REDUCING BIAS IN THE HIRING PROCESS THROUGH CHOOSING BY ADVANTAGES: A CASE STUDY

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ABSTRACT

Construction projects rely on the people in the project team; people are selected to perform their role satisfactorily in the project and contribute to its success. However, the selection in the hiring process has different biases that are often not perceived by those who decide to hire people. This research aims to present a study applying the Choosing By Advantages (CBA) Tabular method for the hiring process of a new team member, aligning the structure of the selection process with the five phases of the CBA system. The selection process is divided into two parts to reduce bias in decision-making: the first preliminary part uses information associated with objective data from the applicants' CVs without knowing their identities. The second part complements information knowing their identities obtained from personal interviews. In this research, we use a practical approach called the SEEDS Model®, represented in five categories of biases present in everyday thinking (similarity, expedience, experience, distance, and safety). Furthermore, the results demonstrate that CBA and SEEDS Model® help reduce bias in the selection process and choose people for their attributes representing their capacities, avoiding bias in the selection.

Keywords

Choosing By Advantages, multi-criteria decision analysis, CBA Tabular Method, SEEDS Model®, hiring process, bias.

INTRODUCTION

Different methods can support decision-making in the Construction sector, where the decisions made are of great importance to increase the value in the different stages of the projects. Thus, in the construction sector, different methods have been applied for decision makings, such as WRC (Weighting, rating, and calculating), AHP (Analytic Hierarchy Process), and CBA (Arroyo 2014). Arroyo et al. (2019) indicate that CBA has gained more attention in the construction industry in recent years. This increase has been driven by demands for more collaborative project organizations and transparent decision-

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making processes due to the synergy of CBA with other agendas such as improving sustainability and safety and by a growing need to incorporate multiple factors into the decision-making process. Although CBA has been applied in several types of decisions; it has focused on design (Arroyo & Long, 2018; Perez & Arroyo, 2019; Sahadevan & Varghese, 2019; Schöttle et al., 2019, 2018), with only one study in the literature on its application in personnel selection for a new member of a construction team (Paucar-Espinoza et al., 2021).

One of the most critical decisions made in construction projects is the team's formation, and many times they are fraught with different types of biases. In addition, there is no standard in practice for selecting project team members, and each company develops its way of choosing its human resources. Therefore, there is no emphasis on avoiding bias. Also, the research on this topic is scarce in Lean Construction. That is why the following article focuses on the application of Choosing by Advantages in the hiring process. The paper presents a case study where project team members select a new team member using the Tabular CBA method to reduce decision-making biases.

BACKGROUND

In this section, the authors initially discuss Choosing by Advantages (CBA), cognitive biases, and hiring biases, as they are relevant to understanding the challenges of the construction recruitment process.

CHOOSING BY ADVANTAGES

CBA is a multi-criteria decision-making method that helps build group consensus more transparently than traditional methods, such as WRC and AHP, because CBA bases value judgments on factual and agreed differences between the alternatives (Arroyo 2014). Suhr (1999) developed CBA, and it has been adopted in the Lean Construction community mainly for design and construction decisions. For example, Paucar-Espinoza et al. (2021) used CBA for selecting a new team member; however, their study did not consider bias mitigation strategies.

COGNITIVE BIASES

By definition, a bias is a deviation from normal, defined by social norms. Cognitive biases, which occur unconsciously, have been studied in psychology; Kahneman (2011) presents multiple types and examples, summarizing decades of research. In this research we used a practical approach developed by the Neuroscience Institute called the SEEDS Model® (Lieberman et al., 2015) to help people identify, interrupt, and mitigate unconscious biased thinking. The SEEDS Model ® represents five different categories of biases present in everyday thinking: Similarity, Expedience, Experience, Distance, and Safety Bias. Lieberman et al. (2015) describe them as follows.

1. Similarity bias: Arises from our innate motivation to distinguish between in-group and out-group biases. We feel more comfortable with people with similar experiences than us. We believe that people similar to us are better than others.

2. Expedience bias: Arises when we try to save mental energy by recalling recent information. This bias includes confirmation and availability bias. We believe that our first feeling should be correct.

