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A Review of Social Sustainability Studies Involving Multiple-Criteria within the Construction Industry

**George da Mota Passos Neto, M.Sc. and
Luciana Hazin Alencar, Ph.D.**
Universidade Federal de Pernambuco
Recife, Brazil

**Rodolfo Valdes-Vasquez, Ph.D. and
Mehmet E. Ozbek, Ph.D.**
Colorado State University
Fort Collins, Colorado

This paper explores future research directions on social sustainability in the construction industry through a systematic literature review of studies focusing on multiple criteria. The analysis involved 36 studies identified through the Web of Science, ScienceDirect, and Scopus. The results uncovered how social sustainability assessment is conducted, and where the studies are taking place, mostly in developing countries. On average, the reviewed studies used 29 criteria to assess social sustainability. That large number of criteria indicates a need to find a subset of criteria capable of representing social sustainability complexity. Regarding the methods identified, Multicriteria Decision-Making/Aiding (MCDM/A) methods are the most used, including the Analytic Hierarchy Process (AHP) and weighted aggregation. However, it is difficult to confirm if they are the most appropriate since the authors did not mention how these methodologies were selected or the decision-makers' rationality, which is necessary for choosing the proper MCDM/A method. Thus, future studies in social sustainability should focus on: i) dimensionality reduction and ii) the structure of the decision problem to correctly choose the decision method. These two recommendations will add to the body of knowledge, especially to the value of integrating the social aspect of sustainability in construction.

Key Words: Social Sustainability, Construction, Projects, Multiple-Criteria

Introduction and Purpose

Social sustainability is one of the three pillars of the triple bottom line of sustainable development, which has been gaining some attention since the Report of the World Commission on Environment and Development: Our Common Future (ONU, 1987). The social aspect of sustainability can be understood as a series of processes to improve the health, safety, and well-being conditions of any person affected directly or indirectly by a construction project during its life cycle (Valdes-Vasquez & Klotz, 2013). However, social sustainability has been taken into consideration less when compared to the other environmental and economic pillars of sustainability (Ahmad & Thaheem, 2017; Sierra, Yepes, & Pellicer, 2018).

This lesser attention to social sustainability is an important area to address in improving the construction industry. Specifically, social sustainability can be considered the pillar responsible for most needs of human well-being (Forsman & Jonsson, 2016), and its implementation provides a

potential economic advantage (Marzouk & Sabbah, 2021). Recently, this topic has been increasingly gaining attention in academic discussions (Nasirzadeh et al., 2020), describing the difficulties of reaching a consensus concerning concepts and operationalizing them, by turning abstract conceptual ideas into measurable observations (Shirazi & Keivani, 2019; Vallance et al., 2011). The main obstacle to implementing social sustainability in construction projects is the lack of knowledge about what social sustainability criteria should be included and the high level of subjectivity in prioritizing their importance (Montalbán-Domingo et al., 2020). In addition to these obstacles, it is difficult to quantitatively measure social sustainability compared to the other aspects of sustainability. Especially when considering each country's specific context (McKenzie, 2004).

Some initiatives have arisen to incorporate sustainability in construction. For example, since the 1990s, many green rating systems have been developed to assess sustainability in construction, but they mainly focus on the environmental aspect of sustainability (Sierra, Yepes, & Pellicer, 2018; Zarghami et al., 2019). Therefore, other ways of assessing social sustainability have been developed (Almahmoud & Doloi, 2015; Karji et al., 2019; Mulliner et al., 2013; Olakitan Atanda, 2019). These studies have advanced the body of knowledge by providing methods to assess social sustainability. However, their limitations of coverage and focus require more effort in this direction (Rostamnezhad & Thaheem, 2022).

For example, Gurmu et al. (2022) and Rostamnezhad & Thaheem (2022) investigated which aspects of social sustainability were considered in previous construction studies. Since each of the previous studies consider different facets of social sustainability, the authors recognized that a comprehensive assessment was missing. These researchers identified that the categories encompassed by social sustainability studies in construction are stakeholders, occupational safety and health, human resources, community, socioeconomic compliance, neighborhood, ecological impact, quality of life, diversity, cultural heritage, subcontractors, ethics, and innovation. These studies reinforce the complexity and comprehensiveness of the social aspect of sustainability. Nevertheless, their results did not focus on the methods or criteria used to assess construction projects and their processes.

