions and implementation of the Community policies and activities referred to in Article 3 of the EU Treaty, in particular with a view to promoting sustainable development" (Bovis, 2007, p.108).

For example, in the United States, "[a] wide array of legislation relating to high-performance, resource-friendly, healthy and green buildings has been considered in state legislatures in 2011" (Sigmon, 2011, p. 1). Sigmon (2011) highlights that "Colorado, Delaware, Maryland, Nevada, and Oregon succeeded in navigating the budget debates and found support for investing in the energy, water and financial savings that green buildings
are designed to deliver, and Wyoming enabled local governments to make similar investments," part of the of the "30 wins for green building across 22 states" (Sigmon, 2011, p. 1). Perhaps the wave of the future, "both legislation and regulation in Alaska, California, Idaho, Maryland, Michigan, Nebraska, North Carolina, Ohio, Oregon, Tennessee, Texas, Vermont, Virginia, Washington and Wisconsin facilitated the advancement of improved mandatory minimums through building codes" (Sigmon, 2011, p. 1).

In short, governments have begun to take seriously the reality that construction and the life cycle costs of buildings have an immense impact on the environment, resource consumption, and society, which is reflected in the burgeoning codes, standards, and laws at all levels that implement preferences and requirements for sustainable construction. Indeed, "[t]he demand for sustainable buildings in the United States…has risen due to accelerated depletion of natural resources, rising energy costs and green house gas emissions, and increased awareness of indoor environmental quality" (Molenaar et al., 2010, p. i). Not limited solely to energy issues,

however, "this demand expanded…to prioritiz[e] maximum energy conservation and occupant well being" (Molenaar et al., 2010, p. i).

As populations expand and resources are used, the demand for additional buildings and infrastructure requires procurement professionals to adapt their acquisition strategies to meet the call of the times. To that end, professionals in the United States and across Europe have developed measures of sustainability and have sought to implement these measures across the spectrum of construction projects in both the private and public sectors.

### *LEED in the United States*

The most common measure of sustainable development and construction that has been widely adopted in the United States is promulgated by the U.S. Green Building Council (USGBC), through the LEED Green Building Rating System. The goal of the LEED system is "[t]o transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life" (USGBC, 2011, "About USBGC," para. 4). LEED certification is based on a 100-point scale. The points are allocated based on the appropriate categories for the specific type of construction (new or renovation), with up to 10 bonus points possible. Points are also "weighted to reflect their potential environmental impacts" (USGBC, 2011, "How to achieve certification," para. 1). Projects that achieve 40+ points are LEED Certified, 50+ points are Silver, 60+ points are Gold, and 80+ points earns the highest level, Platinum certification. The specificity of the categories, ranging from water efficiency, energy use, indoor environmental quality, and materials used in construction, to name a few, demonstrate the complexity of the point system.

LEED has been widely successful in the United States (and around the world), as evidenced by the 16,000 member organization, 78 local affiliates, and over 170,000 LEED Professional Credential

holders (USGBC, 2011, "About USBGC," para. 1). The U.S. Green Building Council is proud of its "diverse constituency of builders and environmentalists, corporations and nonprofit organizations, elected officials and concerned citizens, and teachers and students" (USGBC, 2011, "About USBGC," para. 2). Del Percio (2007) noted that a recent General Services Administration report found that LEED was "'the most credible' of five green building rating systems it evaluated" (Del Percio, 2007, para. 6). The GSA's study compared LEED with "Japan's Comprehensive Assessment System for Building Environmental Efficiency (CASBEE), the United Kingdom's Building Research Establishment's Environmental Assessment Method (BREEAM), a software program called GBTool, developed in 2000 by a consortium of sixteen nations to assess buildings' environmental impact, and the Green Globes, a European green building rating, from 1991" (Del Percio, 2007, para. 6).

Critics of LEED, however, contend that LEED is not a panacea for achieving sustainable development and construction. Some argue that LEED is "a costly and bureaucratic certification process" which is reflected by a low project certification (Del Percio, 2007, para. 6).

"Since 2000, LEED for new construction (LEED-NC) has gotten 3,113 registered project applications. But only 403 have been certified by USGBC - a lackluster thirteen percent clip" (Del Percio, 2007, para. 3). Perhaps more telling is that "[d]espite the fact that they were building an exemplary green building project, the designers of the new 52-story New York Times Tower . . . did not apply for LEED certification" (Del Percio, 2007, para. 3).

