



# Using “Choosing by Advantages” Method to Select Contractor for Design and Build Projects Toward Sustainable Construction

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**Abstract.** Contractor selection in Design and Build (D&B) projects that is not based on a comprehensive evaluation process will lead to undesirable situations affecting the project in many ways, from not promoting the advantages of the D&B model, extending the schedule, increasing project costs, reducing quality, causing great damage to the Investor. Multicriteria decision-making (MCDM) methods can help the project managers to select the best bidder. The main contribution of this study is to propose a comprehensive evaluation process of contractor’s capacity based on Choosing by Advantages (CBA) method in D&B projects that considers the sustainability in construction. Actually, sustainable construction has become more and more important nowadays because it is not only related to environment protection but also to the business strategy of Employer. Data collected from documentation as well as in-depth interviews and surveys have been analyzed to determine the key factors that affect the decision of selecting a contractor. This research also explains why CBA is superior other MCDM methods, for this context.

**Keywords:** Choosing By Advantages (CBA) · Design and Build (D&B) · Multicriteria Decision-Making (MCDM) Methods · Sustainability · Bidding evaluation

## 1 Introduction

Currently, the projects applying Design and Build (D&B) model become more and more popular thanks to the value that this model brings to the project participants. In order to achieve the highest efficiency in D&B project, choosing the most suitable contractor is one of the key factors that largely determines the success of the project. Different from the traditional Design-Bid-Construction projects in which the construction capacity and the contractor’s bid price are the two factors that are put on top, deciding the contractor selection for the project. The D&B project also focuses on the design capacity of the contractor.

In fact, due to the need of completing the project in a short period of time, many investors want to shorten the bidding process and select a contractor based on only one of the following criteria: the lowest price, the reputation of the contractor in the market, contractor relationship acquaintance. Contractor selection that is not based on a comprehensive evaluation process will lead to undesirable situations such as: The selected contractor has a low price but is not qualified to execute the D&B project, Contractor with reputation, construction experience but no design and design management experience, Experienced contractor but high bid price, the contractor do not create value that the Client expect. Among these situations above, cost-based contractor selection is the most popular phenomena which may be the main reason for some problems of project performance. According to [1], many construction contractors purposefully engage in bid cutting in order to gain a competitive advantage in the bidding process to win a contract, which increases the risk of profit reduction and frequently results in a loss for the contractors [1]. Assaf and Al-Hejji [2] through their field survey indicated that awarding a contract based on cost was the most frequent factor causing delays in construction projects [2]. In conclusion, the inappropriate selection of contractors will affect the project in many different degrees of severity, from not promoting the advantages of the D&B model, to prolonging the schedule, increasing project costs, reducing quality and causing great damage to the Investor.

The key result of this study is to provide a comprehensive evaluation method of contractor's capacity based on factors affecting contractor selection. This research will clarify the definition of Design and Build project and Choosing by Advantages method. The author also conducted a survey to find out which factors impact the decisions of choosing a contractor. Moreover, to evaluate the effectiveness of the method in practice, this study will also give case examples for the application of this assessment method, especially in sustainable construction.

## 2 Literature Review

### 2.1 Design and Build Project

Design and Build (D&B) is a method for delivering a project in which design and construction services are contracted by an entity known as a D&B contractor. In contrast to Design-Bid-Build (DBB), D&B is based on a single responsibility contract and is used to minimize risks for project owners and reduce delivery schedule by overlapping the design phase and the construction phase of a project. D&B also has a unique responsibility. The D&B contractor is responsible for the entire work of the project, so the client can seek legal remedies for any fault on the part of one party. Contractual relationships for DBB and D&B projects are performed in Figs. 1 and 2 below.

There are many advantages of using D&B general contractor including creating the value that the Client expects, optimizing investment capital, being active in design, project progress management, better build quality but the most important factor is saving time for the project. A single contract including Design and Construction limits the design change or material selection compared to the old way of doing things. Design and construction are a unified team that fosters collaboration on a common and consistent

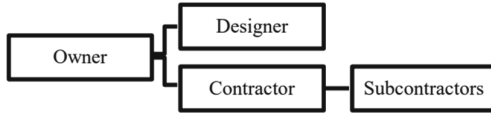


Fig. 1. Contractual relationship for DBB project [3]



Fig. 2. Contractual relationship for D&B project [3]

basis from start to finish. Comparison of timeline between DBB and D&B projects is performed in Fig. 3 below.

