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Systematic Review

Multiple-Criteria Methods for Assessing Social Sustainability in the Built Environment: A Systematic Review

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Abstract: Studies related to social sustainability assessment have presented a variety of methods and criteria, but there is a need to better understand how these studies incorporate multiple criteria along with the issues addressed, the decision-makers, and the overall process followed to promote more socially sustainable outcomes. A systematic literature review methodology is conducted to identify, analyze, and synthesize scholarly articles that use multiple criteria to assess the built environment's social sustainability. This study explores types of problems, decision-makers, criteria, and methods adopted by researchers. The analysis involved 42 studies identified in the Web of Science, ScienceDirect, and Scopus databases. The results revealed a diverse range of studies, covering various issues, project types, and methodologies, highlighting the multifaceted nature of social sustainability evaluation in the context of the built environment. The most considered social sustainability issues in the studies were 'Impacts in Community' and 'Employment'. While most of the selected papers used multi-criteria decision-making/aiding (MCDM/A), not all engaged in these methods for decision-making purposes. Moreover, despite the prevalence of studies involving multiple decision-makers, issues related to group decision-making were often insufficiently addressed. The types of problems that the methods are used for are discussed, as well as the decision context and the process for selecting methods, thereby highlighting future research opportunities. Future studies should ensure that the criteria used are manageable but encompass all facets of social sustainability in the built environment, prioritizing methodological rigor when selecting MCDM/A methods and focusing on the nuances of preference aggregation in group decision-making scenarios.

Keywords: social sustainability; sustainability criteria; built environment; construction; multi-criteria decision-making/aiding (MCDM/A)

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1. Introduction

The concept of the "built environment" is intrinsically intertwined with the construction industry, forming a symbiotic relationship that significantly influences society and the economy, where the "built environment" is a broad term that encompasses all physical structures and spaces where people live, work, and interact [1]. The construction industry is the driving force behind the creation, development, and maintenance of these structures. As the construction industry flourishes, new buildings, infrastructure, and urban landscapes come into being and shape the very fabric of our cities and communities. In this context, the construction industry not only fuels economic growth by generating jobs and investments but also shapes the quality of life by how it designs the built environment and provides its functionalities [2]. Conversely, the state of the built environment directly influences the demands placed on the construction sector including with regard to the need for innovation and improvements in sustainability practices. Whether it is constructing energy-efficient buildings, developing resilient infrastructure, or adapting to urbanization challenges, the collaboration between the built environment and the construction industry remains pivotal in addressing society's needs and its aspirations about creating a more functional, aesthetic, and sustainable world [3].

In this sense, our study focuses on social sustainability, which is a multifaceted and constantly evolving concept, often described as a "concept in chaos" due to its lack of a standardized and comprehensive definition [4]. At the local level, social sustainability can be seen as a condition that enhances the quality of life for communities [5]. Social sustainability in construction projects is also viewed as a process that involves engaging all stakeholders, from employees to clients and communities, to meet the needs of both current and future generations [6]. Other researchers look at social sustainability with the aim to promote community well-being by addressing social needs while preserving cultural and spiritual values [7]. While there are various perspectives on its exact definition, some common themes emerge, including addressing issues related to health, participation, safety, security, accessibility, education, ethics, identity, and job opportunities [8]. Specifically, in the built environment, social sustainability recognizes that a thriving, inclusive, and equitable community is as important as the physical infrastructure itself, seeking to create environments where people can lead fulfilling lives and have the resources and opportunities they need to flourish while respecting the environment and the needs of future generations [9].

While there is growing recognition of the importance of social sustainability, assessing its criteria remains a complex and evolving task [10,11]. The diversity of stakeholders, cultural contexts, and project-specific considerations adds layers of complexity to the evaluation process [12–14]. In addition, social sustainability covers a broad range of factors, including equity, social cohesion, community well-being, and social justice [6,15–17]; assessing and measuring these complex dimensions poses unique challenges for construction planners, designers, policymakers, and researchers [18,19]. Consequently, there is a need for a comprehensive analysis of the methods used in assessing social sustainability to understand their relevance, applicability, and effectiveness.

According to Ghoddousi et al. [20], developing and using multi-criteria decision-making/aiding (MCDM/A) to support decision-making processes in construction projects based on sustainability criteria plays a major role in promoting sustainability in construction projects. MCDM/A can be a valuable tool for assessing social sustainability by providing a structured approach to evaluating and comparing alternatives regarding their social criteria [21,22]. It aids all the steps of the decision-making process, which include characterizing the decision-maker(s), stating objectives and criteria, the set of action, problematics (choice, ranking, sorting, and portfolio), preference modeling, evaluating intra- and intercriteria, evaluating alternatives, conducting sensitivity analysis, drawing up recommendations, and implementing actions [22,23]. Therefore, understanding the criteria used to evaluate social sustainability within the construction industry is crucial so as to effectively apply decision-making processes and, consequently, to promote positive social outcomes.

In this study, our central research question focuses on investigating how researchers are using multiple criteria to assess the social sustainability of the built environment in order to enable a more comprehensive and methodologically informed approach to assessing social sustainability within the construction industry. Hence, this paper explores the various social sustainability issues, methods, criteria, decision-makers, and practices that are adopted to contribute positively to the social sustainability of the built environment. By delving into these questions, we aim to generate valuable insights into the mechanisms and initiatives used by researchers to enhance social sustainability in the built environment, thereby informing future decision-making processes in the field.

The structure of this paper is as follows: in Section 2, we review the conceptual foundations of MCDM/A, thereby providing a theoretical framework for understanding its dimensions and relevance. Section 3 presents the research methodology, which primarily involves conducting a comprehensive literature review. In Section 4, the results are presented, the aim being to provide a comprehensive overview of the existing research on assessing social sustainability in the built environment. This is followed by a discussion in Section 5, which considers in greater depth the criteria and methods used by previous authors in their studies on assessing social sustainability. Finally, Section 6 presents conclusions and recommendations for future directions to enhance the assessment of social sustainability within the construction sector.

2. Multi-Criteria Decision-Making/Aiding Methods

Munda [24] has emphasized the importance of incorporating multiple criteria and stakeholders' perspectives in sustainability assessments. He has advocated using MCDM/A as a tool to address the complex and multi-dimensional nature of sustainability, including social sustainability [21]. Additionally, Munda [24] has emphasized the importance of transparency and communication in sustainability assessments: clear documentation of the decision-making process, including the criteria, constant of scale ("weights"), and methodologies used as crucial for ensuring credibility and accountability [18].

MCDM/A is a preference-driven approach, so the decision-maker's role, whether the decision-maker is an individual or there are a group of decision-makers, is central, as their preferences and judgments shape the evaluation process. Decisions often involve multiple factors and perspectives in today's complex and interconnected world. Thus, MCDM/A empowers individuals or groups to evaluate alternatives based on a range of criteria, thereby enabling a more comprehensive understanding of the trade-offs involved. MCDM/A is regarded as a key tool for enhancing the quality and effectiveness of group decisions [25].

Group decision-making can be defined as a process involving two or more decision-makers who share responsibility for the decision, which uses an analytical procedure to aggregate preferences within the group. This process entails conducting studies and applying methods that facilitate individual interaction and collaboration in pursuit of collective solutions. This approach emphasizes the unity and diversity inherent in group decisions. Within the group decision-making process, decision-makers hold decision-making power and can have similar objectives, and yet may have complementary individual goals that contribute to a larger organizational objective, or they may even have conflicting distinct objectives [26].

