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COMPARING THREE METHODS IN THE TENDERING PROCEDURE TO SELECT THE PROJECT TEAM

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ABSTRACT

Normally, the selection of a project team is based on Weighting Rating Calculating (WRC) and often relies on only one factor; the cost factor. WRC is a method that allows for assessing multiple factors easily but the bidders' differences may not be highlighted, since factors are weighted independently of the attributes. A more recent concept, which is based on WRC, is Best Value Selection (BVS). BVS is a method where the best value score is calculated as the bid price divided by the qualification score. Choosing By Advantage (CBA) is a multiple-criteria decision-making method based on advantages of alternatives. Advantages are compared in order to decide the importance of them. We argue that CBA provides further benefits for helping public clients to differentiate between bidders. A case was constructed, based on the tendering procedure of the project Mission Hall, to exemplify the differences of the three methods for bidder selection in the context of public tendering requirements. This paper presents the analysis and discusses the results of the simulated case.

KEYWORDS

Best value selection, choosing by advantage, weighting rating calculating, selection, tendering procedure, project team.

INTRODUCTION

Traditionally, in a public tendering procedure the selection of the project team is only based on lowest cost, and technical and management qualifications are not involved. Especially in complex, uncertain, and cost-intensive projects the selection by lowest cost can result in conflict situations and lead to protracted disputes. A tendering procedure by "lowest bid" tends to create an unhealthy price competition, resulting in a working environment where bidders hide knowledge and information in order to

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make claims to get money out of the project to survive (Schöttle and Gehbauer, 2013). This leads to waste in terms of conflict resolution and legal procedures.

A complex and uncertain project requires real collaboration for lasting success. However, there is no incentive for bidders to work collaboratively under low bid tendering. So, why do public clients mostly use only price to select the team? Obviously, selection based on cost is clear and simple. There is no room for interpretation and misunderstanding. However, the lowest bid does not result in the best team. When project complexity increases, the tendering procedures employed need to change so that the needs and requirements of the project will shape the decision. Using collaborative approaches like Integrated Project Delivery (IPD) or project alliancing requires a tendering procedure based on competence (Lahdenperä, 2009) and value.

In decision theory different methods to choose between alternatives exist. This paper will compare three methods: Weighting Rating and Calculating (WRC), Best Value Selection (BVS), and Choosing by Advantages (CBA). WRC is a method that assesses multiple factors easily but the bidders' differences may not be highlighted, since factors are weighted independently of the attributes of the bidders. WRC is a method which is widely used in tendering procedures with multiple factors. BVS uses the ratio of value to bid price to select the winning bid. CBA is a multiple-criteria decision-making method based on comparing advantages between alternatives. CBA is not used in the tendering procedures yet, but it could be beneficial in helping owners better discern relative value between proposals.

First, the three methods and the requirements of the tendering procedure will be briefly explained. Then we will illustrate the differences between these bidder selection methods by evaluating each method based on a real case.

RESEARCH METHOD

This research builds on previous research comparing CBA with WRC for selecting building systems and materials (Arroyo, Tommelein and Ballard, 2013; 2014a; 2014b). In those cases CBA demonstrated its benefits. However, research on comparing these two methods has not included selecting a project team, to the best of our knowledge. In addition to CBA and WRC, another procurement method is BVS. For example the University of California, San Francisco (UCSF) used a modification of BVS to select the project team for Mission Hall. Therefore, we extended our research and added BVS to our analysis.

The research questions in this paper are:

- What are the differences between WRC, BVS, and CBA for selecting a project team and how those differences may affect the selection of a project team?
- How objective are the results?
- Which method would be best for selecting the project team?

In this research we first conducted a literature search comparing WRC, BVS, and CBA. Second, based on the tendering procedure of the real project Mission Hall we constructed a case to compare the methods in the context of bidder selection. Finally, we discuss the results and conclude.

THEORETICAL OVERVIEW

This section gives a brief overview over the requirements of public tendering procedure as well as of the WRC, BVS and CBA methods. Before explaining the methods, we have to clarify the term ‘alternative’. In case of selecting a project team, the alternatives are bidders themselves and therefore the project teams, each of which submits technical and price proposals. As the proposals of each team will be evaluated based on identified factors and criteria the proposal itself can also be defined as an alternative.