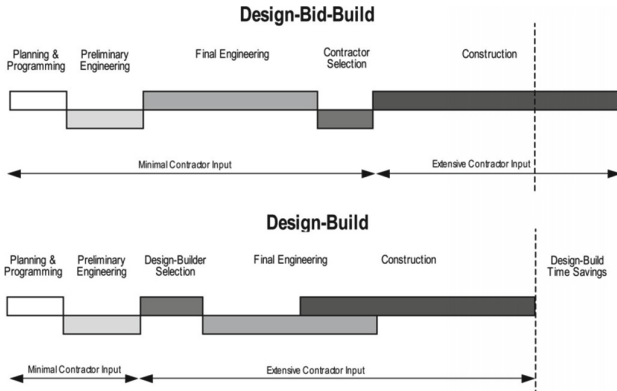


Fig. 3. Conceptual timelines for DBB and DB project administration [4]

### 2.2 Choosing by Advantages (CBA) Method

Choosing by Advantages (CBA) is a collaborative and transparent decision-making system developed by Jim Suhr, which comprises multiple methods. CBA includes methods for virtually all types of decisions, from very simple to very complex [5]. The CBA method allows decision makers to differentiate alternatives and understand the importance of those differences. According to [6], in CBA, decisions are based on the importance of advantages (IofAs) of alternatives, which are positive differences, not advantages and disadvantages; this avoids double counting. The paramount advantage represents the most important advantage for the decision maker [6].

In general, if Factor 1 has difference between alternatives calling Difference 1, Factor “n” has difference between alternatives calling Difference “n”, the advantages here can

be understood as between Difference 1 (at factor 1) and Difference “n” (at factor “n”), which is more important.

Schöttle and Arroyo [6] also did preliminary research for applying CBA in the bidding procedure. In their study, they indicated the differences between MCDM methods such as Weight Rating Calculation (WRC) or Best Value Selection (BVS) and CBA for selecting a project team and how those differences may affect the selection of a project team. Their results demonstrate the benefits of applying CBA in helping public clients to compare among bidders [6].

### 3 Methodology

The key point of CBA method is to identify the factors and their impact in decisions. The author et al. made surveys among experts who had experiences in Design and Build projects in Vietnam to have an objective assessment. Moreover, to evaluate the effectiveness of the method in practice, this study will also give some case examples for the application of this evaluation method, especially in sustainable construction.

#### 3.1 Survey procedure

The survey was carried out through the following steps:

1. Statistics of factors affecting selection of general contractor for D&B projects
2. Create a survey questionnaire
3. Send questionnaires to experts in the field of D&B project construction
4. Assess the importance of factors.

The study collects data by making a survey questionnaire to assess the influence of factors and sending it to a group of 32 people who are experts with experience in D&B projects. Survey participants were asked to rate the influence of factors on the contractor selection decision on a scale of 5 importance levels: 1 = “Almost no influence”, 2 = “Little influence”, 3 = “Normal influence”, 4 = “Much influence” and 5 = “Very much influence”.

#### 3.2 Survey Results

The results of survey are presented in the Tables 1 and 2 below.

From the survey results, the author draws a group of 9 main factors in Bidding stage (with a score higher than the average score of 3.9) that have a lot of influence on the contractor selection decision in the following order (Table 3).

It is important to note that CBA considers money (e.g., cost or price) after attributes (Att) of alternatives have been evaluated based on factors and criteria. Cost is not a factor and it is treated separately from value. This is different from other MCDM methods such as WRC where cost can be a factor and be mixed with the intrinsic value of the alternative [7].

**Table 1.** Information of survey participants

Organization	Number of participants	Experiences	Number of participants
Employer	15.0	Less than 5 years	1.0
Project manager	2.0	5–10 years	12.0
Designer	1.0	More than 10 years	19.0
Quantity surveyor	7.0		
Contractor	7.0		

### 3.3 Case Study

This research focuses on D&B projects relating to sustainable construction. The actual case study below will present an overview about the application of CBA method actual situation.