3. Experience bias: This draws from the unconscious belief that we see things as they are (blind-spot bias) and know all there is to know (fundamental attribution error). We believe that our subjective perceptions are objectively true.

4. Distance bias: Our tendency to value people, events, and things based on their proximity to us in time and space. We unconsciously assign less value to psychologically distant things (temporal discounting bias), and we overvalue short-term concerts while undervaluing long-term concerns (affective forecasting bias). We believe that the people closest to us are better than those far away.

5. Safety bias: Arises from the brain's threat detection network, continuously scanning the environment for danger. Since undetected threats can be fatal, so we assign more value to potential losses than to potential gains (loss aversion bias). We believe that bad results are much more relevant than good results.

HIRING BIASES

The impact of gender bias on career development was studied by Arroyo et al (2018); the findings suggest that gender biases negatively affect hiring and career development for women in AEC Industry. However, other biases may be present in the hiring process, such as age and race biases. This research documents some of the biases present in the hiring process and explores how to mitigate them using strategies from the SEEDS Model® and applying CBA.

RESEARCH METHODOLOGY

CASE STUDY

We selected the case study methodology because the researchers had little control over the events, and the phenomenon is contemporary (Yin, 2003). A controlled experiment was discouraged because the study does not represent a "sample", as an experiment does. We established a longitudinal-holistic case study since the main objective of this research is to extend and conceptualize theories by means of an analytical generalization of causal relationships (simple, complex, and enigmatic), performing a second-level analysis, verifying whether or not the case study supports the proposed theory (Yin, 2003) and not a statistical generalization, the two being epistemologically independent (Yacuzzi, 2005; Yin, 2003).

We used "information-based selection" because of the research feasibility with the construction company. It indicates that the company belongs to a specific economic sector and is located in a specific sector (Lima, Perú).

The unit of analysis consists of a construction project for a hospital building located in an interior sector of the country (Huánuco, Peru) due to the magnitude of the project. It will have a team of 40 people from different support areas; one of these areas is Project Controls specifically; the position analyzed is a Planning Assistant for the architectural works of the project. To select a Planning Assistant, the project team applies CBA, which is explained in the following section.

CHOOSING BY ADVANTAGES

For the CBA application in selecting the new member of the project team, steps were structured through the five phases of the CBA system, shown below in Figure 1.
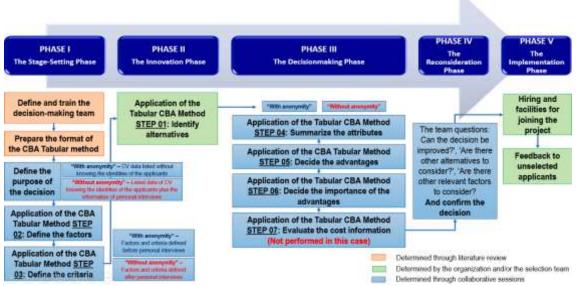
Figure 1: Selection process structured through the phases of the CBA system

As an initial part of the selection, the selection team is defined and trained in the basic concepts of the CBA system, the steps of the Tabular CBA method (with examples from the bibliography), and the typification of the most common biases in selection processes. In addition, the team prepares formats to be used for the adequate development of the method.

The next step is to define the decision's purpose; the project controls team describes the new member's role and functions. Also, the team decided on how to carry out the selection to reduce as much bias as possible, taking at this point the initiative to carry out the development of the selection in two parts.

- The first part of the selection was called "with anonymity," where only the information collected from the curriculum vitae (CV) of each applicant was used (assigning a number to each applicant) without knowing their identities
- The second part of the selection was called "without anonymity." In this stage, the identity of each applicant was revealed to proceed with the interviews. It permits to complement of the information of the previous iteration.

FIRST PART: SELECTION OF CANDIDATES ANONYMOUSLY

The application of the steps of the CBA Tabular are explained below:

Step 01: Identify the alternatives

One person from the work team was assigned to collect the information of all the CVs into a single list without consigning names and providing a number to each applicant. In this step, the project team identified ten participants to select the new member of the project team.