The methods for combining and aggregating preferences can be classified into two categories: aggregation based on initial preferences (input-level aggregation) and aggregation based on final results and decisions (output-level aggregation). Input-level aggregation is appropriate when group members hold similar opinions or are willing to forego personal preferences for the organization's greater good, which can lead to the group acting as a cohesive unit with fewer individual identities. In situations with divergent opinions, output-level aggregation is recommended. This involves eliciting individual preferences followed by aggregating them within decision support systems or by voting mechanisms [27]. There are some specific methods to deal with group decisions, such as the Group Decision Support System (GDSS) PROMETHEE [28] and an extension of the ELECTRE III [29].

What is crucial to consider when selecting an MCDM/A method is the decision-makers' rationality, particularly with respect to additive models where the constant of scale cannot be interpreted as a degree of importance. Hence, attention should be given to inter-criteria evaluation procedures when using additive models in such aggregations [30,31]. In decision-making processes, various methods are used to evaluate and compare alternatives, which can be compensatory or non-compensatory. These methods differ in how they handle their form of compensation for aggregating the criteria, which may be considered the rationality of the decision-maker between different criteria [32].

Compensatory methods, also known as additive methods, consider the overall value or utility of alternatives by assigning a constant of scale to different criteria and aggregating their scores. These methods allow for trade-offs between criteria, as a high score in one criterion can outweigh a low score in another.

In compensatory methods, the constant of scale, contrary to what is commonly thought, does not represent the degree of importance of the criteria [33]. This constant represents a rate of substitution between the criteria, thus creating a weighting measure to assess how preferable one alternative is compared to others, which considers the range of alternatives. They enable decision-makers to consider a wide range of criteria and their "weight" (constant of scale) systematically and quantitatively. By allowing trade-offs, compensatory methods provide a comprehensive assessment of alternatives and can accommodate diverse decision contexts [33]. The indifference point, which represents the exact trade-off between different criteria in compensatory methods, is often difficult to obtain. Thus, other procedures, such as swing, ratio, and use of partial information, are used to help obtain its value [34]. Examples of compensatory methods include simple additive aggregation (SAW) [33], such as a sustainability grading system, which aggregates various criteria into a final score, the analytic hierarchy process (AHP) [35], the flexible and interactive tradeoff (FITradeoff) [36], the simple multi-attribute rating technique using swing (SMARTS) [37], the measuring attractiveness by a categorical based evaluation technique (MACBETH) [38], among many others, as well as methods for uncertainty situations such as multi-attribute utility theory (MAUT) [33].

Non-compensatory methods, also known as outranking methods, do not allow for trade-offs between criteria. The meaning of weights in these methods is that they express the degree of importance between each other [32]. Non-compensatory methods prioritize certain attributes or criteria over others, focusing on the most critical or essential factors, and allowing incomparability among alternatives [32,39]. Examples of non-compensatory methods include elimination et choix traduisant la realité (ELECTRE) and preference ranking organization method for enrichment evaluation (PROMETHEE) [39]. These methods follow a winner-takes-all approach, like the American electoral system, where candidates or parties with the most votes in specific regions or states are declared the winners without considering the total accumulated votes across the entire country. Another example of a non-compensatory system is a volleyball game, where the number of points a team scores in a set does not determine the outcome.

The choice between compensatory and non-compensatory methods in decision-making depends on the nature of the decision problem, the available information, and the decision-maker's preferences and rationality. Both approaches have their strengths and limitations, and the selection of the appropriate method should be based on a careful assessment of the decision context and the decision-maker's preference, as summarized in Table 1.

Table 1. Characteristics of compensatory and non-compensatory methods.

	Compensatory	**Non-Compensatory**
Meaning of the weights	Constant of scale	Degree of importance
Main methods	SAW, MAUT, SMARTS, AHP, FITradeoff, MACBETH	ELECTRE and PROMETHEE

In the context of MCDM/A, the types of results aimed at a specific decision-making problem can be identified as being of four types: choice, ranking, sorting, and portfolio selection. Choice problems involve selecting the alternative with the highest commitment level from a given set of options, where the decision-maker evaluates the alternatives based on multiple criteria and chooses the one that best compromises with their preferences or objectives. Ranking problems require the decision-maker to order a set of alternatives based on their performance or desirability concerning multiple criteria, the aim is to establish a complete or partial ranking of the alternatives. Sorting problems aim to categorize or partition a set of alternatives into distinct groups based on a threshold value, considering multiple criteria for appropriate grouping. Lastly, portfolio selection problems focus on strategically choosing a subset of alternatives from a larger set and aim at maximizing value or achieving the highest possible return [32].

Overall, MCDM/A provides a systematic and comprehensive approach to assessing social sustainability by considering multiple criteria, stakeholder perspectives, and trade-offs. It enhances decision-making processes by promoting transparency, stakeholder engagement, and a holistic understanding of social sustainability [24].

3. Systematic Literature Review Approach

This research followed the systematic literature review methodology, which involves a comprehensive search, selection, and analysis of relevant scholarly articles and publications [40]. The procedure for this research was developed by referring to the well-known guidelines of systematic review [41]. Previously, Gurmu et al. [42] and Rostamnezhad and Thaheem [10] have delved into the construction sector's social sustainability assessment through separate literature reviews, examining distinct issues of this multifaceted concept. Taken together, their papers identify a wide spectrum of categories associated with social sustainability in construction, ranging from stakeholders and the community to ecological impact and innovation. However, their focus primarily centers on identifying these categories rather than addressing the methodologies and criteria used to assess construction projects and processes quantitatively.

To bridge this gap and contribute to a more holistic understanding, this paper undertakes a systematic literature review that explores upcoming directions in the quantitative aspect of social sustainability research. This review aims to operationalize and enhance the applicability of social sustainability in the assessment of the built environment, with a specific emphasis on investigating the methodologies and criteria used. Doing so, the systematic literature review aims to pave the way for a more comprehensive and methodologically informed approach to assessing the social sustainability of construction endeavors.

Firstly, the main research objective, as stated in the introduction, is to investigate how researchers use multiple criteria to evaluate the social sustainability of the built environment, thereby aiming to advance sustainability practices within the construction industry. The next steps of the literature review are described in Figure 1, which indicates the search carried out in the Web of Science, Scopus, and ScienceDirect databases, encompassing papers published from 2012 until June 2023. The search terms and keywords used were carefully chosen to capture the topic's key aspects of the topic. The database search was conducted with the following keywords: "social sustainability", "built environment", construction, buildings, residential, infrastructure, commercial, and industrial.

The initial search yielded 572 articles without duplicates, and all the results were entered into a Microsoft Excel spreadsheet, which facilitated the entire literature review process by tabulating information extracted from the articles. The spreadsheet included information, such as the journal, location of the authors and application of study, construction phase, research question, methods, key findings, decision-makers, criteria used, sample characterization, and limitations. The review was not registered in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) platform since the research does not involve applications in humans or animals, but the PRISMA checklist is available for consultation at the link provided in the supplementary material. The articles were analyzed by the first author and validated by the two co-authors. After applying exclusion criteria, which involved removing articles not directly related to the built environment, those that approached social sustainability qualitatively, descriptively, or conceptually, and articles focusing solely on a single criterion of social sustainability, 90 eligible articles remained. Thereafter, a comprehensive reading of the eligible articles was undertaken. Out of the 90 articles, 42 were selected for analysis due to their explicit presentation of the criteria and metrics for evaluating social sustainability, which revealed quantifiable measures used to assess and evaluate different aspects of a system, process, or project performance. The list of analyzed papers is available at: https://tinyurl.com/sustainabilitylibrary2023.