Case study: Client process bidding to select a contractor to carry out D&B for swimming pool system outside a villa. This villa locates near a beach in Danang, central of Vietnam.

Requirements of Client:

- Budget: VND 500–550 Million (~USD 21,000)
- Scope of work: Design a swimming pool system following specification. Design proposals have to consider sustainability factors.
- Warranty period: at least 2 years
- Schedule for design and build: 50 days.

There are three (03) contractors passing the Pre-qualification stage were invited to submit their proposals.

Table 4 below exemplifies the integration of the prior anchoring process in the CBA tabular. The factors follow the result of the survey mentioned above. The descriptions of the attributes were taken from their real submission. A 0–100 scale of Importance (Imp) is used to weigh the anchor-statement advantage (Adv) and evaluate the proposal as detail table below.

**Table 2.** Survey results

Item no	Factors	The number of responses in influence level					
		Level 1	Level 2	Level 3	Level 4	Level 5	Mean
A	Design submission						
1	Comply with requirement	1	–	4	10	17	4.31
2	Proposed materials and equipment	–	–	2	15	15	4.41
3	Feasibility in construction	1	–	4	15	12	4.16
4	Operation and maintenance capabilities	1	2	9	15	5	3.66
B	Commercial submission						
5	Proposed price	1	–	2	11	18	4.41
6	Contract conditions	1	–	7	12	12	4.06
C	Technical submission						
7	Method statements	1	1	6	15	9	3.94
8	Site organization	1	1	10	15	5	3.69
9	Quality sanagement plan	1	4	4	20	3	3.63
10	Health—Safety—Environment (HSE) plan	1	4	12	13	2	3.34
11	Equipment for construction	1	2	11	15	3	3.53
12	Sub-contractors, suppliers	2	1	11	11	7	3.63
D	Schedule						
13	Comply with requirement	1	–	5	11	15	4.22
14	Proposals to shorten schedule	1	1	9	11	10	3.88
E	Organization						
15	Quality of key persons	1	1	9	12	9	3.84
16	Quality of personal	1	2	7	16	6	3.75
17	Organization chart	1	2	14	11	4	3.47
F	Bidding process						
18	On-time submission	1	1	9	12	9	3.84
19	Interaction during bidding	1	1	7	14	9	3.91
20	Quality of the interview	1	–	8	14	9	3.94

## 4 Results, Analysis and Discussions

In this example, Bidder 2 achieved the highest score, followed by Bidder 1 and Bidder 3. Bidder 2 submitted the best equipment as well as proposed a design that met the sustainable requirements from Client. However, their experiences and method statement

**Table 3.** Main factors of selection decision in order of influence level

Rank	Factors	Influence level
	Bidding stage	
1	Proposed price	4.41
1	Proposed materials and equipment	4.41
3	Design comply with requirement	4.31
4	Schedule complies with requirement	4.22
5	Feasibility in construction	4.16
6	Contract conditions	4.06
7	Method statements	3.94
7	Quality of the interview	3.94
9	Interaction during bidding	3.91

are not as good as their competitors. On the other hand, Bidder 3 is not good at design when they did not propose a good enough system but their experiences in the swimming pool system is considerable. Bidder 1 is between Bidder 2 and Bidder 3 in design, method statement and experience. Despite having little experience, Bidder 2 still ranked the first position in technical evaluation because of the fact that the most important factors impacting the decision in D&B projects, especially with Client who concerns on sustainability, are design and equipment origin. Based on this case, Fig. 4 below represents the related cost versus value diagram. Viewing the cost versus value diagram, the Client can consider selecting a contractor to appoint this package.

In other MCDM methods such as Weight Rating Calculation (WRC), cost will be considered as a factor and mixed with other technical factors and account for a large amount of percentage in assessment level. Actually, some contractors can propose costs that are lower than their estimation or budget of Client to take advantage in bidding evaluation. After winning the contract, they can find many ways to claim more money by variations and relationships between them and the project management unit. CBA method can prevent this lack of transparency by separating cost from technical evaluation.