REQUIREMENTS OF TENDERING PROCEDURE

Public clients are bounded by regulations, which require a fair competition. Therefore, to select the project team objectively the factors and criteria need to be defined clearly in advance (before tendering starts). More general issues include the competence of the client to manage procurement and to build a project team. Thus, the method of bidder selection needs to be practical and easy to understand. These aspects will not be considered in this paper. We will start from the point where factors have been defined for the tendering process.

WEIGHTING RATING AND CALCULATING (WRC)

WRC (often also named as weighted sum, scoring system, ranked scoring, utility analysis) is a much-used decision-making method. In WRC, the weighting of factors and attributes is done directly and indicates the importance of each factor for the decision maker. The factor weights must sum to 100%. The WRC method can be summarized in the following steps: (1) Identify alternatives (bidders). (2) Identify factors and criteria for evaluation. (3) Weigh factors. (4) Rate alternatives (proposals) for each factor. (5) Calculate the ‘value’ of each alternative (proposal) and come to a final decision. Figure 1 shows the steps to apply the WRC method (Belton and Stewart 2002; Arroyo, Tommelein and Ballard 2014b).

Compared to the private sector, in public tendering the number of bidders is reduced by pre-qualification rather than identification by free choice.

1. Identify alternatives. → 2. Identify factors and criteria for evaluation. → 3. Weigh factors. → 4. Rate alternatives for each factor. → 5. Calculate the value of each alternative and come to a final decision.

Figure 1: Steps of WRC method

BEST VALUE SELECTION (BVS)

BVS (or Best Value Scoring Analysis or BVSA) is a method, where the lowest responsible bidder is selected by ‘value’. The method is based on WRC, but differs in the evaluation of the bid price. In WRC the bid price is a weighted factor, whereas in BVS the bid price is a separate factor and the best value score is calculated as the bid price divided by the qualification score. The smaller the ratio between bid price and score the better the proposal (value-for-money). The BVS method can be summarized as WRC decided by calculating bidder price/value score (see figure 2). Abdelrahman, Zayed, and Elyamany (2008) state that BVS rewards innovation, because the “optimal combination of price and technical capabilities” will be obtained, if “the right choice of the evaluation factors […] and their relevant weights” is assessed.

1. Identify alternatives. → 2. Identify factors and criteria for evaluation. → 3. Weigh factors. → 4. Rate alternatives for each factor. → 5. Calculate the value of each alternative. → 6. Calculate cost/ value and come to final decision.

Figure 2: Steps of BVS method

CHOOSING BY ADVANTAGE (CBA)

CBA is a system of making decisions using well-defined vocabulary to ensure clarity and transparency in the decision-making process (Suhr, 1999). According to this, it is important to identify which factors will reveal significant differences between alternatives, not what factor (in the abstract) will be important in the decision.

In this research we used the CBA Tabular method for moderately complex decisions. The CBA Tabular method can be summarized in 7 steps. (1) Identify alternatives (bidders) likely to yield important advantages over other alternatives (bidders). (2) Define factors to evaluate attributes (characteristics) of alternatives (technical proposal). (3)Agree on the criteria for each factor. Criteria can be either a desirable (want) or a mandatory (must) decision rule. (4) Summarize the attributes of each alternative (technical proposal). (5) Decide the advantages of each alternative (bidder). (6) Decide the importance of each advantage. Here the owner must explicitly state their preferences for the advantages. The owner selects the paramount advantage, which is the most important advantage and is usually assigned 100 points. The paramount advantage is used as a reference point to compare to other advantages. Then the owner assigns importance to other advantages by comparing these to the paramount advantage. It is not assumed that advantages are independent; therefore, similar advantages can be grouped or one advantage can be assigned zero importance if the client estimates it does not provide any additional 'value'. The importance of advantages for each alternative (proposal) is summed. Finally, (7) Evaluate cost data summarizes the seven steps (see figure 3).

1. Identify alternatives. → 2. Define factors. → 3. Define must/want have criteria for each factor. → 4. Summarize the attributes of each alternative. → 5. Decide the advantages of each alternative. → 6. Decide the importance of each advantage. → 7. Evaluate cost data.

