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Defining sustainability requirements for design-build (DB) contractor selection in public sector projects

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Abstract: The design-build (DB) delivery system is an effective means of delivering a green construction project and selecting an appropriate contractor is critical to project success. Moreover, the delivery of green buildings requires specific design, construction and operation and maintenance considerations not generally encountered in the procurement of conventional buildings. Specifying clear sustainability requirements to potential contractors is particularly important in achieving sustainable project goals. However, many client/owners either do not explicitly specify sustainability requirements or do so in a prescriptive manner during the project procurement process. This paper investigates the current state-of-the-art procurement process used in specifying the sustainability requirements of the public sector in the USA construction market by means of a robust content analysis of 40 design-build requests for proposals (RFPs). The results of the content analysis indicate that the sustainability requirement is one of the most important dimensions in the best-value evaluation of DB contractors. Client/owners predominantly specify the LEED certification levels (e.g. LEED Certified, Silver, Gold, and Platinum) for a particular facility, and include the sustainability requirements as selection criteria (with specific importance weightings) for contractor evaluation. Additionally, larger size projects tend to allocate higher importance weightings to sustainability requirements. This study provides public DB client/owners with a number of practical implications for selecting appropriate design-builders for sustainable DB projects.

Key words: sustainable buildings, design-build, contractor selection, sustainability requirements.

1. Introduction

Design-build (DB) is one of the integrated delivery systems in which one single entity is contracted to perform both design and construction services for the client/owner [1]. It is an effective delivery system due to advantages such as single-point responsibility, time saving, early cost certainty and increased constructability, and has been gaining popularity around the world in recent decades [2][3](Konchar and Sanvido 1998; Hale et al. 2009).

Latest studies indicate that DB is effective in delivering high performance sustainable construction projects (Molenaar et al. 2010; Korkmaz et al. 2010a, 2010b). With single responsibility, higher levels of team integration and efficient communication in design and build process, DB contractors are in the better position to provide innovative project solutions for client/owners' sustainability requirements. Additionally, as DB contractors are normally selected on the basis of best-value rather than lowest price, DB provides opportunities for design-builders to pursue green objectives in addition to those relating to time, cost and quality (Molenaar et

al. 2010). It is not surprising, therefore, that 75 percent of current new construction projects seeking sustainability certification in the USA were delivered with integrated project delivery methods including DB (Molenaar et al. 2009).

In order to deliver high-performance sustainable construction projects, client/owners need to clearly define their sustainability requirements at an early stage. In particular, as the success of projects depends largely on the selection of appropriate design-builders as they take full responsibility for coordination and project control (Xia et al., 2009), the client/owners should convey their sustainability requirements to the potential design-builders and include these requirements in the contractor selection process. However, to many DB client/owners, defining sustainability requirements is not an easy task, as the majority of project management plans in DB projects do not include sustainable objectives, which restricts the opportunities of contractors to evaluate sustainable solutions (Molenaar et al. 2010).

In order to help client/owners better define sustainability requirements for DB contractor selection, a content analysis was conducted of 40 DB request for proposals (RFPs) collected from public sector client/owners in the USA. The analysis not only provides a review of current practice in the DB industry but also offers practical implications to those involved in the delivery of sustainable construction projects.

2. Research methods

As the primary solicitation instrument in a DB project, the RFP is a document in which DB client/owners define and convey project requirements to prospective design-builders (Harris and MaCcaffer, 1995; Molenaar et al., 2000). For sustainable construction projects, client/owners need also to include their sustainability requirements in the RFPs so that they can be addressed accordingly by interested DB contractors in the project proposals.

Similar to Xia et al. (2012a, 2012b) and Xia et al. (2013), a rigorous content analysis of 40 DB RFPs was used to understand how USA public client/owners define their sustainability requirements for green buildings. Content analysis is an observational research methodology for studying the content of communications. It can help reveal any emerging themes in unstructured data.

40 sustainable construction projects DB RFPs were collected online, mainly from local (County, Town, City, State) governments; public schools; colleges and universities; US Army Corps of Engineers; Naval Facilities Engineering Command; and US, State and Federal Highway Administrations. These RFPs were posted publicly from 18 States between 2000 and 2013 and with an aggregate contract value of over \$1.2 billion. As shown in Table 1, the majority of the RFPs are for institutional buildings.