Another criticism of LEED is that the ten-point spread between certification ratings incentivizes meeting the bare minimum in order to achieve the desired certification. There is no incentive to aim for the high end of the point-spread. Thus, if a new building in Chicago requires a Silver LEED certification, designers have the incentive to garner necessary 50 points, and not 55 or 56 points, because no competitive advantage is gained by the additional work and expense.

The success of LEED and the U.S. Green Building Council, however, demonstrates the urgency of sustainable development and sustainable construction that policy makers have implemented on a wide scale. Indeed, LEED initiatives such as "legislation, executive orders, resolutions, ordinances, policies, and incentives are found in 442 localities (384 cities/towns and 58 counties and across 45 states), in 34 state governments" (USGBC, 2011, "Policy and Governmental Resources," para. 2). In addition, LEED initiatives are found in "14 federal agencies or departments, and numerous public school jurisdictions and institutions of higher education across the United States" (USGBC, 2011, "Policy and Governmental Resources," para. 2).

### *BREEAM and European Measures of Sustainability*

Several European sustainable development rating initiatives exist, in addition to the national Green Building Councils in individual European nations. One of the most popular and widely used standards is BREEAM, which is the "first environmental building rating system in the world" (Gu et al., 2006, p. 183). This ratings scheme has been used to certify more than 110,000 buildings, mostly in the UK (Cheshire, 2011, "BREEAM versus LEED," para. 3). BREEAM Europe Commercial, for example, works with individual nations' National Scheme Operators to measure the sustainability of construction projects for "retail, office, and industrial buildings" (BREEAM, "Which countries," para. 3). Where there is no National Scheme Operator, however, then the standards of BREEAM Europe Commercial can be used to determine eligibility for BREEAM certification (BREEAM, "Which countries," para. 3).

BREEAM is based on measuring the environmental impacts of construction projects via a ten-category weighting scheme. The categories include: "Management, Health and Wellbeing, Energy, Transport, Materials, Waste, Water, Land Use and Ecology, Pollution and Innovation" (BREEAM, "BREEAM Europe Commercial," para. 4). Each category receives a score, which is weighted, then the "weighted scores are combined and the final score translated into a rating of Pass, Good, Very Good, Excellent or Outstanding" (BREEAM, "BREEAM

Europe Commercial," para. 6). Michler (2010) explains that "BREEAM uses a point system that covers a multitude of sustainable building issues such as reductions in water and energy use, increasing natural lighting and fresh air, the use of recycled materials, and placement" (Michler, 2010, para 2). Parker (2009) notes that in the UK, many "Government departments require BREEAM ratings of all their buildings" and "most local authorities require BREEAM as part of planning approval for developments over a certain size" (Parker, 2009, "BREEAM or LEED," para. 28). Cheshire (2011) argues that as compared to LEED in the UK, BREEAM is dominant "simply because [BREEAM] is better adapted to UK legislation and standards, and consequently, is cheaper to apply" (Cheshire, 2011, "BREEAM versus LEED," para. 25).

The widespread use of LEED and BREEAM demonstrates a growing interest and commitment to sustainable development in the United States and across Europe. The importance of construction to the overall measures of sustainability is also reflected in both of these ratings schemes. Within these formalized certification regimes, however, public procurement professionals and their clients are further limited by the legal strictures binding construction delivery. The remainder of this paper turns to the impact of construction delivery methods, to be understood in light of the certification and rating schemes wherein developers and procurement professionals operate.

## CONSTRUCTION DELIVERY METHODS AND FLEXIBILITY FOR SUSTAINABLE DEVELOPMENT

Public procurement professionals operate within the legal regimes and legislative schemes of their national, regional, or local governments. Consequently, several methods of procuring construction exist across the individual fifty states of the United States, the federal government of the United States, the European Union, and localities within European nations. The most common methods of construction procurement in the United States and across

the EU member nations include the traditional method of design-bid-build, and several alternative methods, including design-build, construction manager agent, construction manager at risk (or Fixed Price Contract), design-build-operate-finance-maintain, and various Public Private Partnership methods.

### *Design-Bid-Build Prevalence and Experiences in the United States and Europe*

Hale (2005) explains that the typical design-bid-build project will begin with the owner and an architect/engineer firm engaging in a contract. The contract will specify the owner's requirements, and from the information obtained from the owner the design team will draw the plans and specifications for the building. Then after this design phase is completed, the owner will enter a new contract with a construction firm via a bidding process whereby construction firms provide bids to the owner based on the design documents provided (Hale, 2005). The essential elements of a typical design-bid-build are the clear separation between designing and building the project and the bidding process that occurs between the designing and the building.