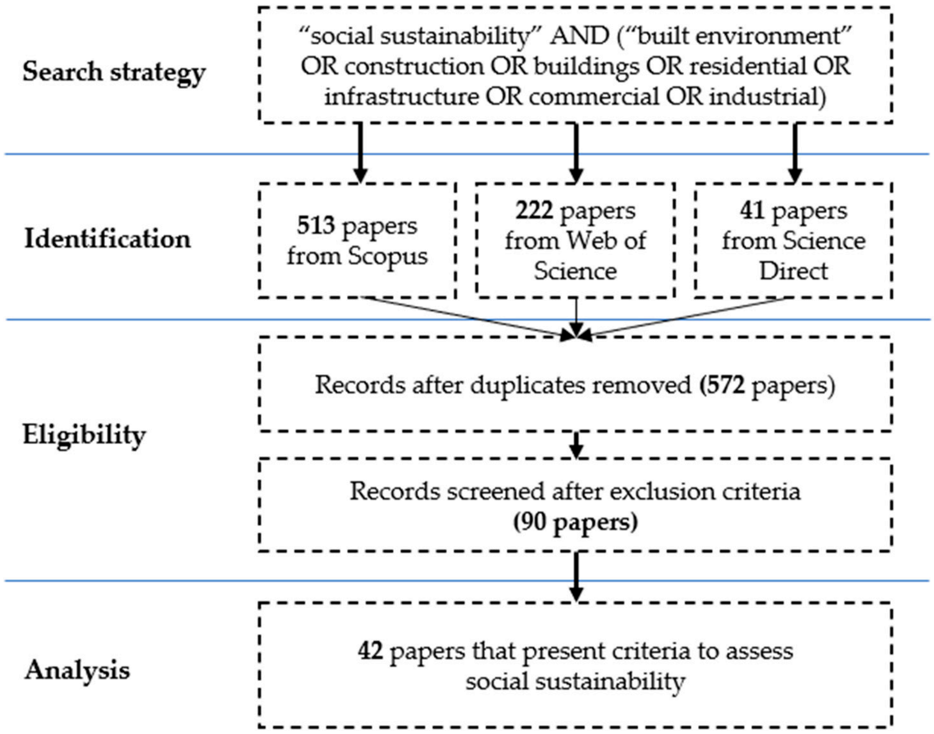

Figure 1. Study workflow.

The research objectives were defined to guide the process of the literature review. The primary aim was to explore and synthesize existing knowledge and research findings on the topic of interest. The process for selecting papers consisted of two stages: title and abstract screening, followed by full-text assessment. Then, data were extracted using a standardized data extraction form. The key information extracted from each article selected included the authors, the year of publication, research methodology, decision-makers, sample size, set of action, type of decision problem, type of criteria aggregating approach, key findings, and implications relevant to the research objectives. The data extracted were organized and analyzed to identify common themes, trends, and research gaps.

The summarized findings of the articles selected were analyzed and interpreted to draw meaningful conclusions and identify emerging patterns or themes. Connections and relationships between different studies were established, while conflicting or contradictory findings were identified and discussed. To ensure a systematic, transparent, and rigorous approach to identify, analyze, and summarize the relevant published papers, we used a methodology that enabled us to uncover and present valuable knowledge regarding the strategies and actions used by the construction industry to improve social sustainability. This will contribute to developing informed decision-making processes and guidelines in the field, thus benefiting future endeavors.

4. Results

In this section, we present the findings based on a systematic selection process that included peer-reviewed articles and conference papers. The results section of this study is organized in a structured manner by including subsections. These subsections provide a comprehensive analysis of the data. The organization of the results section include: (i) discussions on the places in which relevant studies were published, (ii) the social sustainability issues and topics addressed, (iii) the diverse decision contexts encountered, (iv) the types of criteria considered, (v) the methods used, and (vi) the key decision-makers involved.

4.1. Places of Publication

Quantifying social sustainability is a topic actively discussed in journals and conference proceedings, such as the Proceedings of the Institution of Civil Engineers—Sustainability, and the Proceedings of the Institution of Civil Engineers, Urban Design, and Planning. As shown in Table 2, most of the selected publications that present metrics for evaluating social sustainability in construction projects are attributed to five specific journals: the *Journal of Cleaner Production*, *Sustainability*, *Sustainable Cities and Society and Environmental Impact Assessment Review*, and *Facilities*, which together correspond to 22 out of the 40 journal articles published (55%).

Table 2. Journals in which the selected studies were published (from 2012 to June 2023).

Journal	No. of Relevant Articles Published by Journal
Journal of Cleaner Production	8
Sustainability	5
Sustainable Cities and Society, and Environmental Impact Assessment Review	4 each
Facilities	2
Environments; International Journal of Life Cycle Assessment; Engineering Construction and Architectural Management; Cleaner Environmental Systems; Environment and Planning B; Advances in Civil Engineering; Regional Sustainability; City, Territory, and Architecture; Civil Engineering and Architecture; Sustainable Production and Consumption; Geoforum; Omega; Sustainability—Science Practice and Policy; Land; Journal of Industrial and Production Engineering; Science Talks; and Journal of Building Engineering	1 each

As illustrated in Figure 2, an analysis of the publication trends indicates a steady growth in the number of articles published until the onset of the pandemic. However, there has been a noticeable decline, possibly attributed to the impact of the pandemic. The research for this paper was conducted until June 2023. This means that our search of the databases did not cover articles published after this period. Out of the total publications involving quantitative analysis of social sustainability, a striking 88% (37 out of 42) have been published within the last 7 years. The surge in recent studies signifies that a heightened awareness of the urgent need to create sustainable and equitable societies has led to substantial progress being made in addressing social challenges.

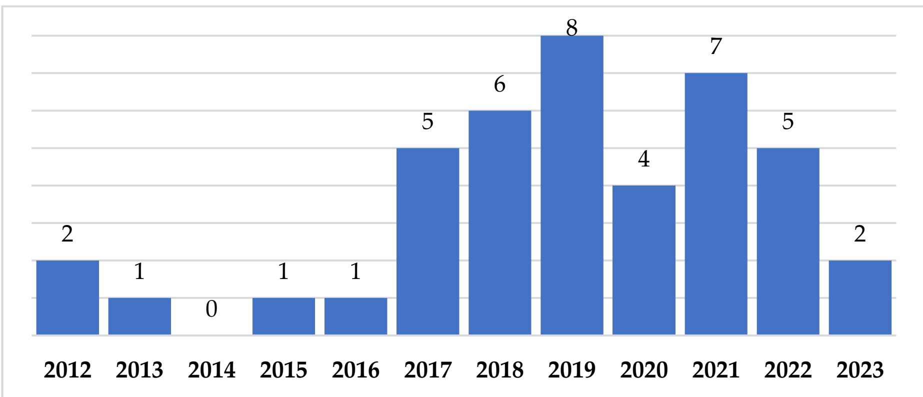

Figure 2. Quantity of articles published per year.

4.2. Social Sustainability Issues and Topics

As mentioned in Section 3, past literature reviews [10,42] have discussed various issues and topics related to social sustainability in the built environment, yet it is important to acknowledge that not all these issues find uniform consideration across all 42 selected articles. These multifaceted topics encompass stakeholders' participation, occupational safety and health, employment, impacts on community, socioeconomic compliance, ecological impact, neighborhood amenities, final users' consideration, diversity, cultural heritage, supply chain, ethics, and innovation. The variability in the inclusion of these topics within the selected articles underscores the nuanced and context-specific nature of social sustainability research, with each study prioritizing specific aspects based on its objectives and the unique socio-environmental contexts it addresses. Figure 3 shows the frequency of specific social sustainability issues in the analyzed papers.