Table 1. Summary of the Data Sample

Project type	Number of RFPs
Institutional buildings	22
Commercial buildings	9
Renovation projects	4
Residential buildings	3
Civil and industrial projects	2
Total	40

For each proposal, the information of project size and location, time of release, Leadership in Energy and Environmental Design (LEED) certification levels, statements of sustainability requirements, importance weightings of sustainability requirements and price proposal, contractor selection methods and client/owner-provided design proportions were recorded for further analysis. Once the data for these variables were collected, qualitative and quantitative analysis was used to investigate how DB client/owners define their sustainability requirements and explore the relationships between the different variables involved.

3 Data analysis

3.1 Sustainability certification levels

The LEED rating systems cover all requirements for projects needing to achieve a certain sustainability certification. Different LEED levels in RFPs reflect client/owners' sustainability objectives. As shown in Fig 1, client/owners use "Encouraged but not required", "LEED Certified or Equivalent", "Minimum LEED Certified", "LEED Silver", "Minimum LEED Silver", "LEED Gold", and "LEED Platinum" to convey the message of sustainability targets. The "Minimum Silver" (43%) is the most frequently required, and more than 60% of the projects target silver or higher levels.

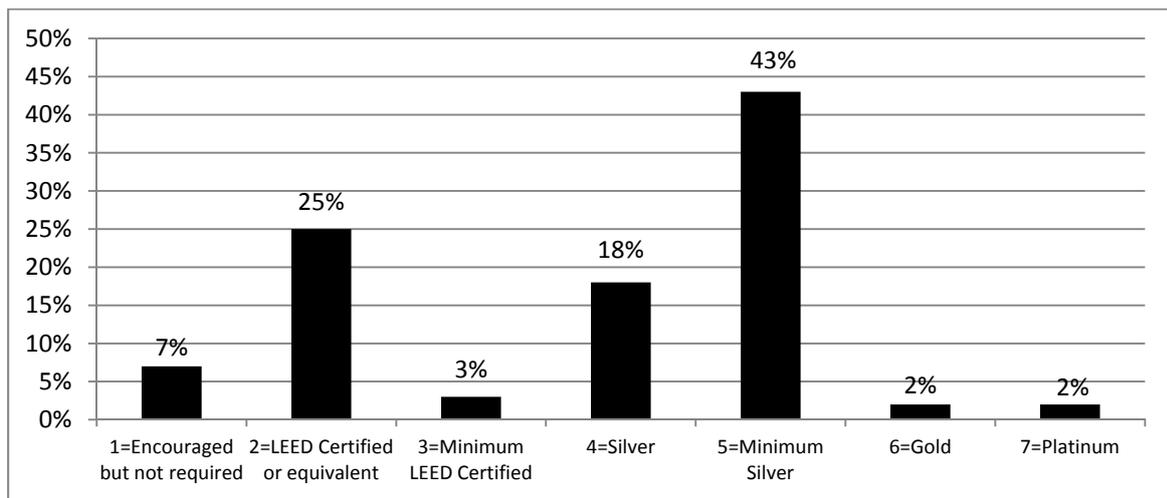


Fig 1. Sustainability requirements levels in RFPs

3.2 Sustainability requirements for contractor evaluation

In DB RFPs, client/owners need to establish the selection criteria, and their importance weightings, for the evaluation of prospective design-builders. According to Xia et al. (2013), the most frequently used selection criteria for design-builders are *price*, *experience*, *technical approach*, *management approach*, *qualification*, *schedule*, and *past performance*, with *price* as the most important criterion - accounting for 27% of the total weightings.