Step 02: Define the factors

The team conducted a brainstorming session to define the factors for the selection, considering the Lean Construction Professional Profile (LCPP) (Pavez & Alarcon, 2007 and Paucar-Espinoza et al., 2021) and the context of the project, listing 11 factors.

For this first part of the selection, the team divided factors into two categories (Figure 2):

- The factors whose attributes could be extracted directly from the list with information from the CVs were assigned the label "with anonymity" (6 factors).
- The factors whose attributes could be obtained due to the interaction in the interviews were assigned the label "without anonymity" (5 factors).

Step 03: Define the criteria

The team agreed on the respective criteria associated with each factor (Figure 2).

For this first part of the selection, we proceeded with the following steps using only the factors labeled "with anonymity".

LCPP	Label	Factor Number	Factor (Criterion)
A (Technical Competence)	"With anonymity"	1	ACHIEVEMENTS
			The more achievements, the better
A (Technical Competence)	"With anonymity"	2	KNOWLEDGE IN REVIT
			If he/she is proficient in REVIT, better
A (Technical Competence)	"With anonymity"	3	EXPERIENCE IN THE FIELD/WORKS
			The more months of work experience, the better
A (Technical Competence)	"With anonymity"	4	KNOWLEDGE IN PROJECT CONTROL
			The more knowledge in Project Control, the better
A (Technical Competence)	"Without anonymity"	5	REFERENCES
			If he/she has project references, better
C (Enterprise Vision)	"Without anonymity"	6	AFFINITY FOR PROJECT CONTROL
			The more security of his/her targets in the area, the better
—	"With anonymity"	7	LOCATION
			The closer to Lima, the better
B (Social Competence)	"Without anonymity"	8	CREATION OF A GOOD WORK ENVIRONMENT
			The more development in his/her answers, the better
C (Enterprise Vision)	"Without anonymity"	9	ATTITUDE AND PREDISPOSITION TO WORK
			The better his/her attitude in the cases raised, the better
B (Social Competence)	"With anonymity"	10	CONTINUOUS LEARNING
			The more recent training, the better
C (Enterprise Vision)	"Without anonymity"	11	COMMUNICATION SKILLS
			The better his/her response to the cases raised, the better

Figure 2: Factors and respective criteria obtained by the selection team

Step 04: Summarize the attributes

The attributes inherent to each alternative were transferred to the Tabular Format, obtained from the consolidated list with information from the CVs.

Step 05: Decide on the advantages

For this step, the team first identified the least preferred attribute and then objectively compared each attribute versus the least preferred attribute on each factor, the differences being the advantages of the alternatives.

Step 06: Decide the importance of the advantages

In this step, the discussion was generated within the team with all the information centralized in the Tabular Format. First, the most favorable advantages were highlighted, then a scale from 0 to 100 was used to assign the Importance of Advantage (IoA). Next, collaboratively, the team reviewed all of the most favorable advantages, selecting the paramount advantage (100 IoA score) "high knowledge in Project Control." Then weighted the IoA of the other most favorable advantages against the paramount advantage and finally weighted the IoA of all remaining advantages, comparing them to the most favorable advantages. Once the IoA score was assigned to all the advantages, the final IoA score representing the value of each of the alternatives was calculated, taking into account only the factors labeled as "with anonymity."

Step 07: Evaluate the cost information

In this decision, the project team did not evaluate costs because the salary of this position is similar for the participants.

Tables 1, 2, and 3 describe the first part of the decision. Then, half of the applicants with the highest IoA were selected. In this stage, the project team revealed the identity of the participants to schedule personal interviews and send e-mails with acknowledgments to the people who did not pass this part of the selection.