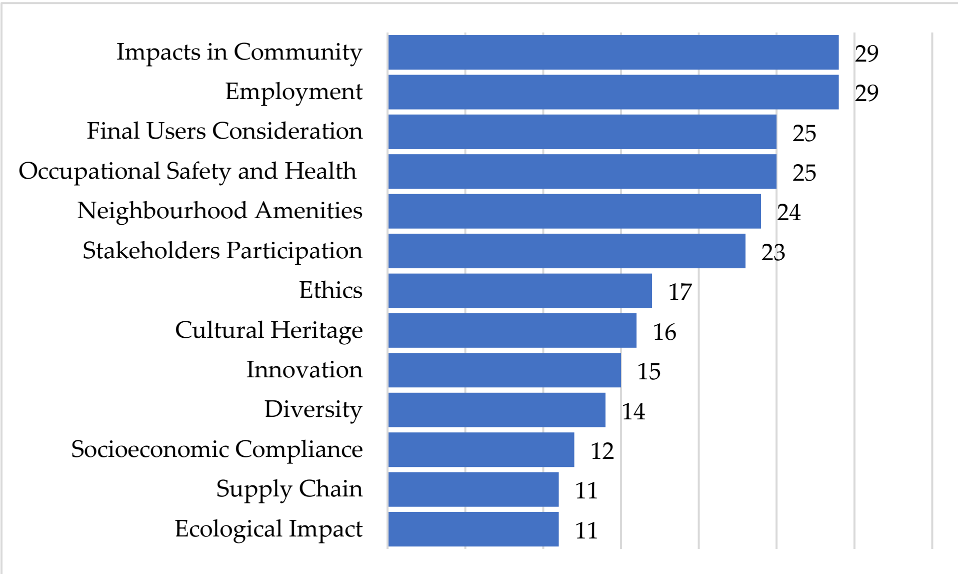

Figure 3. Frequency of social sustainability issues included in the 42 selected studies.

As shown in Figure 3, the issues that were most considered in the analyzed papers were 'Impacts in Community' and 'Employment', both featured in 29 out of the 42 selected articles, not necessarily in the same articles. 'Impacts Community' encompasses a wide range of factors, such as the duration of project construction [43], changes in the income of the local population [44], noise pollution [44], traffic congestion [45], community security [46], regional economic development [47], and the design of structures to facilitate the utilization of local construction labor [7]. And "Employment" encompasses aspects related to job creation [43,47–49], employee training and development [50], job satisfaction [51], fair remuneration [52], and workers' rights [53].

The next most considered issues in the selected articles included 'Final Users Consideration', 'Occupational Safety and Health', 'Neighborhood Amenities', and 'Stakeholders' Participation'. The following issue 'Ethics' was considered in 17 papers, encompassing a wide spectrum of considerations, including social codes of conduct [54], contributions to sustainable projects [54], examination of corruption practices in construction [55], transparency [56], and the implementation of corporate social responsibility initiatives [57].

'Cultural Heritage', considered in 16 papers, includes a variety of elements, such as local cultural characteristics [58], the promotion of cultural diversity [58], the adaptability of outdoor spaces to accommodate diverse social and cultural groups [59], and its impact on architectural and cultural heritage [18], as well as the assessment of the project's influence on the cultural and ethnic identity of the community [18]. The 'Innovation' issue covers such aspects as the creation of new products [60], technological advancements [56], patent applications [55], research and development, and contributions to scientific publications [60]. 'Diversity', considered in 14 papers, represents a comprehensive approach aimed at promoting cultural diversity [58], preventing discrimination [60], and embracing diversity in terms of gender [54], nationality [54,61], race, and sexual orientation [61]. Socioeconomic Compliance' encompasses a range of elements, including adherence to government regulations [62], the prevention of forced and child labor [63], protection of the rights of indigenous peoples [60], and an assessment of the level of policy support [50].

Finally, the two least considered issues or topics are 'Supply Chain' and 'Ecological Impacts'. 'Supply Chain' involves considerations related to social sustainability when selecting subcontractors and suppliers [60], and 'Ecological Impact' takes into consideration various factors, including material choices [64,65], water and waste management [64,66], pollution [64,65], energy efficiency [63], environmental protection [47], effective management of heating, ventilation, and air conditioning (HVAC) [67], and the presence of environmental problems [68]. While 'Ecological Impact' issues may have received less attention in these 42 selected papers, it does not mean they are less important. Their lower relevance in this case might be because the papers were focusing on the social sustainability pillar. Still, this result shows how some of these topics are intertwined with the environmental pillar, such as environmental justice. The following section will illustrate the decision context. In the subsequent section, we will delve into the diverse contexts in which these issues have been assessed.

4.3. Decision Context

Through this literature review, we identified various types of problems addressed in previous studies that used multiple criteria to assess social sustainability. To present a clear and concise overview of these findings, we have compiled them into Table 3. Note that some problems that aim to choose an alternative are using methods developed for the ranking problems, for example, AHP and SAW, as a decision-maker selected the top-ranked alternative as the final choice. The decision context listed in the first column of the table is intricately tied to the method applied. However, the method used was not necessarily specifically designed for the type of problem it is being applied to. Table 3 categorizes the diverse range of issues explored, thus shedding light on how the multifaceted nature of social sustainability is evaluated in the context of built environments.

Table 3. Decisions problems found in the 42 selected papers.

Context of Decision	Quantity of Social Criteria	Method Applied [Reference]
Choose a project (building, infrastructure) that is the most committed to social sustainability	18 [47], 32 [48], 37 [56], 39 [8], and 41 [43]	AHP [8,43,47,48,56]
Choose the construction material (concrete aggregate) using a social sustainability grading model to assess and compare the social sustainability performance of recycled and natural construction materials	30	SAW [63]
Choose a supplier/subcontractor based on their social performance in aspects related to employment, health and safety, stakeholder involvement, donations, and training	17 [47] and 33 [69]	AHP [54,69]
Choose the most socially sustainable construction method for a building	37	AHP [56]
Choose the most socially sustainable construction company in a procurement	47	SAW [49]

Table 3. *Cont.*

Context of Decision	Quantity of Social Criteria	Method Applied [Reference]
Rank alternatives for an infrastructure project from a subset of alternatives according to their social sustainability	21	Multi-objective harmony search algorithm [70]
Rank construction suppliers according to their social sustainability	7	Best–worst method (BWM) [57]
Rank residential areas regarding their social sustainability	20	Complex proportional assessment (COPRAS) [68]
Rank construction companies regarding their social sustainability	20	SAW [53]
Sort a construction project regarding its social sustainability within 5 levels varying from extremely socially sustainable to poorly socially sustainable	71	SAW [62]
Rank European Union countries based on their procurement practices related to social sustainability and aggregate the results through cluster analysis to identify common challenges	25	PROMETHEE II [55]

Although MCDM/A methods were originally developed for decision-making, many studies apply these methods not for decision-making purposes but rather to assess specific cases regarding their social sustainability, to examine whether the criteria are suitable for evaluating social sustainability or for conducting a literature review of criteria to assess social sustainability [44].

Studies that have examined specific cases concerning their social sustainability have used a range of methods, including SAW [7,18], AHP [64,66,71–74], the decision-making trial and evaluation laboratory (DEMATEL) [10], descriptive analysis [59,75,76], social network analysis (SNA) [46,77], the analytic network process (ANP) [50], factor analysis [51,58], and machine-learning techniques [78]. In some other cases, the selected studies have avoided formal methods altogether, opting instead to evaluate the case according to selected criteria [45,61]. Additionally, studies that have sought to evaluate whether the chosen criteria are suitable for assessing social sustainability have predominantly used methods such as factor analysis [15,52,67], AHP [65], analysis of variance (ANOVA) [60], or the Delphi method [79].

