

# COMPARING CHOOSING BY ADVANTAGES AND WEIGHTING RATING AND CALCULATING RESULTS IN LARGE DESIGN SPACES

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## 1 BACKGROUND AND IDENTIFICATION OF PROBLEM

Buildings are complex systems that incorporate multiple criteria in the design phase. Collaborative work is highly necessary in the design of buildings. Most of the time, decisions that are taken by some experts for a specific discipline in a building, have consequences in other disciplines.

Multidisciplinary Design Optimization (MDO) methods allow to develop buildings with a collaborative work, and generates thousands of designs, which grant to achieve optimal design solutions. These methods have been successfully applied in the Architectural, Engineering and Construction (AEC) industry.

Multi-criteria Decision Making (MCDM) methods, allow to assess alternatives. Weighting Rating and Calculating (WRC) is the most widely used method. Nonetheless, Choosing by Advantages (CBA) is a method that present benefits over WRC.

CBA is a method based on the advantages of the alternatives and scores them to obtain the Importance of Advantages (IoA).

However, these methods have been applied in a reduced design space (2-10 alternatives).

This study fills the gap of knowledge by comparing CBA and WRC apply in large design spaces, like the ones generated by MDO methods.

## 2 RESEARCH AIM AND METHODOLOGY

This research compares the results of using CBA and WRC in large design spaces.

This study is based on a charrette experiment. Figure 1 shows the methodology developed in this research.

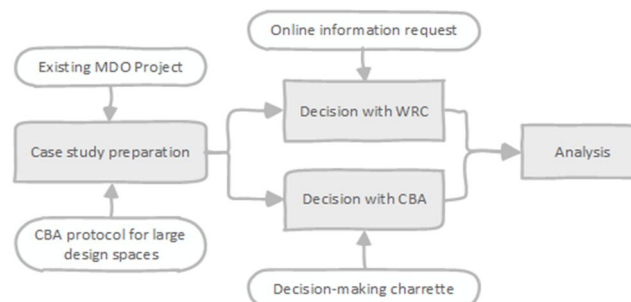


Figure 1: Research methodology

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First, researchers prepare the case study to apply in the charrette, where they must identify the alternatives that were going to be assessed and determine the protocol to apply CBA in this large design space. Second, the charrette was developed with practitioners from AEC industry. Before the charrette, practitioners were asked to score factors to apply WRC and in the charrette, they apply CBA over the design space, according to the protocol found in the previous phase and they answer a survey about the methods. Finally, researchers analyze the data to make conclusions about the MCDM methods.

The case study developed, consisted in a hotel placed in Orlando, Florida, USA. MDO methods were used to create the design space and the factors assessed by the MCDM methods were VOC emissions, energy, and acoustic reverb. Cost is treated as a restriction that is analyzed at the end of the CBA method.

### 3 RESEARCH FINDINGS

Researchers evaluate the Pareto's optimal curve in the graph of cost vs IoA. An alternative belongs to the Pareto's optimal curve, if there does not exist any alternative with at least the same score for IoA and less price than the alternative assessed. For example, in figure 2 the WRC is outside of Pareto's optimal curve.

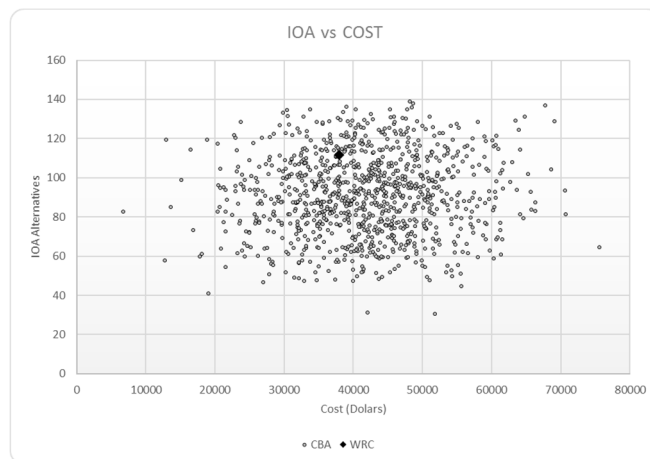


Figure 2: WRC alternative outside Pareto's optimal curve.

From charrette, 4 practitioners obtained their WRC alternative outside of Pareto's optimal curve and 7 practitioners had their WRC alternative inside. All the practitioners that their WRC alternative was outside Pareto's optimal curve choose a CBA alternative with a better performance, i.e., in Pareto's optimal curve and 5 from 7 practitioners which WRC alternative was in Pareto's optimal curve choose a CBA alternative also in Pareto's optimal curve, but different from WRC alternative.

In the survey, practitioners answer about which of the two possible alternatives were their final decision. In two cases, the WRC and CBA alternatives were the same. Out of the 9 remaining, just in one case the WRC alternative was preferred over the CBA alternative, and in the rest of the cases, CBA alternative was chosen over WRC alternative. Also, in the survey, researchers ask about the transparency of both methods and what of the two methods practitioners choose if they must make decisions. Practitioners indicate that CBA is more transparent than WRC and they will use CBA in a decision maker context.

Regarding the results, researchers indicate that CBA method presents benefits over WRC method when it is applied to large design spaces. Practitioners preferred CBA to WRC because of the nature of the CBA method, that allows assessing all the alternatives and not just having one alternative as the best as WRC does.