Figure 3: Steps of CBA method

CASE BACKGROUND

The simulation is based on the UCSF academic office building named Mission Hall, located at the Mission Bay campus in San Francisco. The 264,000 square foot (sf) seven floor building was opened in October 2014. To select the project team UCSF used BVS with elements of CBA, as the performance criteria contain judgments about their relative importance, which are reflected in the scoring. The tendering consisted of a pre-qualification process and a bid process. After the pre-qualification process three Design-Build (DB) teams were identified. The bid process began in April 2012. During the bid process each team developed a proposal based on the Bridging Documents, which consisted of a project program, design criteria package, and a comprehensive tiered performance specification for the building. Proposals were rated using seven performance categories (including 267 performance criteria with a minimum requirement, 39 possible Tier 2 criteria, and 20 possible Tier

3criteria). The performance criteria are: A Quality Work & Learning Environment, A Model of Architectural & Urban Design, A High Performing Building, Environmentally Sustainable, Durable & long-lasting, Efficiently Serviced & Maintained, Quality & Clarity of Project Plan. By achieving Tier 2 and Tier 3 teams are able to add value to important technical criteria as described by UCSF. The required criteria can be defined as 'must have' criteria and Tier 2 and 3 as 'want to have criteria'. Structural and energy performance were weighted higher than other technical criteria on the. Overall quality of design of the workplace was equal to the entire technical half of the scoring. Based on the performance criteria evaluation, teams could achieve up to 6,000 points. For the first two categories the bidders could achieve 1.500 points. For category three till seven a maximum of 600 points were possible. The difference of maximum achievable points can be seen as weights. The more points on offer, the more important the category was for UCSF. During the bid process UCSF decided to change the scoring system to ranked scoring, where the top-ranked bidder gets the maximum achievable points, the bidder ranked on the second place 2/3, and the third ranked bidder 1/3 of the maximum possible points per category. This fact will not be used for the simulation.

The project team was selected in July 2012 and after two months of pre-qualification and three months for the bid process. Table 1 shows the calculation leading to the award. As UCSF stipulated that the full sum would be spent and requested bidders to maximize building design quality and technical performance for the stipulated sum, bidders did not have the option to propose a lower price. All teams had to work with the stipulated sum, which was written into the bid form by UCSF. Thus, the effect of price was neutralized, and the competition became one of which proposal could provide the most meaningful advantages.

Table 1: Final Award Calculation of Mission Hall

Team	Points	Target Cost	Cost/Quality Point
A	2,400	$ 93,800,000	$ 39,083.33
B	5,800	$ 93,800,000	$ 16,172.41
C	4,200	$ 93,800,000	$ 22,333.33

CONSTRUCTED CASE

To compare the methods WRC, BVS, and CBA we constructed a case and simulated the case with each method. As described earlier, the case is based on (but not identical to) the tendering procedure used for Mission Hall. First we modified the background case in terms of the number of performance criteria to simplify the simulation. Table 2 shows the 18 factors which are used for the constructed case. Every factor has an identification number (ID) to represent the simulation clearly for every method. In order to simulate the price proposal, we assume the following bid prices in million $: bidder 1 submits 93.8, bidder 2 submits 92.5, and bidder 3 submits 93.7.

Table 2: Performance Criteria with identified Factors

Category	Performance criteria/Factor	Tier	ID
A Quality Work & Learning Environment	All **building interior program spaces** shall fit into the designated gross area (266,000 GSF).	R	1.A
	Set a model for the future of UCSF workplace through an **Activity-Based Workplace** tailored to the function, activities, and tools of UCSF faculty, staff, and students.	R	1.B
	Foster an **interactive**, collegial, and collaborative environment that fuses the clinical programs with dry, basic and translational research.	R	1.C
	Maximize **daylight** and views throughout the interior spaces to provide a quality experience, connection to the outside, and health & wellness.	R	1.D
A Model of Architectural & Urban Design	A network of **sight lines and passageways** linking landmarks, focal points, and open spaces, enhanced by effective way-finding devices, will streamline movement across campus and strengthen physical and visual unity.	R	2.A
	The **facade** design should be harmonious with the adjacent landscape spaces and existing buildings and contribute to the urban context. Materials, color, ornamentation, texture and composition should be cohesive and incorporate with the surroundings.	R	2.B
	Design the **building interior** to be imaginative, contemporary yet timelessly elegant, cohesive and meaningfully transparent.	R	2.C
A High PerformingBuilding	Design a building with an integrated high efficiency envelope, high efficiency **lighting** and HVAC systems that uses less than 33 kBtu/sf/year**.**	2	3.A
	Provide**Vegetated Roof**.	3	3.B
EnvironmentallySustainable	Design hot and cold water distribution system per CPC 2010 to achieve 30% **water savings**.To exceed gray water shall be filtered, purified and reused for flushing toilets and irrigation to achieve 45% water saving.	3	4.A
	Use **materials** that can be fully recycled at end of service life.	2	4.B
Durable &long-lasting	**Vibration** shall not exceed 8,000 µ-in/sec at any location under a walking pace of 75 steps/minute.	2	5.A
	The Mission Bay area has a history of unstable soil with settlement and potential liquefaction. The proposed **utility system** design must accommodate these factors and address the following considerations: 1. Minimize piping under slab 2. No electrical under slab 3. Utilities should enter building at the perimeter and a maintainable pathway should be provided 4. The design solution should include support anchorage and flexibility 5. Materials used must respond to the corrosive environment	R	5.C
EfficientlyServiced&Maintained	Provide for flexibility within the **Faculty Workspace**. Standardize sizes of room types and use a modular planning approach to support long-term adaptability.	R	6.A
	Site **lighting elements** should be of low maintenance and shall be considered to have an illumination life span of greater than 25,000 hours. The elected lighting element should also include a manufacturer's warranty on all components of the light fixture.	R	6.B
Quality & Clarity of Project Plan	Use the **Last Planner™** method of production management during design and construction.	R	7.A
	Set-based design approach to produce design solutions and to continuously improve the building and site design.	R	7.B
	Integrate a **Target Value Design** into the project.	R	7.C