4.4. Social Sustainability Criteria and Metrics

An analysis of the 42 articles identified a total of 1164 criteria, which means there was an average of approximately 28 criteria per article, which can also be expressed as varying from 7 to 71 per study. This sheds light on various aspects relevant to the research topic. These criteria covered a wide range of dimensions, methodological approaches, empirical findings, and conceptual contributions. The abundance of criteria signifies that the subject matter is rich and complex, which emphasizes the need for a meticulous and systematic approach to extract meaningful insights. Previous reviews of the literature [10,42] have showcased the diverse spectrum of categories encapsulating the dimension of social sustainability. However, despite the comprehensive landscape these categories sketch out, their inclusion is inconsistent when viewed across individual studies. This inconsistency inadvertently leads to the omission of significant criteria essential for a comprehensive evaluation of social sustainability. Regrettably, such exclusions often lack a well-justified rationale, creating a gap in the overall understanding of the dynamics of social sustainability in the built environment.

For instance, Ahmad and Thaheem [8] assessed the social sustainability of three building projects by primarily focusing on stakeholder engagement criteria. The evaluation involved using a Likert scale ranging from 1 to 5 to measure the extent to which stakeholders' opinions were considered throughout the project's lifecycle. Additionally, the study considered the comfort of end-users, gauging factors such as natural lighting and overall quality of life. However, this approach highlights that only a limited number of aspects within the dimension of social sustainability were taken into account, thus pinpointing the need for a more comprehensive assessment model that covers a broader spectrum of criteria.

On the other hand, Sierra et al. [48] took a distinct approach in evaluating the social sustainability of six infrastructure project alternatives. The assessment had a broader range of criteria, emphasizing employability-related aspects. These criteria included variables such as the number of individuals used, the project's completion timeline, and the local unemployment rate, as well as practices concerning occupational health and safety. Furthermore, the evaluation took into account the potential impacts of the project on the neighborhood, including factors like property expropriations resulting from the project and the compensation provided for the property rights affected.

Moreover, evaluating the dimension of social sustainability lacks a universal consensus when it comes to the metrics and criteria used. In the context of job training, some studies opt for a Likert-scale approach to assess the perceived growth of employees' abilities [12,63], while others focus on quantifying the number of training hours invested [60]. Moreover, a financial perspective is not uncommon, where the investment made in employee training is assessed [53].

A similar web of ambiguity emerges within the assessment of innovation. This complex facet can be measured using a variety of criteria, each highlighting a different dimension of the influence of innovation. Financial investment in pioneering projects serves as one possible metric [75] and demonstrates the organization's commitment to pushing beyond the boundaries of conventional practices. On the other hand, the percentage of innovative products can be indicative of a company's forward-thinking approach, emphasizing tangible outcomes [64]. Alternatively, relying on a Likert scale, ranging from 1 to 5, to capture perceptions of innovation adds a subjective layer, potentially reflecting a holistic organizational attitude toward novel ideas [45]. Lastly, the number of patents obtained represents yet another avenue to be explored, underlining the commitment to turning novel concepts into legally protected intellectual property [55]. The variety of metrics in the context of innovation not only underlines the complexity of the task but also emphasizes the need for a standardized framework to ensure meaningful comparisons and a global understanding of social sustainability.

This lack of consensus in the literature with regard to selecting metrics is pervasive throughout the evaluation of various dimensions of social sustainability. For instance, the assessment of child labor reflects a similar dichotomy in approach. While some studies quantify the number of identified cases [56], others employ a Likert scale to gauge the perceived importance of addressing child labor within the organizational context [52]. This disparity underscores the diverse perspectives on evaluating a critical social concern and illustrates how the choice of metric can influence the possible results of the study.

Likewise, the dimensions of corruption and transparency encounter a similar challenge. The evaluation of these often politically delicate concepts involves using different international indices, each emphasizing a distinct facet of these dimensions [55,56]. However, it is noteworthy that this diversity of metrics extends even further. A striking observation is that a substantial proportion of these metrics, more than half, are anchored in applying Likert scales. These scales provide a nuanced framework for evaluating a wide array of facets within social sustainability. Ranging from assessing employee satisfaction with diversity initiatives to quantifying stakeholders' perception of community engagement, the prevalence of Likert scales in the assessment landscape underscores their versatility in capturing the multifaceted nature of social sustainability. However, this prevalence also prompts the critical examination of how these scales are designed, administered, and interpreted to ensure the accuracy and comparability of the results across different studies and contexts.

Regarding the sources of the criteria identified in the research study, the analysis indicates that a significant portion of the criteria, specifically in 28 papers, used criteria from the literature review, thus reflecting the value of existing scholarly knowledge in informing the research. Five papers used experts as sources, and the three other papers used sustainability reports, such as the Global Reporting Initiative, thereby suggesting the importance of industry-specific information and corporate sustainability practices in generating relevant criteria. Additionally, four papers used the sustainability building assessment tool (SBAT), such as LEED, BREEAM, and Green Globes, among others. Lastly, two papers had international databases as their sources, thus emphasizing the global nature of the research and the use of comprehensive data sources. These diverse sources used to identify the criteria underscore the multidimensional nature of the research process.

Furthermore, social sustainability is approached differently according to the project life cycle. Social sustainability involves engaging with stakeholders and considering their needs and aspirations during the pre-construction phase [8,18,47,48]. This includes conducting comprehensive social impact assessments to identify potential risks and opportunities [47,74], consulting with local communities, and incorporating their feedback into project design and planning [18,45,46,59]. Additionally, social sustainability entails promoting inclusive and equitable practices, such as ensuring fair employment opportunities, promoting diversity, and safeguarding workers' rights throughout the supply chain [49,53].

Throughout the construction phase, social sustainability covers measures to protect the health, safety, and well-being of construction workers and surrounding communities [45,62,69]. This involves implementing robust health and safety protocols [54], providing adequate training [63] and protective equipment [62], and minimizing resident disruptions and negative impacts [45]. Furthermore, social sustainability recognizes the importance of minimizing environmental externalities and optimizing the efficiency with which resources are used during construction, as these factors can indirectly affect the quality of life and social fabric of communities in the long term [63].

Post-construction, social sustainability involves monitoring and evaluating the social performance of the built environment, by ensuring that it continues to meet the community's [52,58,75] and final user's [15,51,58,67,68,71,72,75,76] needs. This may include assessing the provision of social infrastructure, such as affordable housing, schools, and healthcare facilities [15,71,76], as well as evaluating the project's long-term impact on local economies, cultural heritage, and social cohesion [15,51]. The aim is to foster a built environment that enhances social well-being, promotes social inclusion, and contributes to present and future generations' overall quality of life [15,75].

4.5. Methods Used for Assessing Social Sustainability

As shown in Table 3, various methods have been used, not exclusively aimed at making decisions. These methods have extended beyond the realm of decision-making and have been used to comprehensively assess and quantify social sustainability aspects, thereby facilitating a deeper and potentially comparative analysis of various dimensions within the construction sector. Notably, even methodologies like multi-criteria decision-making/aiding (MCDM/A), typically used for decision-making purposes, have been found to be useful in a different capacity. Namely, they aid in the structural framing of social sustainability issues and provide insights into specific cases.

In addition to the MCDM/A techniques, other multiple-criteria methods, such as multi-objective optimization (MOP), statistical, and other methods and approaches were also used, as set out in the following Table 4. These diverse methodologies have been instrumental in exploring different aspects of sustainability in the built environment, ranging from comprehensive assessments of social, economic, and environmental factors to optimizing multiple objectives simultaneously. Incorporating these methods has contributed to a more robust analysis and a deeper understanding of the complex challenges associated with achieving sustainable development goals in the context of built environments.

Table 4. Multi-objective optimization (MOP), statistical and other methods used.