Table 1: First part of the selection process (referred to as "with anonymity")

FACTOR (Criterion)		Postulant 01	IoA	Postulant 02	IoA	Postulant 03	IoA	Postulant 04	IoA	Postulant 05	IoA
ACHIEVEMENTS	Att.:	1 achievement		**Did not document achievements**		1 achievement		3 achievements		**Did not document achievements**	
The more achievements, the better	Adv.:	1 more achievement	7		-	1 more achievement	7	3 more achievements	20		-
KNOWLEDGE IN REVIT	Att.:	Yes		Yes		**No**		Yes		**No**	
If he/she is proficient in REVIT, better	Adv.:	He/She is proficient in REVIT	70	He/She is proficient in REVIT	70		-	He/She is proficient in REVIT	70		-
EXPERIENCE IN THE FIELD/WORKS	Att.:	29 months		33 months		36 months		18 months		**Did not work on site**	
The more months of work experience, the better.	Adv.:	29 more months of work experience	48	33 more months of work experience	55	36 more months of work experience	60	18 more months of work experience	30		-
KNOWLEDGE IN PROJECT CONTROL	Att.:	**Little knowledge in Project Control**		**Little knowledge in Project Control**		High knowledge in Project Control		Medium knowledge in Project Control		**Little knowledge in Project Control**	
The more knowledge in Project Control, the better	Adv.:		-		-	More knowledge in Project Control	66	Little more knowledge in Project Control	33		-
CONTINUOUS LEARNING	Att.:	2 recent trainings		2 recent trainings		5 recent trainings		**0 recent trainings**		3 recent trainings	
The more recent training, the better	Adv.:	2 recent trainings more	28	2 recent trainings more	28	5 recent trainings more	70		-	3 recent trainings more	42
IoA Total			153		153		203		153		42

Table 2: First part of the selection process (continuation)

FACTOR (Criterion)		Postulant 06	IoA	Postulant 07	IoA	Postulant 08	IoA	Postulant 09	IoA	Postulant 10	IoA
ACHIEVEMENTS	Att.:	**Did not document achieve-ments**		3 achieve-ments		3 achieve-ments		3 achieve-ments		**Did not document achieve-ments**	
The more achievements, the better	Adv.:		-	3 more achieve-ments	20	3 more achieve-ments	20	3 more achieve-ments	20		-
KNOWLEDGE IN REVIT	Att.:	**No**		Yes		Yes		Yes		**No**	
If he/she is proficient in REVIT, better	Adv.:		-	He/She is proficient in REVIT	70	He/She is proficient in REVIT	70	He/She is proficient in REVIT	70		-
EXPERIENCE IN THE FIELD/WORKS	Att.:	**Did not work on site**		29 months		**Did not work on site**		**Did not work on site**		8 months	
The more months of work experience, the better.	Adv.:		-	29 more months of work experience	48		-		-	8 more months of work experience	13
KNOWLEDGE IN PROJECT CONTROL	Att.:	**Little knowledge in Project Control**		Very high knowledge in Project Control		Medium knowledge in Project Control		**Little knowledge in Project Control**		**Little knowledge in Project Control**	
The more knowledge in Project Control, the better	Adv.:		-	Much more knowledge in Project Control	100	Little more knowledge in Project Control	33		-		-
CONTINUOUS LEARNING	Att.:	4 recent trainings		2 recent trainings		**0 recent trainings**		2 recent trainings		**0 recent trainings**	
The more recent training, the better	Adv.:	4 recent trainings more	56	2 recent trainings more	28		-	2 recent trainings more	28		-
IoA Total			56		266		123		118		13

Table 3: Results of the first part of the selection process

Alternative	Applicant name	IoA Total	Comment
Postulant 07	AAA AAA	266	Continue with the second part of selection
Postulant 03	BBB BBB	203	Continue with the second part of selection
Postulant 01	CCC CCC	153	Continue with the second part of selection
Postulant 02	DDD DDD	153	Continue with the second part of selection
Postulant 04	EEE EEE	153	Continue with the second part of selection
Postulant 08	FFF FFF	123	Does not continue selection process
Postulant 09	GGG GGG	118	Does not continue selection process
Postulant 05	HHH HHH	42	Does not continue selection process
Postulant 06	III III	56	Does not continue selection process
Postulant 10	JJJ JJJ	13	Does not continue selection process

SECOND PART: SELECTION OF CANDIDATES WITHOUT ANONYMITY

The team selected and interviewed Applicants 07, 03, 01, 02, and 04 for the second part of the selection. Again, the questions were structured according to the factors "without

anonymity" to obtain information on their attributes. After the interviews section, the steps of the CBA Tabular method are restarted from step 04, completing the information in the remaining factors and criteria.