After identifying factors and criteria, we established the CBA table. Table 3 shows the evaluation of the 18 factors by using CBA.

Table 3: Constructed Case - CBA Tabular method

	Factor (Criterion)	Alternative 1: Bidder 1		Alternative 2: Bidder 2		Alternative 3: Bidder 3	
A Quality Work & Learning Environment	1.A Building interior program spaces	Att.: 261,283 GSF.		Att.: 264,197 GSF, but missing some classrooms.		Att.: 258,178 GSF.	
	(The more fit between program space and designated gross area (266,000 GSF), the better.)	Adv.: Significantly Better fit between program spaces and gross area.	Imp.: 100	Adv.: Slightly better fit between program spaces and gross area.	Imp.: 50	Adv.:	Imp.:
	1.B Workplace	Att.: Visual accessibility is ad-hoc to support spaces.		Att.: Acceptable. In equal access to ad-hoc support spaces. Could be better organized.		Att.: Meets requirement. Bad breakout.	
	(The more activity-based, the better.)	Adv.: Considerably more activity-based.	Imp.: 50	Adv.: More activity-based.	Imp.: 30	Adv.:	Imp.:
	1.C Building interior	Att.: Typical floor plans have one major point of intersection for groups to collide and interact. Ground floor is separated into disparate zones without much required interaction.		Att.: Communal space and ground floor are very strong from a collaborative /interactive perspective.		Att.: Interactive. Atrium centralized with circulation and interactive spaces. Limited prefunction space.	
	(The more interactive, the better.)	Adv.:	Imp.:	Adv.: Significantly more interactive concept.	Imp.: 60	Adv.: More interactive concept.	Imp.: 40
	1.D Daylight	Att.: High amounts of natural lighting/ access to views perspective. No shading strategies.		Att.: Various glass openings, but no shading strategy.		Att.: Various glass openings with shading strategy.	
	(The more daylight, the better.)	Adv.: Significantly more amount of daylight.	Imp.: 70	Adv.:	Imp.:	Adv.: More shading strategies	Imp.: 30
A Model of Architectural & Urban Design	2.A Sight lines and passageways	Att.: Effective.		Att.: Effective.		Att.: Very effective.	
	(The more effective, the better.)	Adv.:	Imp.:	Adv.:	Imp.:	Adv.: Most effective approach.	Imp.: 60
	2.B Facade	Att.: Fits good.		Att.: Fits totally.		Att.: Fits totally.	
	(The more the design fits to the surroundings, the better.)	Adv.:	Imp.:	Adv.: Better fit.	Imp.: 80	Adv.: Better fit.	Imp.: 80
	2.C Building interior: Workplace	Att.: Meets requirement. Articulated circulation ceiling, creative use of color.		Att.: Meets requirements.		Att.: Meets minimally requirement. Limited color palette.	
	(The more timeless and creative, the better.)	Adv.: Significantly more creative.	Imp.: 60	Adv.: Slightly more creative.	Imp.: 20	Adv.:	Imp.:
A High Performing Building	3.A Light systems	Att.: 32 kbtu/sf/year		Att.: 33 kbtu/sf/year		Att.: 15.5 kbtu/sf/year	
	(The more less the kbtu/sf/year, the better.)	Adv.: 1 kbtu/sf/year less.	Imp.: 5	Adv.:	Imp.:	Adv.: 17.5 kbtu/sf/year less.	Imp.: 40
	3.B Vegetated Roof	Att.: 130 sf		Att.: 150 sf		Att.: 80 sf	
	(The more sf, the better.)	Adv.: 50 sf more.	Imp.: 10	Adv.: 70 sf more.	Imp.: 30	Adv.:	Imp.:
Environmentally Sustainable	4.A Water saving	Att.: 30%		Att.: 30%		Att.: 35%	
	(The higher, the better.)	Adv.:	Imp.:	Adv.:	Imp.:	Adv.: 5% more saving.	Imp.: 30
	4.B Materials	Att.: Partially addressed.		Att.: Choose not to pursue.		Att.: Partially addressed.	
	(The more recyclable, the better.)	Adv.: Slightly more recyclable.	Imp.: 20	Adv.:	Imp.:	Adv.: Slightly more recyclable.	Imp.: 20