Type	Method	Definition	Application Example
Multi-Objective Optimization	Harmony Search algorithms	Metaheuristic optimization method inspired by the musical improvisation process that aims to find optimal solutions to complex problems.	Determine the socially optimal infrastructure [80].
	Compromise Programming Method	Decision-making technique that seeks a balanced solution by seeking compromise among conflicting objectives in multi-criteria problems.	Choose the most compromised project among six alternatives to interurban roads [48].
	Euclidean distance	Used in decision-making methods that seek to minimize the distance to an ideal solution.	Sort construction projects based on the extent they consider social sustainability [62].
Statistical	Exploratory Factor Analysis (EFA)	Statistical technique used to identify underlying latent factors and their relationships within a set of observed variables.	Analyze if the criteria are appropriate to assess the social sustainability of the urban neighborhood [15].
	Confirmatory Factor Analysis (CFA)	Statistical method used to test and validate the structure of the hypothesized factor and relationships between observed variables and latent constructs in a research model.	Verify which criteria are the most appropriate for assessing the social sustainability of urban conservation [58].
	ANOVA	Statistical test that is used to compare means of three or more groups to determine if there are significant differences between them.	Identify the most appropriate criteria for assessing the social sustainability of the supply chain, thus helping to select the criteria that significantly contribute to the overall performance [60].
	Pearson Correlation Coefficient	Statistical measure used to quantify the linear relationship between two continuous variables.	Classify European countries according to their social sustainability challenges [55].
Others	Delphi Method	Structured and iterative approach that is used to gather expert opinions and reach a consensus on complex topics or decision-making processes.	Reach a consensus in identifying criteria to assess social sustainability and discuss their fundamental theoretical and managerial implications [79].
	Data Envelopment Analysis (DEA)	Method for evaluating the relative efficiency of multiple entities by comparing their input-output relationships to identify the most efficient ones.	Rank construction companies in public-works procurement [53].
	Social Network Analysis (SNA)	Method for studying and analyzing the relationships and interactions between individuals, groups, or organizations within a social network.	Analyze the social sustainability of a commercial building [46].
	Focus Group	Qualitative research method that gathers insights and opinions from a small, selected group of individuals on a specific topic or issue.	Analyze if the criteria are appropriate to assess the social sustainability of urban house demolition [52].

Among the other methods, the Delphi method was the most used, mainly to find a consensus among the experts on the criteria that would be used to assess social sustainability. In addition to this method, data envelopment analysis (DEA) was used to define the weighting system based on the main social weaknesses [53]; social network analysis (SNA) was used to develop a network considering 20 stakeholders and 26 criteria to assess the social sustainability performance of a commercial building project in Saudi Arabia [46].

Furthermore, exploratory factor analysis (EFA) was used to verify which criteria are the most appropriate to assess social sustainability [58], ANOVA was used to determine criteria to assess the supply chain [60], Pearson correlation analysis (CA) was performed to detect multicollinearity, allowing redundant criteria to be excluded [55], and a social scientist defined ways to measure social sustainability using a focus group [61].

Regarding MCDM/A techniques, taking 57% of the studies, the following table (Table 5) presents a comprehensive overview of the methods identified in the literature, along with their practical applications within the context of social sustainability in the built environment. By examining the diverse range of methods and their respective applications, this table aims to shed light on the advancements made in the field of assessing social sustainability, and how these methodologies contribute to fostering inclusive and resilient built environments. The synthesis of these findings provides a valuable resource for both academics and practitioners seeking to explore, understand, and address social sustainability challenges in urban development.

Table 5. The application of MCDM/A methods.

Method	Definition	Application Example
Simple Additive Aggregation (SAW)	A decision-making method that evaluates alternatives based on their weighted attributes, considering the decision-maker's preferences.	Proposes a method to assist agencies in including indicators and objective assessments of social sustainability in public-works procurement, applied to civil engineering projects in the infrastructure life-cycle construction stage using design-bid-build delivery [49].
Analytic Hierarchy Process (AHP)	A method that structures problems into a hierarchical model and uses pairwise comparisons to determine relative priorities among criteria and alternatives.	Identify the project most committed to social sustainability criteria among three alternatives of a residential building [8].
Analytic Network Process (ANP)	A method that extends the AHP to incorporate interdependencies and feedback among criteria and alternatives in a network-based model.	Develop an indicator system for measuring the social sustainability of offshore wind power farms, and apply it to the case of Taiwan's offshore wind power project [50].
COPRAS	A method that prioritizes alternatives based on their closeness to the positive ideal solution and distance from the negative ideal solution.	Rank three residential areas in the UK considering social sustainability aspects [68].
PROMETHEE II	A method that ranks alternatives based on relative preferences and net outranking flow relationships.	Rank European countries with regard to their social sustainability challenges [55].
Best–Worst Method (BWM)	A technique that identifies the best and worst attributes or criteria among a set of alternatives to determine their relative importance.	Rank potential suppliers regarding their social sustainability [57].
DEMATEL	A method used to analyze the complex relationships and causal interactions among factors in a decision-making problem.	Model the social dimension of sustainability in construction projects, applied in a highway project [12].

Although most of the papers, 24 out of 42, used MCDM/A, not all of them used the method to make some kind of decision. Seven of them used the methods to form weighting between the criteria and used the framework to discuss, or analyze, a specific project. As was the case of Sharif et al. [71], who used the AHP to aggregate the criteria and to be able to evaluate the social sustainability of a specific neighborhood, or Bui et al. [72] who also used AHP, but to assess the social sustainability of groundwater resources.

Regarding the non-MCDM/A methods applied, only three of them used multi-objective programming (MOP) methods, while seven other methods that aided the assessment of social sustainability were also used. For example, Sierra et al. [70] used 21 criteria to evaluate different alternatives for a road infrastructure project, considering their short- and long-term impacts. They used the Delphi method to find a consensus between the experts, and then used multi-objective harmony search algorithms to determine the socially optimal project.

The papers that used MCDM/A methods and performed some kind of decision solved different type of problems: eight papers solved a choice problem, five of them solved a ranking problem, and two of them used the method to sort the alternatives, as show in Table 5. For example, Sierra et al. [43] used AHP to choose the best alternative among six options for road infrastructure improvement, Mulliner et al. [68] used the COPRAS method to rank three residential areas, and Hendiani et al. [62] used fuzzy additive aggregation combined with Euclidean distance to classify the status of social sustainability of a construction.

Regarding rationality, the non-compensatory methods used were PROMETHEE II [55], and DEMATEL [12], which were used in only two of the studies. The remaining studies that used MCDM/A (22) used compensatory methods, including AHP, SAW, ANP, COPRAS, and BWM. Among the papers that did use a decision-making method, the analytic hierarchy process (AHP) emerged as the most used approach, with 12 out of 24 studies utilizing this method. AHP is a popular method with an available software that makes it easy to apply. It was perceived that the literature lacks a structured approach to decision-making in assessing social sustainability. The method selection should be appropriate to the decision problem, compensatory or not, and the information available in the decision process.

The papers used AHP mainly in a choice problem, or just to discuss/analyze a specific project. For example, Atanda [65] developed a framework based on 35 criteria from LEED and consolidated by Delphi to assess buildings using the AHP to weight the criteria. Likewise, Olukoya et al. [64] used the AHP method solely to give weights to criteria. They sent a questionnaire to 135 people asking them to conduct an intercriteria evaluation of 35 criteria using a 5-point Likert scale. Based on this questionnaire, they found a weight for each criterion, and then used that weight in a check list to assess the social sustainability of vernacular architecture. If the project met the criteria, it was considered green; if the criteria were partially met, yellow; and if they were not met, red. Finally, the project received a final score and was classified according to the range: Certified: 45–54%, Silver: 55–64%, Gold: 65–79%, Platinum: 80–100%. Lastly, Sharif et al. [71] used AHP to assess social sustainability in Jordanian residential neighborhoods based on 56 criteria.