Given this gap, through a systematic literature review, this paper explores future social sustainability research directions for its operationalization and applicability in assessing construction projects. The review focuses on how social sustainability is evaluated in the construction industry in studies that specify the criteria used. The following four questions are addressed:

- What are the prominent academic journals that discuss criteria used to assess social sustainability in the construction industry, and which countries have most applied them?
- What sources are used for the social sustainability criteria when assessing the construction industry?
- Which methods are used to assess social sustainability in the construction industry?
- What are the opportunities for improvement in assessing social sustainability in the construction industry?

The methodology will be introduced in the following sections. Subsequently, the results and discussions will be presented. Finally, the conclusions and two main recommendations for future research will be provided to enable an efficient assessment of social sustainability in the construction industry.

Methods

This research followed the systematic literature review methodology to enhance the knowledge base

and inform practice (Tranfield et al., 2003). This literature review can be classified as a scoping review, which broadly and systematically searches the literature regarding the topic, extracts information from the papers, and synthesizes them. This technique also allows the studies to be placed in a historical and academic context (Xiao & Watson, 2019). The review involves three main phases: planning, conducting, and reporting (Tranfield et al., 2003). The procedure for this research was developed referring to the well-known guidelines of systematic review (Moher et al., 2016). The key steps of the screening process are shown in Figure 1. The search in the databases was conducted with the following keywords: “social sustainability” AND (construction OR buildings OR residential OR infrastructure OR commercial OR industrial). As shown in Figure 1, 222 papers were initially found in the Web of Science database, 513 in Scopus, and 41 in Science Direct, for a total of 776 papers. After the exclusion of duplicates, 572 articles were selected based on the title.

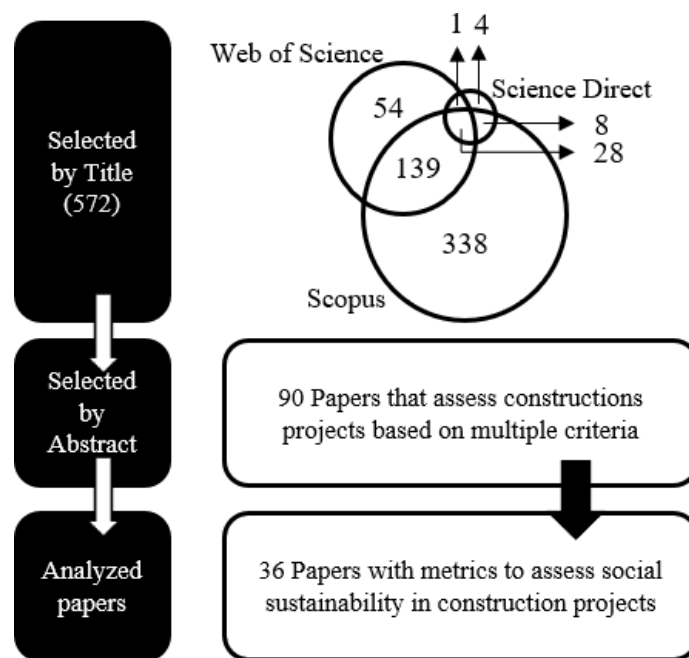


Figure 1. Flowchart for the screening process

Two previous literature reviews were found among the studies addressing social sustainability in construction. These two literature reviews served as a basis for analyzing the extent of social sustainability in construction (Gurmu et al., 2022; Rostamnezhad & Thaheem, 2022). However, they do not examine the metrics used to evaluate the impact of construction, which is fundamental to its operationalization. Thus, 90 papers were identified to quantitatively assess the social sustainability in the construction industry, considering multiple criteria in their assessment. Nevertheless, after reading these papers, some studies were excluded because they did not explicitly bring criteria with metrics, were not applied in a case related to construction, or did not deal exclusively with the social aspect of sustainability. After all the screening, 36 papers were selected for further analysis. The list of analyzed papers is available at: <https://tinyurl.com/libraryasc2022>.