In many jurisdictions that require use of design-bid-build, the public procurement official must award the contract to the lowest responsive and responsible bidder. The National Institute for Government Purchasing (NIGP) defines the lowest responsive and responsible bidder as "[t]he bidder who fully complied with all of the bid requirements and whose past performance, reputation and financial capability is deemed acceptable and has offered the most advantageous pricing or cost benefit, based on the criteria stipulated in the bid documents" (NIGP, n.d.).

### *Design-Bid-Build Use in the Individual American States*

The fifty state governments and the semi-autonomous District of Columbia have different and distinct governing procurement laws that regulate when, where, and to what extent design-bid-build can or must be used to procure public construction delivery. After

conducting a survey of state statutory codes and reviewing supplemental sources from the Design Build Institute of America (DBIA, 2010), the authors found that every state and the District of Columbia specifically authorize the design-bid-build method of construction procurement. In a majority of states the law requires the design-bid-build method of procuring public construction projects except where an authorized entity finds that an alternative method would be more advantageous for the state. For example, in Connecticut, the law allows the Commissioner of Public Works to designate a project as a 'designated total cost basis project' whereupon an alternative construction delivery method may be utilized (Conn. Gen. Stat. 4b-24(4)). No states *require* design-build for public construction projects, but rather merely authorize its use in specific situations. Additionally, one state, Mississippi, requires use of design-bid-build for large public construction projects (Miss. Code Ann. 31-7-13(c)(i)(1)) except where the legislature, by specific statutory authorization, permits the use of design-build for an individual project (Miss. Code Ann. 31-7-13.1(1)). Few other states require the use of design-bid-build with as draconian a limitation on alternative construction delivery methods as does Mississippi.

### *Design-Bid-Build Use at the Federal Level*

The Federal government in the United States promulgates its procurement law through the Federal Acquisition Regulation (FAR). Like the individual states, Federal law allows specifically for the design-bid-build approach and provides procedural guidelines and requirements. In section 6.401, Federal law allows for both sealed bids and competitive proposals, but the law prefers the use of sealed bids. The law states that competitive proposals may only be used if "sealed bids are not appropriate" (FAR 6.401(b)(1)). Thus, Federal law contemplates that in general, the standard construction contract will be accomplished though the design-bid-build methodology.

There are situations, however, where Federal law contemplates that an alternative method of construction delivery should be used, as evidenced in the FAR sections cited above. The reasons for preferring a competitive proposal method primarily rest

on situations where "consideration of technical factors other than price; discussion with offerors concerning offers submitted; negotiation of contract price or estimated cost and other contract terms and conditions; revision of proposals before the final contractor selection," among other factors, are important (HUD, 2007, p. 7-1). In this scenario, the Federal procurement official usually awards the contract on the "basis of the proposal that represents the best overall value" taking into account "price and other factors, e.g., technical expertise, past experience, quality of proposed staffing, etc., set forth in the solicitation and not solely the lowest price" (HUD, 2007, p. 7-1).

While the traditional design-bid-build method was the standard and typical mode of procuring construction delivery at the Federal level, "due to changes in procurement laws, public agencies now share the ability of their private-sector counterparts to acquire construction services via alternative project delivery methods" (Touran et al., 2009, p. 1). Even though Federal law currently allows the use of alternative methods of procuring construction delivery, it is important to bear in mind that the Federal Acquisitions Regulations and other regulatory schemes maintain a certain bias in favor of methods compliant with design-bid-build. For example, the Design Build Institute of America recently heralded the passage of the Fiscal Year 2012 Appropriations bill, which was itself a combination of three funding bills as a Continuing Resolution. "The Agriculture bill report upheld language previously passed in the House of Representatives that encourages the use of the design-build project delivery method" (Thomas, 2011, para. 1). This change is important, because until the passage of this bill in 2011, "the USDA-RD's preferred project delivery method has been design-bid-build and the result has been a chilling effect on the use of design-build for local projects" (Thomas, 2011, para. 2). The potential of being denied federal loans and loan guarantees "if they opted to use design-build prompted many local governments use design-bid-build. Higher costs and project delays frequently resulted. In addition, design-build practitioners lost the opportunity to work on these projects" (Thomas, 2011, para. 2).