Moreover, Sierra et al. [48] used the AHP method to conduct an intercriteria evaluation between 32 criteria in a consensus with eight experts (group of decision-makers) and then conducted a weighted aggregation. They divided the criteria into short- and long-term social improvements and applied the method to six road alternatives in three different regions. Finally, the AHP was used to make an intercriteria evaluation between 41 criteria, and then the compromise programming method was used to determine the smallest Chebyshev distance to an ideal point, thereby establishing balanced solutions. This proposed method was developed to be applied to infrastructure projects during the feasibility phase, considering different infrastructure alternatives in different regions, combining MCDM/A with MOP [43].

The second most used method was SAW, presented in seven studies with the aim to choosing, ranking, or sorting the alternatives or analyzing a specific project. For example, Hendiani et al. [62] developed a social sustainability index to be applied in the construction domain using 71 criteria. This index was generated by using a fuzzy-weighted aggregation. Also, a fuzzy performance importance index was calculated for each criterion by combining the performance rating and importance weight using the Euclidean distance method to classify the status of social sustainability of a bridge.

When it comes to non-compensatory methods, Montalbán-Domingo et al. [55] used PROMETHEE II. However, they did not thoroughly examine the rationale behind choosing a non-compensatory method. In contrast, the authors Rostamnezhad et al. [12] provided a justification for using a non-compensatory method, DEMATEL, by basing this choice on the use of weights as the degree of importance. This difference in approach underscores the importance of elucidating the reasons behind the selection of non-compensatory methods in decision-making contexts, thus contributing to a more comprehensive understanding of the research methodology.

Hossain et al. [63] created a social sustainability grading (SSG) model based on 30 criteria from the UNEP/SETAC guidelines published (UNEP/SETAC 2009), and GRI and used them to choose materials for a construction project, while Yu et al. [52] used 22 criteria to assess the social sustainability of demolishing urban housing in Shanghai. They carried out hierarchical cluster analysis (a two-wave questionnaire) to investigate the internal relations among the criteria and aggregated them by weighted aggregation, but they aimed to analyze the influence of each aspect (criteria) in the social sustainability of urban house demolition, not involving any decision.

4.6. Decision-Makers

The decision-maker's role is pivotal in MCDM/A methodologies, serving as a cornerstone for informed choices. Remarkably, within the sampled cases, this decision-maker's role was notably absent in 19% of instances, primarily attributed to the absence of any decision-making within the scope of the study. Intriguingly, among the remaining 81% of cases, only two of them had a single decision-maker [49,69]. Instead, a collective of decision-makers was the prevailing norm. This emphasizes the collaborative nature of decision-making processes when applying MCDM/A techniques, where diverse perspectives converge to navigate complex, multi-dimensional scenarios, ultimately striving for robust and inclusive solutions.

However, despite the prevalence of studies, 31 out of the 42, involving multiple decision-makers, aspects related to group decision-making have not been adequately addressed. The use of multiple decision-makers may be justified because, as demonstrated in Section 4.3, social sustainability involves criteria encompassing a wide range of stakeholders, including employees, final users, and communities. While numerous investigations have focused on aggregating individual preferences and opinions, the complexities inherent in collaborative decision-making processes within a group setting remain relatively understudied, these only being addressed in the study of Petrudi et al. [57]. For example, Shiau and Chuen-Yu [50] examined the social sustainability of wind farms in a context marked by conflicting interests among diverse decision-makers. In their study, an evident conflict emerged where the interests of fishermen ran counter to the wind farm project. Despite the presence of this decision-maker disapproval, it was observed that the opinions of fishermen were not consistently taken into account during certain stages of the assessment process. Instead, preference was often given to the viewpoints of experts. However, in light of the contentious nature of the decision-makers' landscape, it becomes evident that using group decision-making methods designed to address conflicts of interest would have been more suitable.

Not all decision-makers face conflicts of interest as overt as those seen in the aforementioned case, as shown by Sierra et al. [48] who used the Delphi method to aggregate preferences based on initial preferences (input-level aggregation) leading the group to act as a cohesive unit with diminished individual identities. Nevertheless, even in scenarios where conflicts might not be as apparent, applying group decision-making methods can still be advantageous to facilitate the decision-making process: for example, decision-makers encompassing experts in social sustainability, final users [71], and inhabitants of a neighborhood [51]. Making use of group decision-making methods in these contexts not only ensures a well-rounded assessment but also helps to cultivate a sense of ownership and inclusivity in the decision-making process. By facilitating open discourse and converging diverse viewpoints, such methods can lead to outcomes that are more holistically aligned with the interests and well-being of both stakeholders and communities. According to the level of agreement among decision-makers, they can either proceed with initial aggregation, if there is consensus, or opt for final results' aggregation in cases of disagreement or a desire to preserve each decision-maker's individual preferences.

In 12 instances, decision-makers involved in the decision-making process are experts—distinguished academics, professionals from the public works department and from high-ranking design and construction organizations with experience in social development [18,71,80]. For instance, Sodangi [18] engaged a panel of 16 experts to evaluate a construction project's social sustainability facets. Similarly, in the study by Petrudi [57], the assessment of potential suppliers was informed by the insights of five experts, guiding the ranking and selection process. Moreover, Atanda [65] relied on multiple experts to critically appraise the suitability of the criteria chosen for evaluating the social sustainability of buildings.

In summary, while the prevalence of studies involving multiple decision-makers is evident, it is crucial to recognize that aspects related to group decision-making remain largely unexplored in a significant portion of the literature. The examples provided underscore the importance of employing group decision-making methods tailored to the specific needs of each scenario. Such methods, whether in contexts of overt conflicts or subtler divergences, not only facilitate well-rounded assessments but also promote ownership and inclusivity in the decision-making process, aligning outcomes with the interests and well-being of stakeholders and decision-makers. Furthermore, the involvement of experts in decision-making processes is prevalent and serves as a valuable resource in guiding evaluations and selections, contributing to the advancement of social sustainability in various contexts.

5. Discussion

As mentioned in the results, previous literature reviews [10,42] have evidenced that social sustainability covers a wide array of issues, such as stakeholders' participation, occupational safety and health, employment, impacts on the community, socioeconomic compliance, ecological impact, neighborhood amenities, final users' consideration, diversity, cultural heritage, supply chain, ethics, and innovation. Yet, not all of these issues are consistently considered in each of the 42 selected studies. The discussion section is structured as follows: beginning with discussions about the criteria used to evaluate social sustainability in the built environment, followed by considerations regarding the MCDM/A methods utilized, and ending with discussions concerning decision-makers.

5.1. Social Sustainability Criteria

The selection of criteria for each individual study exhibits significant variation, highlighting the lack of a standardized approach in assessing social sustainability within the built environment. This variability raises important questions about the comparability and comprehensiveness of the findings across different research endeavors and underscores the need for a more systematic and inclusive approach to ensure that all relevant dimensions of social sustainability are adequately addressed in future assessments.

The utilization of an extensive number of criteria, but not necessarily encompassing all aspects of social sustainability, has become a prevalent practice in the literature. For instance, Montalbán-Domingo et al. [49] used 47 criteria by applying a compensatory method. The incorporation of numerous criteria raises questions about the rationality or compensation between them. The challenge lies in effectively balancing and compensating these various criteria, as it becomes increasingly difficult to ascertain their constant of scale and interactions. This complexity can potentially lead to a loss of transparency and comprehensibility in the decision-making process, posing a significant hurdle in achieving robust and actionable outcomes in social sustainability assessments. In addition to that, the greater the number of criteria employed, the more diminished the likelihood of achieving successful decision-making, implying that there exists a substantial risk of failure when utilizing seven criteria or more [81].