The following section presents the results and discussions based on the 36 articles selected through a systematic process that addresses the metrics used to evaluate constructions. The results and analysis were cross-checked among the authors, and the conclusions were based solely on systematically selected papers. First, a descriptive analysis of the studies is presented, emphasizing the prominent

journals discussing social sustainability assessment with explicit metrics and the leading countries evaluating social sustainability. Then, how this evaluation is being conducted will be discussed.

Results and Discussion

Descriptive Analysis of the Selected Papers

As illustrated in Figure 2, four journals account for more than half of the publications that provide metrics for the evaluation of social sustainability in construction projects: Journal of Cleaner Production (six), Sustainability (Switzerland) (five), Sustainable Cities and Society (four), and Environmental Impact Assessment Review (four). Regarding the countries, Table 1 shows in which countries the studies have applied the assessment methods for social sustainability.

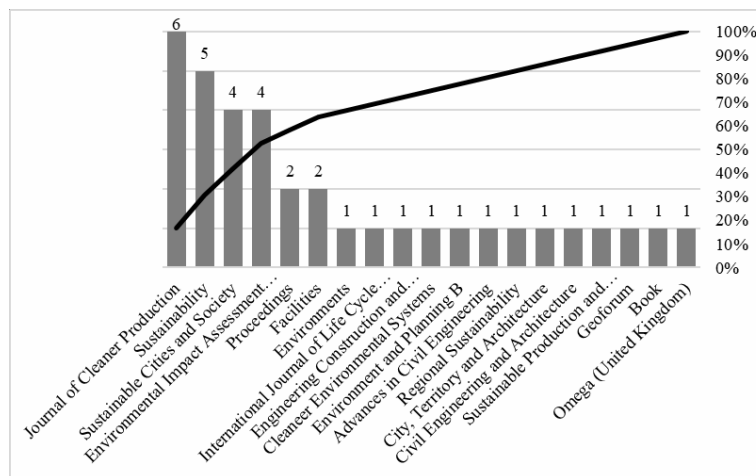


Figure 2. Journals where the analyzed studies were published

Table 1

Location of studies assessing social sustainability

Classification*	Number of studies	Country
Developing Countries	5	Iran
	4	China
	3	El Salvador
	6 (2 in each)	Hong Kong, Jordan, and United Arab Emirates
	9 (1 in each)	Taiwan, Singapore, Egypt, Ethiopia, Nigeria, Pakistan, Saudi Arabia, Vietnam, and Malaysia
Developed countries	4 (1 in each)	Cyprus, Hungary, New Zealand, and the United Kingdom

*Classification according to the United Nations Department of Economics et al. (2022)

According to Table 1, 27 studies were applied in developing countries, while only four were applied in developed countries. The authors based the classification on the United Nations Department of Economics et al. (2022). Specifically, in developing countries, Sierra et al. (2018) selected 21 criteria

to assess a set of alternatives for road infrastructure projects in El Salvador, and Karji et al. (2019) used 33 indicators to determine the social sustainability of the Mehr Housing Project in Iran. Whereas in developed countries, for example, Olukoya & Atanda (2020) selected 37 criteria to assess four architectural typologies in a village in Cyprus, and Mulliner et al. (2013) used 20 criteria to assess three residential neighborhoods in Liverpool, UK. Thus, Table 1 shows that 87% (27/31) of the studies have been performed in developing countries. The main reason for this could be that developing countries have been working to make interventions considering these aspects. On the other hand, in developed countries, the concept of recognizing the rights of neighbors, neighbors, and employers is more deeply rooted (VillarinhoRosa & Haddad, 2013).

Social Sustainability Assessment

Figure 3 shows the source of the social sustainability criteria used and which part of the construction industry they are applied to. In particular, Figure 3a displays most studies use social sustainability criteria from a literature review and expert judgment. A total of 21 studies use more than one source, and 11 combine criteria selection from some documentation with a subsequent screening process by experts. Regarding the green rating systems, the most used references are LEED (five), followed by BREEAM (two), and CASBEE (two).