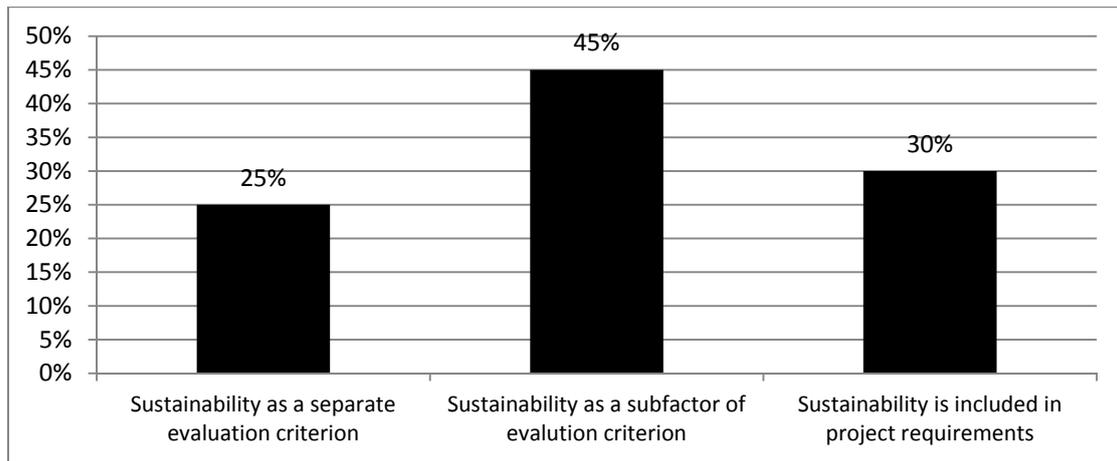


Fig. 2 Sustainability requirements for DB contractor evaluation

Of all the 40 RFPs for green DB projects, 25% (10 RFPs) include sustainability requirements as a separate evaluation criterion in addition to those in Xia et al. (2013) (see Fig 2). As shown in Table 2, “Approach to sustainability requirements” is the most frequently used expression for the sustainability evaluation of DB contractors.

Table 2. Expression of sustainability requirements as a separate evaluation criterion

No.	Expression of sustainability criteria	Frequency	Percentage
1.	Approach to sustainability (LEED) requirements	5	50%
2.	Sustainability with lower life-cycle cost (durability, maintenance, constructability)	4	40%
3.	Provision of LEED checklist	1	10%

Meanwhile, 45% of RFPs (18) include sustainability requirements as the sub-factor(s) of other selection criteria, i.e. technical approach, past performance and experience, and qualification of design-builders. The sustainability requirements are most frequently mentioned in design criteria and project performance specifications.

Table 3. Sustainability as a sub-factor of evaluation criterion

No.	Sustainability requirements	Frequency	percentage
1.	Sustainability as sub-factor of technical (design) approach	10	56%
2.	Sustainability as sub-factor of past performance, experience	7	39%
3.	Sustainability as sub-factor of qualification of design-builders	5	28%

Furthermore, the majority (68%) of RFPs allocate importance weightings to sustainability requirements, ranging from 1% to 25% in the contractor evaluation system. As shown in Fig 3, around 80% of the RFPs allocate less than 10% importance weightings to sustainability requirements. For those defining none of the

specific sustainability factors and importance weightings for contractor selection, the sustainability requirements are normally covered in the description of project requirements and objectives.

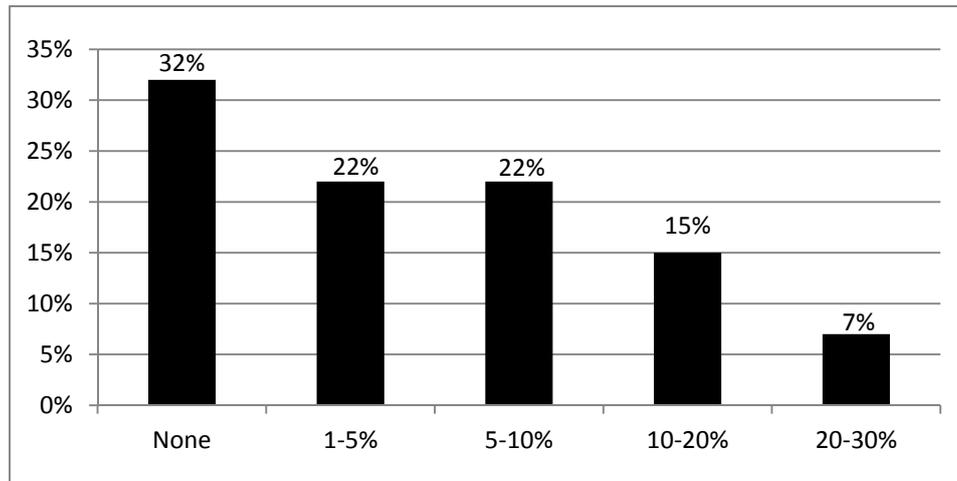


Fig 3. Sustainability weightings for the contractor evaluation (%)

3.3 Two-way contingency table analysis

A series of Chi-Square (χ^2) contingency table analyses were conducted to investigate the relationship between the importance weights of sustainability and other coded variables. According to McClave et al. (2010), the Chi-square test helps to determine whether a statistical relationship exists between two variables and it is widely used for categorical data analysis. However, it should be noted that a statistical association between the two variables does not infer a causal relationship.