In short, while the Federal government has opened the door to using non-design-bid-build methods, the bulk of Federal

construction projects remain under the direction of the design-bid-build method.

## Procurement Methods in the EU and European Nations

The European Union and individual European nations, like the United States, utilize a plethora of construction delivery methods. Jeffers et al. (2007), as part of a scan team representing the United States, travelled to Europe to evaluate the various procurement methods used, focusing on road and transportation construction. They visited England, France, Ireland, Portugal, and Spain (Jeffers et al., 2007). "In Europe, major projects generally are defined as greater than $14 million and are carried out under some type of design-build (DB) process, including design-build-finance-operate (DBFO) and design-build-operate-maintain (DBOM), rather than the design-bid-build model (DBB) that is the U.S. standard" (Jeffers et al., 2007, p. 17). Thus, insofar as transportation construction is concerned, these European governments do not use design-bid-build as the preferred mode of construction delivery.

Cox et al. (2002) studied the European nations of Portugal, the Netherlands, France, and England to learn the contract administration procedures of those countries, with the intent to implement superior procedures in the United States (Cox et al., 2002). This scan team discovered that in Europe, "[s]tandard EU regulations. . . and use of alternative contracting methodologies by many different EU members . . . mak[e] it easier for EU members wanting to use alternative methodologies to obtain internal legislative approval to proceed" (Cox et al., 2002, p. 13). Cox et al., (2002) reported that "[i]nnovations in procurement, contracting methods, and payment methods have resulted in an enhanced collaboration with the private sector. The European construction industry is beginning to understand the mutual benefit of long-term relations and managing its supply chain" (Cox et al., 2002, p. 13).

Cox et al.. (2002) were struck with the difference between American and European procurement emphasis. They found that one

of "the most notable difference between European and U.S. procurement methods is that best value (referred to in the Directive as 'most economically advantageous tender') is used in virtually all types of procurements" (Cox et al., 2002, p. 14). This is a sharp contrast to the decisionmaking process in American design-bid-build procurement, because "[b]est-value selection involves the evaluation of technical and management factors in addition to cost—as opposed to the low-bid selection, which involves only cost comparison of responsive bids from responsible bidders" (Cox et al., 2002, p. 14). Indeed, Cox et al. (2002) notes that "[a]lthough the EU Directive permits low-bid selection. . . . [t]he Europeans have found that best-value selection, using transparent and uniform processes, enhances competition and innovation" (Cox et al., 2002, pp. 14-15).

As between individual nations, Germany is most similar to the United States in its choice of construction procurement methodology. DeWitt et al. (2005) found that "Germany primarily uses a traditional design-bid-build system with a low-bid procurement, but it has a system to allow for alternate designs/proposals to be submitted at the same time as contract bid submissions" (DeWitt et al., 2005, pp. 10-11).

In Finland, DeWitt et al. (2005) also found that, at least for Finnish Road Administration procurement, "[t]he most common form of project delivery has been the traditional design-bid-build method, which accounted for about 75 percent of all projects by quantity and about 35 percent based on the total expenditure in 2002" (DeWitt et al., 2005, p. 12). Though design-bid-build, by quantity, vastly exceeded alternative methods in 2002, even at that time, "[c]ontract development has advanced toward more integrated methods, such as use of the design-build project delivery method, which accounted for about 25 percent of all projects by quantity and about 65 percent of the total expenditure in 2002" (DeWitt et al., 2005, p. 12).

The Netherlands, in 2004, was on the verge of a sea-change in its procurement strategy. DeWitt et al. (2005) reported that the "traditional project delivery method in the Netherlands is a design-bid-build system. The Netherlands, however, is making a major shift

toward design-build in the next 4 years" " (DeWitt et al., 2005, p. 11). DeWitt et al. (2005) found that "[t]he primary reason for this shift is a philosophy of risk shifting to the private sector" (DeWitt et al., 2005, p. 11). In a dramatic shift, the Netherlands in 2004 used design-bid-build for 67% of the public project delivery methods, while it was projected that by 2007 the Dutch would use design build for 90% of such projects (DeWitt et al., 2005, p. 11).

Scotland is more progressive with their shift from the traditional to alternative methods of construction delivery. "Since 1990, Scotland has shifted from traditional unit price design-bid-build to design-build. About 70 percent of the program is delivered using the design-build method" (DeWitt et al., 2005, p. 12). Scotland does use the traditional design-bid-build method "[f]or projects under €5 million. . . with a lump-sum bid, and provides 100 percent plans to the prospective bidders for lump-sum project delivery. For projects over €5 million, Scotland uses several design-build processes" (DeWitt et al., 2005, p. 12).