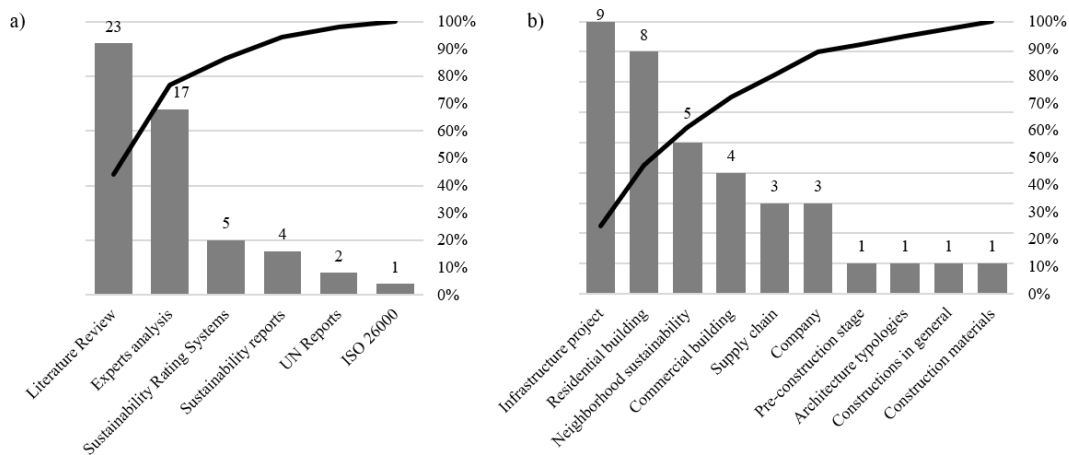


Figure 3a. Data source. 3b. Focus of the study related to construction.

Figure 3b shows that social sustainability criteria have been used to evaluate infrastructure projects and residential buildings. Five of the 36 studies discussed criteria without implementation and 31 developed case studies. In the case studies analyzed, each construction alternative was assessed, on average, according to 29 different criteria. The work of Hendiani & Bagherpour (2019), for example, used 71 different criteria, aggregating them additively. On the other hand, the study by Petrudi et al. (2021) used the fewest criteria (seven). However, their study could have explained how this subset of criteria would effectively represent the complexity of the social aspect of sustainability. Most likely, this considerable amount of criteria generally used by previous studies may be due to the complexity and comprehensiveness of the stakeholders and factors related to social sustainability (Gurmu et al., 2022; Rostamnezhad & Thaheem, 2022). Furthermore, such issues can be applied to different project

phases, as well as to different project types (e.g., residential, commercial, and infrastructure) and, finally, to other location contexts (e.g., neighborhood, region, and country), as shown in Figure 4.

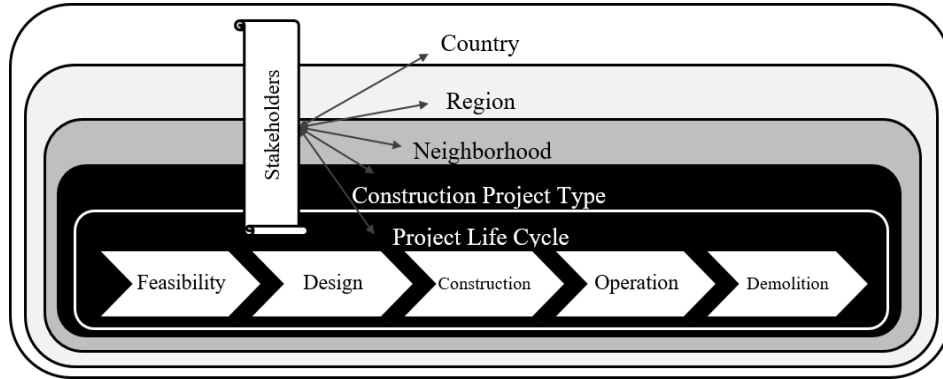


Figure 4. The extent and complexity of social sustainability in the construction industry.