Based on the importance weightings of *price* (using 27% as the threshold according to Xia et al. 2013), the RFPs were divided into two groups, i.e. price focused RFPs and qualification focused RFPs. According to the results as shown in Table 4, the null hypothesis that the “price” importance is independent of sustainability importance is rejected ($p=0.020$). In other words, when the contractor evaluation is more price oriented, the evidence is in favour of client/owners tending to allocate less importance weight to sustainability requirements. As shown in Table 4, most of price-focused RFPs (81%) allocate less than 5% of importance weights to sustainability requirements while the majority of qualification-based RFPs (57%) allocate more than 5% to sustainability requirements.

Table 4. Chi-square analysis of price importance and sustainability weights

Price importance in contractor evaluation	Sustainability importance		Total
	No more than 5%	More than 5%	
Qualification focused	6 42.9%	8 57.1%	14 100%
Price focused	17 81%	4 19%	21 100%
Total	23 65.7%	12 34.3%	35 100%

Note: $\chi^2 = 5.411$ ($p=.020$, d.f.=1)

As shown in Table 5, although the relationship between project size and sustainability importance is not statistically significant ($p=.061>0.05$), the results imply that larger size projects tend to have more important of sustainability requirements. The major reasons for this are that large projects are likely to benefit from life cycle analysis and can afford the green certification costs more than smaller ones.

Table 5. Chi-square analysis of project size and sustainability importance

Project size	Sustainability importance		Total
	No more than 5%	More than 5%	
Small (less than 33.5*million)	17 77.3%	5 22.7%	22 100%
Large(33.5 million and over)	6 46.2%	7 53.8%	13 100%
Total	23 65.7%	12 34.3%	35 100%

Note: $\chi^2 = 3.512$ ($p=.061$, d.f.=1), *33.5 million USD is the standard size of small construction businesses in the North American Industry Classification System (NAICS, 2007)

4. Discussion and conclusions

DB is an effective delivery system for not both traditional and sustainable construction projects. With an increasing number of public client/owners resorting to DB to deliver their green buildings, it is crucial to understand how they define their sustainability requirements in RFPs.

The LEED rating system released by the United States Green Building Council (USGBC) has become one of most popular green building assessment tools. The content analysis demonstrates that almost all sustainable DB projects demand certain levels of LEED certification, with more than 60% requesting LEED Silver or higher. Additionally, client/owners prefer to use open-ended statements, such as “minimum LEED Certified” and “minimum Silver”, rather than specific LEED levels, in order to leverage DB contractors’ sustainability input.

The selection criteria and importance weightings are an important component in design-builder evaluation in RFPs (Xia et al., 2013). The majority of RFPs (70%) include sustainability requirements as selection criteria or sub-criteria with importance weightings up to 25%. The subsequent Chi-square test revealed that client/owners tend to allocate higher importance weights to sustainability requirements in large and qualification-oriented DB projects. This is understandable as most of large construction projects use best-value procurement methods for contractor selection. Higher sustainability requirements, while usually involving higher project cost, lead to longer durability, better constructability, and less maintenance and operation costs.

The findings of this study provide a number of practical implications for different project stakeholders. First, for experienced DB client/owners it is recommended that sustainability requirements be incorporated into the contractor selection criteria of: technical (design) approach; contractor past performance; experience; and qualifications. Second, for those with limited project delivery experience of sustainable construction projects, the requirements of LEED certification levels and LEED checklists can serve as an effective way of communicating sustainability requirements. Finally, DB contractors need to be familiar with the LEED certification process and have internal LEED certified professionals in order to achieve sustainable design solutions.

One of limitations of this study is the small number of RFPs examined. Possible subjectivity and bias are also inherent in the content analysis, which make the generalization of the results uncertain.. Future research is needed to validate the findings with inputs from client/owners and industry practitioners.

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