Step 04: Summarize the attributes

The team completed the Tabular Format with the attributes inherent to each alternative obtained from the interviews with each participant.

Step 05: Decide on the advantages

For this step, the team first identified the least preferred attribute and then objectively compared each attribute versus the least preferred attribute on each factor.

Step 06: Decide the importance of the advantages

In this step, the team discusses if it is convenient to weigh all the advantages together again or not. Because the team observed that one of the applicants grouped a greater number of more favorable advantages of the factors "without anonymity." Agree that it was no longer necessary to weigh the advantages since this applicant would have the highest IoA. Therefore, and ignoring step 07, the decision was made to select applicant 07 as the new member of the project team. Table 4 describes the results of the second part of the selection.

The reconsideration of the decision was carried out throughout the process. The team questioned whether other factors or even alternatives could be considered and even if the decision could be improved, concluding to reaffirm the decision made.

Finally, the last step of the selection process consisted of providing a formal response from the project for hiring through the company's headquarters and making arrangements to provide the selected person with the necessary facilities for their immediate incorporation into the project. Like the first part of the selection, the team sent e-mails with acknowledgments to the participants not selected.

Table 4: Second part of the selection process

FACTOR		Postulant 01	IoA	Postulant 02	IoA	Postulant 03	IoA	Postulant 04	IoA	Postulant 07	IoA
(Criterion)		CCC CCC		DDD DDD		BBB BBB		EEE EEE		AAA AAA	
ACHIEVEMENTS	Att.:	1 achievement		**Did not document achievements**		1 achievement		3 achievements		3 achievements	
The more achievements, the better	Adv.:	1 more achievement	7		-	1 more achievement	7	3 more achievements	20	3 more achievements	20
KNOWLEDGE IN REVIT	Att.:	Yes		Yes		**No**		Yes		Yes	
If he/she is proficient in REVIT, better	Adv.:	He/She is proficient in REVIT	70	He/She is proficient in REVIT	70		-	He/She is proficient in REVIT	70	He/She is proficient in REVIT	70
EXPERIENCE IN THE FIELD/WORKS	Att.:	29 months		33 months		36 months		18 months		29 months	
The more months of work experience, the better.	Adv.:	29 more months of work experience	48	33 more months of work experience	55	36 more months of work experience	60	18 more months of work experience	30	29 more months of work experience	48
KNOWLEDGE IN PROJECT CONTROL	Att.:	**Little knowledge in Project Control**		**Little knowledge in Project Control**		High knowledge in Project Control		Medium knowledge in Project Control		Very high knowledge in Project Control	

Attribute	Ind.	P01		P02		P03		P04		P05	
The more knowledge in Project Control, the better	Adv.:	-		-		More knowledge in Project Control	66	Little more knowledge in Project Control	33	Much more knowledge in Project Control	100
AFFINITY FOR PROJECT CONTROL	Att.:	**Medium affinity for Project Control**		High affinity for Project Control		High affinity for Project Control		High affinity for Project Control		Very high affinity for Project Control	
The more security of his/her targets in the area, the better.	Adv.:	-		Higher affinity for Project Control		Higher affinity for Project Control		Higher affinity for Project Control		Much higher affinity for Project Control	
CREATION OF A GOOD WORK ENVIRONMENT	Att.:	**Regular performance in dynamic team**		Good performance in Dynamic team		Good performance in Dynamic team		**Regular performance in Dynamic team**		Very good performance in dynamics	
The more development in his/her answers, the better.	Adv.:	-		Better performance in creating good working environment		Better performance in creating good working environment		-		Much better performance in creating good working environment	
ATTITUDE AND PREDISPOSITION TO WORK	Att.:	**Good attitude and predisposition to work**		Very good attitude and predisposition to work		Very good attitude and predisposition to work		Very good attitude and predisposition to work		Very good attitude and predisposition to work	
The better his/her attitude in the cases raised, the better	Adv.:	-		Better attitude and predisposition to work		Better attitude and predisposition to work		Better attitude and predisposition to work		Better attitude and predisposition to work	
CONTINUOUS LEARNING	Att.:	2 recent trainings		2 recent trainings		5 recent trainings		**0 recent trainings**		2 recent trainings	
The more recent training, the better	Adv.:	2 recent trainings more	28	2 recent trainings more	28	5 recent trainings more	70	-		2 recent trainings more	28
COMMUNICATION SKILLS	Att.:	**Good communication skills**		Very good communication skills		Very good communication skills		**Good communication skills**		Very good communication skills	
The better his/her response to the cases raised, the better	Adv.:			Better communication skills		Better communication skills				Better communication skills	
IoA Total		**153**		**153**		**203**		**153**		**266**	