DeWitt et al. (2005) also considered the prevalence of best-value procurement within the methodologies of design-bid-build and the alternatives used in Europe and Canada. They concluded that "Finland, England, and Scotland use best-value procurement almost exclusively. Germany and Ontario generally award construction contracts on the basis of low price" (DeWitt et al., 2005, p. 20). The Netherlands, perhaps unsurprisingly, is more progressive than the other countries in this realm, as "[t]he Netherlands uses [best-value considerations] for all design-build projects and also on selected design-bid-build projects, particularly in conjunction with those projects in which it shortlists contracts" (DeWitt et al., 2005, p. 20).

### *Design-Build Use in the American States and the Federal Government*

As highlighted previously, the state and Federal governments allow for alternative construction delivery procurement methods, after satisfying various hurdles. Not all states, however, impose high barriers to utilizing the design-build procurement strategy. Most

states simply require an agency official or authorized individual to determine that design-build is more advantageous than design-bid-build before a specific public project for construction can be procured through design-build. The last decade has revealed a burgeoning use of design-build across the states and in the Federal government. A report conducted by RCD/RSMeans Market Intelligence shows that design-build commands "slightly more than 40 percent of market share [of non-residential construction projects]. . . with steady growth of the delivery method since 2005. Usage rates and market size were calculated for projects bid between 2005 and 2010" (DBIA, "Design-build project delivery," 2011, para. 2). Furthermore, nearly "80 percent of military construction projects . . . are delivered via design-build. Design-build for medical construction, which includes hospitals, clinics, nursing homes and offices, and design-build for commercial construction (offices and parking garages) have exceeded 40 percent of market share" (DBIA, "Design-build project delivery," 2011, para. 3).

Since the Federal law changed with the Federal Acquisition Regulation's (FAR) approval of the integrated approach, many Federal projects have used design-build. For example, the Naval Facilities Engineering Command (NAVFAC) uses design-build for nearly 75 percent of their projects (Hines, 2010, p. 12). NAVFAC's Joseph Gott, the Capital Improvements director and chief engineer, stated that "'[t]he largest reason we select a project for the design-build delivery vehicle is the single point of accountability and responsibility. We have an architect-engineer and a design-build constructor on the same team and have a contract with one company'" (Hines, 2010, p. 12). Another Federal entity, the Federal Bureau of Prisons, "has relied exclusively on design-build project delivery" since the 1990s (Hines, 2010, p. 14). The Federal Bureau of Prison's Pete Swift explained that "'[d]esign-build shortens the delivery period because it eliminates the procurement phase between the design and the construction phase'" (Hines, 2010, p. 14). In short, design-build has been used and continues to be used on an expanded basis across the public procurement sectors at the state and Federal levels.

## SUSTAINABLE PROCUREMENT COMPARED ACROSS CONSTRUCTION DELIVERY METHODOLOGIES

The preceding sections of this article highlight the growth of the sustainable construction industry and the growth of alternative procurement methods in the United States and Europe. These two growth systems directly impact the efficacy of sustainable procurement of public construction projects. This section evaluates the efficacy of procuring sustainable construction products through the design-bid-build and the design-build methods. Molenaar et al. (2010) conducted a groundbreaking performance study of the influence that project delivery methods have on the achievement of sustainable buildings. Each of the buildings studied pursued sustainable products through LEED certification and ranking. Molenaar et al. (2010) performed twelve case studies of the project delivery stage and "compared them with building performance at project completion" (Molenaar et al., 2010, p. i). The researchers found "that the level of integration in the delivery process affects final project outcomes, particularly sustainability goals" (Molenaar et al., 2010, p. ii). Importantly, "[t]he findings also suggest that strong owner commitment towards sustainability, early involvement of the constructor, and early inclusion of green strategies are crucial attributes for a delivery process that can potentially affect project outcomes, especially sustainability goals" (Molenaar et al., 2010, p. ii). These conclusions bear important implications for public procurement officials when choosing a project delivery method, especially if the goal is to obtain a sustainable construction product.