Durable & long-lasting	5.A Vibration	Att.: 75 steps/minute		Att.: 100 steps/minute		Att.: 75 steps/minute	
	(The more steps/minuet, the better.)	Adv.:	Imp.:	Adv.: 25 steps/ minute more.	Imp.: 40	Adv.:	Imp.:
	5.B Utilities system	Att.: General responses for the utility system design provided.		Att.: Inventive way to avoid utilities under slabs. Team proposes settlement vaults within landscape areas, flexible connections, and a raised floor system for utility routing.		Att.: Narrative of compliance only, but no description of how.	
	(The more beneficial, the better.)	Adv.: Slightly more beneficial system.	Imp.: 10	Adv.: More beneficial system.	Imp.: 50	Adv.:	Imp.:
Efficiently Serviced & Maintained	6.A Faculty Workspace	Att.: Very flexible. Spaces (hard walls) are used in a very modular approach to be easily adjusted for changes. Focus rooms can be converted into huddle rooms, etc.		Att.: Little flexible. Room sizes are standardized. Irregular neighborhood modules will constrain long term flexibility.		Att.: Flexible. Spaces are standardized and designed with a modular approach. No major constraints to long-term flexibility.	
	(The more flexible, the better.)	Adv.: Considerably more flexible.	Imp.: 90	Adv.:	Imp.:	Adv.: More flexible.	Imp.: 60
	6.B Site lighting elements	Att.: Maintenance meets requirement. Life span is 25,000 hours.		Att.: Maintenance meets requirement. Life span is 30,000 hours.		Att.: Maintenance is very low. Life span is 25,000 hours.	
	(The lower the maintenance and the greater the life span, the better.)	Adv.:	Imp.:	Adv.:5,000 hours more of life span.	Imp.: 30	Adv.: Lower maintenance.	Imp.: 10
Quality & Clarity of Project Plan	7.A Last Planner™ method	Att.: Demonstrate full understanding.		Att.: PPC during construction only.		Att.: Proposal shows thorough understanding. Response is general and does not show how this will be applied.	
	(The greater the understanding, the better.)	Adv.: Considerably more.	Imp.: 20	Adv.:	Imp.:	Adv.: Slightly more understanding	Imp.: 5
	7.B Set-based design	Att.: Clearly fully understand and use the concept. Show how it would be applied.		Att.: Not sure that bidder has fully understanding.		Att.: Same comment as in 7.A.	
	(The greater the understanding, the better.)	Adv.: Considerably more understanding.	Imp.: 20	Adv.:	Imp.:	Adv.: Slightly more understanding	Imp.: 5
	7.C Target Value Design	Att.: Same comment as in 7.B.		Att.: Does not demonstrate a full understanding concept.		Att.: Same comment as in 7.A.	
	(The greater the understanding, the better.)	Adv.: Considerably more understanding.	Imp.: 20	Adv.:	Imp.:	Adv.: Slightly more understanding	Imp.: 5
	Total of As		**475**		**390**		**385**

Once the CBA example was finished, we define the weights (W) and the scale for WRC and BVS. In dependence of the BVS method, where the project team is selected by cost/quality point, price in WRC was assumed to be 50%. All other categories were estimated based on the points of the real case. For example, the category "A Quality Work & Learning Environment" was rated with a maximum of 1,500 points. Therefore, for WRC the weight is 12.5 % and for BVS 25.0% as price is not a weighted factor. Adapted from the available information, we establish the following rating: (0) doesn't meet minimum requirement, (1) meets requirement minimally, (2) meets requirement, (3) meets requirement good, (4) meets requirement very good, and (5) exceeds requirements. A bigger scale would be also possible, but therefore more information is necessary. Table 4 presents the evaluation using WRC and BVS.