DISCUSSION

In the first stage, 10 participants were considered, and the selection focused on identifying the participants with the best attributes, which were participants 01, 02, 03, 04, and 07. In this first stage, participant 07 (Table 02) obtained a higher IoA (266) mainly due to their affinity for project management. This information could be obtained by reviewing their CV anonymously. In the second stage, 05 participants were considered, and the project control team sought to know them in greater depth through an interview. From the interview, we could obtain that participant 07 (Table 04) had a more significant number of advantages in the attributes: affinity for project control, good working environment, attitude, and predisposition to work and communication skills. Because participant 07 had higher scores in stage 01 and more advantages, the team decided not to weigh the advantages and proceeded to choose participant 07. These results could change for future applications if, during the interview phase, the selection team considers that the participant with the highest score in the initial phase has fewer advantages in this second stage.

Due to the team's awareness of potential bias throughout the selection process, the discussion and rhetoric focused on this topic were important.

After the selection, a brief positive and introspective discussion was held in the team regarding possible biases incurred. As a result of that conversation, some were detected that are listed below:

- Similarity bias: This bias was incurred when determining that the candidates should have similar technical capabilities to the members of the selection team, evidencing this point when determining the supreme advantage associated with the "Knowledge in Project Control" factor. [*"The person we select must know about topics related to our area"*].

- Expedience bias: It was identified that this bias was incurred when considering the first feeling caused by the answers provided by the applicants to summarize the attributes associated with the factor "Creation of a good work environment," presenting them with a case situation. [*"His/Her response gave me a good insight into how she would handle that situation."*].

- Experience bias: This bias was minimized when supporting the identification of selection factors with the LCPP. Factors related only to the technical part would traditionally have been considered. The selection team indicated they were all the factors they knew and believed to be sufficient to select the new team member based on their previous experiences.

- Distance bias: This bias was minimized by taking the initiative to identify alternatives for external applicants since the team pointed out that generally, in previous selections, the only alternatives they had were close referrals indicated by the company's recruitment area.

- Safety bias: It was identified that prior to the interviews, the applicants' answers when answering the telephone calls to set the interview schedule influenced them to think about possible threats that would prevent the development of the interviews and the success of the selection. [*"I hope he/she participates in the interview…, I perceived a lack of interest"*].

In addition, taking as a reference a previous documented experience (Paucar-Espinoza et al., 2021), it was shown that the face-to-face use of the CBA method was more beneficial than its virtual use. Social aspects play an important role in the decision-making process (Martínez et al., 2016), even more so if the objective is to minimize bias. In this case, they became more dynamic and transparent, generating trust to talk constructively about biases.

CONCLUSIONS

Training in the CBA system and the CBA Tabular Method for the selection team was essential; it allowed them to become familiar with the vocabulary, the principles, and the steps of applying the method. Adding to this training, the concept, and typification of biases, using the SEEDS Model®, allowed to create a reflection in the selection team to mitigate biases as the main objective when selecting a new member of the project team.

The selection team concluded that knowing the biases before starting the selection process allowed them to design a better way to minimize biases influencing the selection. This application proved to be effective in allowing the selection team to recognize and reduce bias throughout the selection process. The use of the CBA Tabular Method allowed the decision to be made transparent, dynamic, and collaborative, reaching a consensus on the decision made. After this selection, selectors are aware of the biases they may have before making a decision.

This work contributes to the body of knowledge of CBA applications, raising awareness of the influence of biases in a hiring process and suggesting a way to reduce them. Also, this research helps construction companies and construction teams to select team members in a better way and reduces bias in the hiring process.