Molenaar et al. (2010) studied twelve construction projects, including three design-bid-build projects and four design-build projects. While the majority of all the projects studied were private enterprises, the results should inform public procurement strategies when pursuing sustainable construction. Molenaar et al. (2010) determined that integration was essential to successful sustainable construction. Integration refers to the concept of "highly effective collaboration among the owner, the prime designer, and the prime constructor" (American Institute of Architects, 2007). While integration can occur across every type of project delivery method,

the design-bid-build system usually separates the design element from the construction element. Since builders cannot collaborate with the designer since the builder is not chosen during the design stage, it should not be surprising that the three design-bid-build projects analyzed by Molenaar et al. (2010), ranked the lowest on the project integration scale (Molenaar et al., 2010, p. 15). As expected, the case studies showed that "[t]he responses from the participants suggested that the poor performance was mainly because the contractor only became involved at the bidding phase" (Molenaar, 2010, p. 15). This proved to be instrumental in undermining the effectiveness of the product's outcome. Molenaar et al. (2010) concluded that "projects delivered purely by the DBB method (i.e., contractor involvement at the biding phase) resulted in low integration and also lower overall success because the contractor could not provide input at the design phase" (Molenaar et al., 2010, p. 24).

In contrast to the lower level of integration in design-bid-build projects, the researchers found that the design-build projects had the highest integration scores of all the projects studied (Molenaar et al., 2010, p. 16). Indeed, all the "[p]rojects adopting the DB method mostly ranged at the high end of successful outcomes. Most of these projects had high levels of integration in the delivery process" and these projects possessed "high owner commitment" (Molenaar, et al., 2010, p. 21). Owner commitment is a significant determinant for success in the sustainable construction process. Procuring and delivering a sustainable building "is complex in nature owing to required interaction among multidisciplinary teams. Due to increased complexity, owners, as primary decision makers, must demonstrate high commitment toward the project and inclusion of green strategies" (Molenaar et al., 2010, p. 23).

The key lessons to be drawn from the Molenaar et al. (2010) study is that both design-bid-build and design-build project delivery methods "have the potential to facilitate *at least* a medium level of integration by informal involvement of the constructor at earlier phases of the design process (i.e., prior to construction documents)," and most importantly, "[p]rojects delivered purely by the DBB method (i.e., contractor involvement at the bidding phase) resulted in low

integration and also lower overall success because the contractor could not provide input at the design phase" (Molenaar et al., 2010, p. 23).

## RECOMMENDED LEGAL EXPANSION OF ALTERNATIVE PROCUREMENT DELIVERY METHODS

This paper has focused on the distinctions between design-bid-build and design-build methods for procuring construction projects because both methods are used extensively throughout the United States and design-build is heavily used in Europe. The studies and articles cited herein demonstrate that increased opportunity to communicate and collaborate amongst project stakeholders leads to improved outcomes for sustainable construction. Indeed, there is an increasing interest in using alternative methods of procurement to achieve sustainable buildings. Tolan (2011) notes that "[t]he trend in green building, using a consolidated design and construction team from project inception, benefits the government when using a design-build approach by avoiding constructability problems." (Tolan, 2011, p. 5).

Construction for LEED certification, for example, is best suited to clear communication and input between the designer and construction team. Touran et al. (2009) reported that the design-bid-build method suffers due to the "builder's lack of input … [which] means that there will be little opportunity to take advantage of builder knowledge of sustainable design, and the owner, in certain cases, can thereby risk losing LEED certification" (Touran et al., 2009, pp. 24-25). In comparison, when using design-build, the owner can specify expectations "by assigning weight to the LEED criteria in relation to other factors in the DB evaluation plan and by using sustainable design and construction as performance criteria during design and construction" (Touran et al., 2009, pp. 25).

These studies demonstrate the importance of early communication between the designers and the builders, especially when the owner expressly indicates a desire to achieve a sustainable construction project. While the growing demand for sustainable construction continues, the pressing issues of limited funds and

government budget provide an opening for strategic-minded public procurement professionals to creatively acquire the best products. As this article has demonstrated, increasing collaboration during the entire procurement process leads to the best outcomes for owners. The design-bid-build method is inherently limited in the collaborative opportunities afforded to project stakeholders given the separation in design and construction. In contrast, the unified nature of the design and building teams in the design-build method creates an environment where collaboration and communication more effectively takes place.

Thus, national, state, and local governments should authorize and encourage design-build and other procurement methods that emphasize the principles of early collaboration and maximize communication by depositing the designing and building responsibilities in the same entity. As between design-bid-build and design-build, this paper demonstrates that design-build is best suited for the challenge of achieving sustainable construction in the public procurement arena.

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