Table 4: Constructed Case - Evaluation using WRC and BVS

				WRC				BVS			
Category	Rating (Scale 0-5)				Calculating				Calculating		
	B 1	B 2	B 3	W	B 1	B 2	B 3	W	B 1	B 2	B 3
Quality Work & Learning Environment	**3,50**	**3,00**	**2,50**	**0,125**	0,44	0,38	0,31	**0,25**	0,88	0,75	0,63
1.A Building interior program spaces	4	2	2								
1.B Workplace	4	3	2								
1.C Building interior	2	5	3								
1.D Daylight	4	2	3								
Model of Architectural & Urban Design	**3,33**	**3,00**	**3,00**	**0,125**	0,42	0,38	0,38	**0,25**	0,83	0,75	0,75
2.A Sight lines and passageways	3	3	4								
2.B Facade	3	4	4								
2.C Building interior: Workplace	4	2	1								
High Performing Building	**3,00**	**3,50**	**4,00**	**0,050**	0,15	0,18	0,20	**0,10**	0,30	0,35	0,40
3.A Light systems	2	2	5								
3.B Vegetated Roof	4	5	3								
Environmentally Sustainable	**2,00**	**1,00**	**2,50**	**0,050**	0,10	0,05	0,13	**0,10**	0,20	0,10	0,25
4.A Water saving	2	2	3								
4.B Materials	2	0	2								
Durable & long-lasting	**2,00**	**4,00**	**1,50**	**0,050**	0,10	0,20	0,08	**0,10**	0,20	0,40	0,15
5.A Vibration	2	4	2								
5.B Utilities system	2	4	1								
Efficiently Serviced & Maintained	**3,00**	**3,00**	**3,00**	**0,050**	0,15	0,15	0,15	**0,10**	0,30	0,30	0,30
6.A Faculty Workspace	4	2	3								
6.B Site lighting elements	2	4	3								
Quality & Clarity of Project Plan	**4,00**	**1,33**	**2,00**	**0,050**	0,20	0,07	0,10	**0,10**	0,40	0,13	0,20
7.A Last Planner^{TM}method	4	1	2								
7.B Set-based design	4	2	2								
7.C Target Value Design	4	1	2								
Price	**2**	**4**	**3**	**0,500**	1	2	1,5				
Total points					**2,554**	**3,392**	**2,838**		**3,108**	**2,783**	**2,675**
Price [in million $]									**93,8**	**92,5**	**93,7**
Cost/Quality point [in million $]									**30,177**	**33,324**	**35,028**

DISCUSSION

Figure 4 demonstrates the bidder ranking for each method. For our case in WRC the lowest bidder (bidder 2) would be selected. As the weight of the price proposal is 50 % in the case, price has a high impact on the ranking. With a high weight of the price factor the result does not differ from the lowest bid. However, by using BVS and CBA bidder 1 would be selected. Bidder 1 has a significantly higher score per price and is the best proposal. The difference in the value is visually better presented in using CBA. With a total score of 390 for bidder 2 and 385 for bidder 3 both teams have almost the same score, but they differ in the price. Bidder 2 is cheaper compared to bidder 3, but also compared to bidder 1. If total scores between two bidders are close, the public client could (if allowed by law) decide to choose the lower value with the lower bid price, if it presents the best value option. In WRC and BVS the bidder has to rank the calculated ratios. As a result, the score of the ratio is presented and will be compared. Cost ratio in BVS (if the project cost is not fixed) is not as clear as the CBA chart showing value vs. cost. In CBA we can clearly see that bidder 3 should not be selected because it provides a lower score than bidder 2, and it is more expensive. If using Target Value Design (TVD) the cost will be the same for all three bidders in CBA, and the analysis would be similar to BVS. However, the scores between BVS and CBA may differ even using the same information. Therefore, in the CBA example the only question is whether or not the owner is willing to pay 1.6 million more in order to obtain an 85 point higher score(importance of advantages). That decision is related to the available budget for the project, and not only to the cost/score ratio. The issue with the BVS ratio is that it may be an alternative that has a great cost/score ratio, but the cost may be over budget anyway unless the project cost is fixed in advance of the bid process. Moreover, in the BVS example developer herein it is not as easy to see which alternative is the one that provides more value. The BVS process of Mission Hall became a CBA-type process where the advantages are the determining factors and because the stipulated sum was written on to the bid form by the client the cost/score ratio was not in danger of providing a result where a lower-value project could win over a higher-value project. Hence, we state that the philosophy behind CBA is different compared to WRC and BVS.