However, this large number of criteria used to represent this complexity makes the evaluation very difficult and subjective. Moreover, according to Roselli & de Almeida (2021), the more criteria used, the lower the probability of decision-making success. Therefore, there is a high risk of failure when seven criteria or more are used. One possible implication of this is that the applicability of social sustainability depends on a reduction of the dimensionality of the problem. Therefore, finding a subset of criteria that can represent the complexity of this aspect of sustainability is a big challenge on which efforts must be concentrated. Regarding the analytical methods used, Table 2 shows the ones used in these 36 studies. Most studies use Multicriteria Decision-Making/Aiding Methods (MCDM/A) to select the alternatives, but statistical analysis, multi-objective algorithms, and others are also used to assess different alternatives.

Table 2
Methods to assess social sustainability

Classification	Method	Quantity	Total
Multicriteria Decision Method	Analytic Hierarchy Process (AHP)	10	23
	Weighted Aggregation	7	
	DEMATEL	1	
	TOPSIS	1	
	Analytic Network Process (ANP)	1	
	Best Worst Method (BWM)	1	
	PROMETHEE	1	
Statistical Analysis	COPRAS	1	6
	Cluster Analysis	3	
	Factor Analysis	2	
Multi Objective Algorithm	One-way Statistical Analysis (ANOVA)	1	4
	Harmony Search Algorithm	1	
	Pareto Border	1	
	Euclidean Distance	1	
Others	Chebyshev Distance	1	3
	Data Envelopment Analysis (DEA)	1	
	Social Network Analysis (SNA)	1	
	System Dynamics	1	

It is worth noting that some studies combine different methods while others do not use any method; they only evaluate the alternative concerning the selected criteria. That tendency for aggregation may also be due to the large number of criteria used to assess the alternatives in construction. In terms of MCDM/A, most studies (74%) use either the Analytic Hierarchy Process (AHP) or Weighted Aggregation to decide their studies, which are methods of compensatory rationality in which a worse performance on one criterion can be compensated for by better performance on another (Stewart, 1992). Nevertheless, researchers have not explored the justification for the method used or put any effort into structuring the decision problem.

Therefore, strategies to enhance the evaluation of social sustainability in construction projects involve exploring the structuring of the problem as well as the rationality of the decision-maker (de Almeida et al., 2015). Since the choice of multicriteria decision method depends on the decision maker's preference structure and rationality, there is no way to judge whether the methods have been adequately chosen. However, compensatory rationality does not seem to be the most appropriate to use in social sustainability problems since it does not seem to be adequate to compensate for low occupational health and safety performance by improving thermal comfort performance for end users.

Conclusions and Future Research

This paper explores future social sustainability research directions for its operationalization and applicability in the construction industry. To this end, the authors conducted a systematic literature review to identify how social sustainability assessment has been applied. Besides exploring the descriptive character and where and by what means this subject has been discussed, this work presents results that have important implications for future studies in assessing social sustainability in construction.

Initially, the complexity and comprehensiveness of social sustainability in construction were reaffirmed, which does not match the importance given to this aspect of sustainability by green rating systems - around 20% (Abed, 2017). Moreover, this complexity is translated in social sustainability assessments through many criteria in the decision problems, applying the frameworks developed so far difficult. Thus, a crucial strategy to strengthen how to operationalize social sustainability is to reduce the problem's dimensionality by selecting a subset of social sustainability criteria that can represent the problem efficiently. Furthermore, most previous studies used compensatory rationality to decide on the construction industry but still need to discuss structuring the multicriteria decision problem. This lack of specificity in the choice of method can easily lead to wrong decisions or paths. Therefore, future works should explore the structuring of the decision problem and justify the choice of method to assess social sustainability, highlighting the rationality of the decision maker (compensatory or non-compensatory), as well as their preference structure.

Future work can attempt to operationalize the social aspect of sustainability in construction by structuring the decision problem to correctly choose the method, and use fewer criteria to assess the alternatives. To address this recommendation, future studies can evaluate which metrics are most used in the frameworks developed. This information is of great value in finding a subset of criteria that can represent the complexity of the problem. In addition, other ways of reducing the problem's dimensionality should also be explored, such as using data-driven and statistical methods to check which criteria provide the most information, eliminating those highly correlated with others. These two strategies of problem structuring, and dimensionality reduction are essential for an efficient operationalization of social sustainability.

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