**Table 4.** CBA evaluation

No	Factors	Bidder 1		Bidder 2		Bidder 3	
1	Main equipment origin	Attribute (Att): Australia		Att: USA		Att: China	
	EU/G7 is preferred	Advantage (Adv): acceptable	Imp: 70	Adv: G7	Imp: 100	Adv:	Imp:
2	Water filter method	Sand filter, Antiseptic by Chlorine feeder directly to water pH controlling by Acid Replace water per 3 months Cleaning by hand equipment		Sand filter, Antiseptic by Salt Chlorinator, pH controlling by Acid No need to replace water Cleaning by pool vacuum		Sand filter, Antiseptic by Chlorine feeder equipment pH controlling by Acid Replace water per 6 months Cleaning by hand equipment	
	Friendly with environment is better	Adv: Quite friendly	Imp: 70	Adv: Most friendly	Imp: 90	Adv: Not friendly	Imp:
3	Schedule	Att: 45 days		Att: 50 days		Att: 40 days	
	Comply but Shorter is better	Adv: Shorter	Imp: 50	Adv: Comply	Imp: 30	Adv: Shortest	Imp: 70
4	Feasibility in construction	Att: Feasible		Att: Feasible		Att: Feasible	
	More feasible is better	Adv: Comply	Imp: 60	Adv: Comply	Imp: 60	Adv: Comply	Imp: 60
5	Warranty period	Att: 1 years for all equipment		Att: 3 years for all equipment		Att: 2 years for all equipment	
	Comply but Longer is better	Adv:	Imp:	Adv: Longest	Imp: 50	Adv: Comply	Imp: 40
6	Method statement	Att: Quite clear information, feasible and safe		Att: Not enough information		Att: Clear information, feasible and safe	
	More information is better	Adv: Better method statement	Imp: 30	Adv: Better method statement	Imp:	Adv: Best method statement	Imp: 40

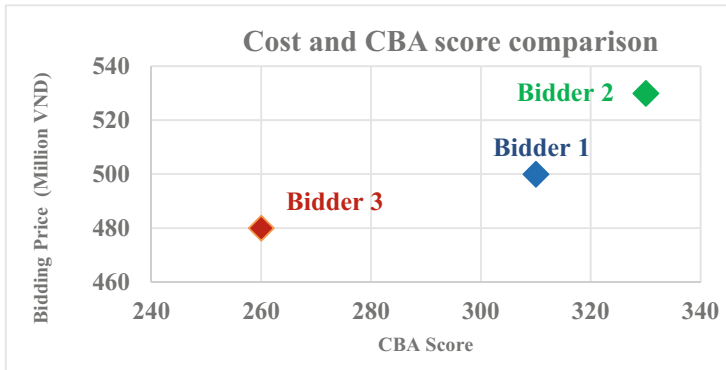
*(continued)*



**Table 4.** (continued)

No	Factors	Bidder 1		Bidder 2		Bidder 3	
7	Interview	Att: Fluently and focus on content of question		Att: Not good		Att: Very fluently and focus on content of question	
	More fluently is better	Adv: Fluently	Imp: 20	Adv:	Imp:	Adv: Most fluently	Imp: 30
8	Interaction during bidding	Express their good willing to study about this package Easy to get in touch Late response for questions		Usually respond questions late and did not perform proactiveness in interaction		Express their good willing to study about this package Easy to get in touch Quick response for questions	
	More professional is better	Adv: more professional	Imp: 10	Adv: less professional	Imp:	Adv: most professional	Imp: 20
	Total Importance of Advantages (IofAs)		310		330		260

For the price proposal, Bidder 1 submitted VND 500 million, Bidder 2 submitted VND 530 million and Bidder 3 submitted VND 480 million



**Fig. 4.** Cost and CBA score comparison

## 5 Conclusion

Through the survey and case study mentioned above, the research proposes a potential evaluation method to make the decision of selecting contractors in D&B projects which concern more about sustainability. The researchers acknowledge that CBA method in

this context is still objective in some aspects such as assessing the point of Importance of Advantages. More research is needed to have a comprehensive procedure of applying CBA as well as to fully understand how CBA is superior to other MCDM methods.

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