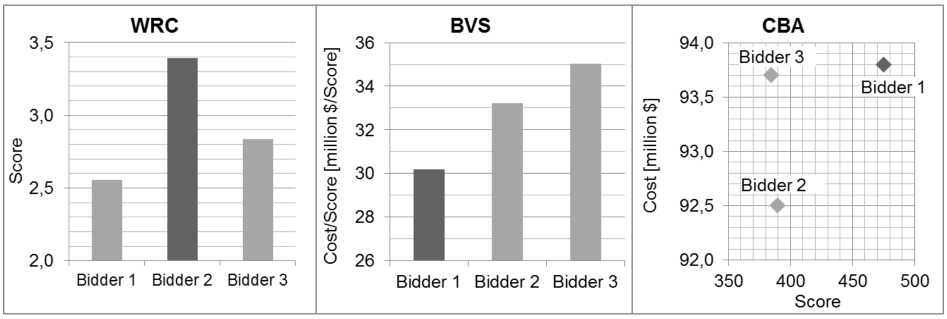

Figure 4: Overview of Results

In addition, using WRC and BVS are not as clear as documenting the rationale for the decision in transparent fashion as compared to CBA; because the attributes of the alternatives may not be as carefully summarized as in CBA. In other words in CBA one can more easily understand what attributes or characteristics of the alternatives are more valued by the owner. Besides, in CBA the criteria for selection also help decision-makers to agree on the differences between the bidders. On the other hand in WRC and BVS it is easier to assign scores, but without the more developed framework of CBA it is harder to explain what those scores mean. Consequently, it is important to mention that the difference in the score between bidders 2 and 3 is higher in CBA than when using BVS, because CBA only assigns scores to proposals which present an advantage in a factor, whereas in BVS and WRC every bidder receives a score for every factor.

For the public tendering procedures with complex decisions WRC is problematic as contrary factors are ignored. Another problem is the determination of the scoring scale and weights. Practically, the method is often implemented with insufficient data, resulting in misinterpretation. Factors are rated separately even when they depend upon each other. CBA includes the possibility that factors and criteria can be added at any time and a more important advantage than the paramount advantage can be added later. This possibility is problematic for the public tendering procedure. A public tendering process requires a stable framework, which does not change in a meaningful way as the proposal evolution process is carried out. Therefore, public owners need to establish procurement methods in advance; otherwise bidders can make claims against the tendering process, complicating or even nullifying the results, or forcing selection of a less-desirable alternative.

CONCLUSION

In this case study we can see that it is not a good idea to mix value with cost, as may be the case in WRC where the lowest bidder can use lower cost to overcome poorer value proposition compared with the other proposals. We recommend studying value separately from cost as in the case of BVS or CBA. BVS is an important improvement with regards to selecting the lowest bidder compared to WRC. However, we think that CBA provide additional benefits for helping public clients to differentiating between bidders. In CBA the value vs. cost relationship is showed in a chart, without assuming that a smaller cost/value ratio is better, allowing for a clearer perspective on value and cost. Furthermore, decisions are documented in greater detail; even when relative importance of advantages may be a subjective assessment, the relevant differences between the attributes of alternatives is highlighted.

Finally, we would like to comment on this study's limitations. The scoring behind the three methods may be biased by the researchers since we developed CBA first and then the scoring for WRC and BVS. Future research may provide a different setting for testing the three methods with different people using the three methods and trying to compare the level of conflict and consensus that the methods provide. Besides, for WRC a sensitivity analysis could be done to see how the weight of price factor impacts the bidder ranking. It also may be interesting to test the actual performance of the bidders after the decision is made with different methods.

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