Finally, the authors suggest replicating the selection using CBA in other positions, such as heads of projects and project managers, and studying the influence of biases in decision-making.

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REFERENCES

Arroyo, P. (2014). Exploring decision-making methods for sustainable design in commercial buildings. University of California, Berkeley.

Arroyo, P., Schöttle, A., Christensen, R., Alves, T., Costa, D. B., Parrish, K. & Tsao, C. (2018), 'Impact of Gender Bias on Career Development & Work Engagement in the OAEC Industry & Lean Practice' In:, 26th Annual Conference of the International Group for Lean Construction. Chennai, India, 18-20 Jul 2018. pp 442-451

Arroyo, P., & Long, D. (2018). Collaborative design decisions. *26th Annual Conference of the International Group for Lean Construction, IGLC 2018*, *1*, 463–472. https://doi.org/10.24928/2018/0509

Arroyo, P., Christensen, R. Schöttle, A. & Long, D. (2019). "Lessons Learned on Teaching Choosing by Advantages" In: Proc. 27th Annual Conference of the International. Group for Lean Construction (IGLC), Dublin, Ireland, pp. 405–416

Kahneman, D. (2011). Thinking, fast and slow. Macmillan.

Lieberman, M. D., Rock, D., Halvorson, H. G., & Cox, C. (2015). Breaking bias updated: The seeds model. Neuroleadership Journal, 6, 4-18.

Martínez, E., Tommelen, I. y Alvear, A. (2016). "Formwork System Selection Using Choosing By Advantages", Construction Research Congress. DOI: 10.1061/9780784479827.170

Paucar-Espinoza, A. F., Erazo-Rondinel, A. A., & Yong-Zamora, S. (2021). Choosing by Advantages for the Selection of a New Member of the Project Team. In L. F. Alarcón & V. A. González (Eds.), *Proc. 29th Annual Conference of the International Group for Lean Construction (IGLC)* (pp. 562–571). https://doi.org/10.24928/2021/0219

Pavez, I. & Alarcon, L. F. (2007). 'Lean Construction Professional's Profile (LCPP): Understanding the Competences of a Lean Construction Professional' In: Pasquire, C.L, C. L. & Tzortzopoulos, P., *15th Annual Conference of the International Group for Lean Construction.* East Lansing, Michigan, USA, 18-20 Jul 2007. pp 453-464.

Perez, C., & Arroyo, P. (2019). Designing municipal waste management programs using choosing by advantages and design structure matrix. In C. Pasquire & F. R. Hamzeh (Eds.), *27th Annual Conference of the International Group for Lean Construction, IGLC 2019* (pp. 1345–1356). https://doi.org/10.24928/2019/0194

Sahadevan, V., & Varghese, K. (2019). AHP and CBA application to layout design: A case of classroom layout assessment. In C. Pasquire & F. R. Hamzeh (Eds.), *27th Annual Conference of the International Group for Lean Construction, IGLC 2019* (pp. 1333–1344). https://doi.org/10.24928/2019/0256

Schöttle, A., Arroyo, P., & Christensen, R. (2018). Demonstrating the value of an effective collaborative decision-making process in the design phase. In V. A. González (Ed.), *26th Annual Conference of the International Group for Lean Construction, IGLC 2018* (Vol. 2, pp. 899–909). https://doi.org/10.24928/2018/0500

Schöttle, A., Christensen, R., & Arroyo, P. (2019). Does choosing by advantages promote inclusiveness in group decision-making? In C. Pasquire & F. R. Hamzeh (Eds.), *27th Annual Conference of the International Group for Lean Construction, IGLC 2019* (pp. 797–808). https://doi.org/10.24928/2019/0209

Suhr, J. (1999). The Choosing by Advantages Decisionmaking System. Westport: Quorum Books.

Yacuzzi, E. (2005). *El estudio de caso como metodología de investigación: Teoría, mecanismos causales, validación (The case study as a research methodology: Theory, causal mechanisms, validation, and validation)*.

Yin, R. K. (2003). Case Study Research: Design and Methods. In *SAGE Publications* (3th ed.).