Consequently, researchers and practitioners must critically evaluate the necessity and practicality of including a multitude of criteria in their assessments to ensure that the resulting insights remain meaningful and useful. Therefore, a vital approach to enhance the practical implementation of social sustainability involves reducing the complexity of the problem by identifying a subset of criteria that can efficiently represent the overarching issue.

5.2. MCDM/A Methods for Assessing Social Sustainability

Additionally, the results of our analysis highlight some interesting trends regarding the use of decision-making methods in assessing social sustainability within the built environment. Out of the 42 selected papers, 26 did not apply an MCDM/A method for making decisions. This finding suggests that a considerable number of studies in the field of social sustainability assessment rely on criteria to discuss and analyze, rather than explicitly to make decisions based on the findings. While this approach can provide valuable insights and contribute to the theoretical understanding of social sustainability, it may hinder practical implementation and translating research into action.

As shown in Tables 4 and 5, previous studies exhibit a diverse range of methodologies used to investigate various aspects of sustainability within the built environment. Researchers have applied a multitude of techniques, including the analytic hierarchy process (AHP), the preference ranking organization method for enrichment evaluations (PROMETHEE), simple additive aggregation (SAW), social network analysis (SNA), complex proportional assessment (COPRAS), optimization models, the decision-making trial and evaluation laboratory (DEMATEL), the analytic network process (ANP), and analysis of variance (ANOVA), among others. These methodologies have been selected based on the specific objectives of the studies, which have ranged from analyzing sustainability in individual projects to assessing the overall sustainability performance of companies. However, a critical observation regarding the selection of methods of these studies is the lack of a clear explanation regarding the decision-maker's rationality and preference structure, potentially undermining the reliability and validity of the social sustainability assessments in the built environment.

Nevertheless, by using such a wide array of methods, researchers have captured diverse dimensions of social sustainability and offered comprehensive insights into the complex interactions between various social factors in the built environment. Moreover, applying these methodologies has been extended beyond mere theoretical analyses. The studies have undertaken these approaches in practical contexts, such as evaluating the impact of urban development projects on local communities, assessing the social performance of construction companies, and identifying social criteria for measuring social sustainable development progress.

In the realm of MCDM/A, several common mistakes can hinder the effectiveness of the decision-making process. One prevalent neglected aspect is the selection of MCDM/A methods, for instance, disregarding the rationality of the decision problem [66]. Using an ill-fitting method may yield inaccurate or irrelevant results. Additionally, a bias in method selection can influence the decision-making process. Individuals may favor MCDM/A techniques they are already familiar with, leading to subjectivity and the potential exclusion of more appropriate alternatives.

According to de Almeida [23], the application of MCDM/A methods must encompass a comprehensive understanding of various factors, which can be summarized into three distinct phases. In the initial phase, decision-makers and other stakeholders are characterized in order to establish their roles. Objectives are then identified, allowing for a focused approach. Criteria are subsequently established, and categorized as natural, proxy, or sub-objective types. Moving to the second phase, the action space and problem type are set, followed by identifying uncontrollable factors. The process of preference modeling takes center stage, aligning the decision-maker's preferences with the selected rationality approach. Intracriteria evaluation then refines the criteria, while intercriteria evaluation determines the appropriate aggregation method. Finally, in the third phase, alternatives are evaluated using the model constructed. Sensitivity analysis gauges the model's robustness, leading to a comprehensive analysis of results and informed recommendations. These three phases guide the decision-maker through the process, highlighting potential weaknesses and risks. The final decision is implemented, considering potential agent involvement and strategic adaptations.

The findings underscore the importance of exercising prudence when selecting MCDM/A methods for future endeavors. As found in Section 4.4, a substantial majority of the studies applying MCDM/A techniques have leaned towards compensatory methods, which do not allow for the preference relation of incomparability. This observation raises valid concerns, particularly in the context of problems involving a wide spectrum of criteria, such as employee occupational safety, health considerations, and user comfort, i.e., by involving criteria that directly affect completely different stakeholders. When using compensatory methods, it is implicitly assumed that tradeoffs between criteria are allowed, which may often not hold true due to the multidisciplinary nature of social sustainability. The incongruity between the chosen methods and the intricate nature of these multifaceted criteria, which affect distinct groups (employers, users, and neighbors, among others), warrant a more judicious approach, namely one that aligns with the complexity inherent in decision-making scenarios within the built environment.

5.3. Decision-Makers

The studies involving MCDM/A consistently revealed the presence of decision-makers. However, a notable trend was observed where the application of multi-criteria decision-making methods for group decisions and the consideration of pertinent aspects of group decision-making were often overlooked, such as not addressing conflicts of interest among the decision-makers [51,58]. The field of group decision-making aims to facilitate collaborative decision-making by evaluating problems and developing methods that allow groups or individuals within them to interact effectively toward a collective decision. The support of the field of group decision-making can be analytical, involving the construction of mathematical models to aggregate individual preferences, or process-oriented, focusing on integrating individuals during the decision-making process [27].

The aggregation of preferences pertains to decision-makers, aiming to obtain their preference structures. In cases where decision-makers have conflicting objectives and do not necessarily seek a unanimous outcome, a challenge lies in accurately capturing and representing these preferences. Understanding the organizational context enables an assessment to be made of power dynamics and their influence on interrelations between decision-makers and their preferences, consequently impacting the analytical model. The aggregation can be achieved by individually assessing alternatives followed by compiling individual decisions into a single collective outcome. Alternatively, all decision-makers may interact according to their preferences to reach a unique result.

Therefore, when selecting and applying MCDM/A methods in group decision-making, scenarios should be approached with heightened consideration for the specific characteristics of the decision context and the various preferences and interactions among decision-makers, such as conflicts of interest among decision-makers, as well as the desire to either preserve or disregard individual preferences. By acknowledging the nuances of group dynamics and integrating appropriate MCDM/A techniques, researchers and practitioners can contribute to more effective and robust decision-making processes within complex decision contexts. Addressing these aspects is essential for a holistic understanding of decision-making dynamics in complex social and organizational settings, ultimately contributing to more effective and inclusive strategies for achieving sustainable outcomes.

Therefore, despite the studies examined having contributed significantly to addressing social sustainability aspects within the built environment, they underscore the need for enhanced caution when MCDM/A methods are selected. While these methods offer valuable tools for navigating the intricate decision-making landscape, the findings highlight the importance of aligning methodological choices with the nuanced complexities inherent in social sustainability challenges.

6. Conclusions

This systematic literature review provides a comprehensive exploration of multi-criteria decision-making/aiding (MCDM/A) in the context of assessing social sustainability within the built environment. The results presented a global overview of prior studies' topics, methods, criteria, and analytical tools. The subsequent discussion critically examined the methods and criteria used by previous researchers, highlighting the complexities and challenges inherent in assessing social sustainability. This study underscores the significance of MCDM/A as a valuable approach for informed decision-making in pursuing social sustainability goals. It emphasizes the need for thoughtful and context-sensitive methodological choices to ensure robust and effective assessments.

Firstly, it is essential for future endeavors in assessing social sustainability in the construction industry to consider all the facets of social sustainability identified in previous literature reviews [10,42]. This approach prevents bias by comprehensively considering all identified facets, fostering a holistic understanding of social sustainability within the construction sector. However, decision-making with excessive criteria may result in less committed results [81]. Thus, future studies should prioritize the identification of a subset of criteria that comprehensively encompass all facets of social sustainability, with a clear justification for their selection. That is, identifying a subset of criteria capable of representing the complexity of social sustainability. In cases where not all criteria are deemed relevant, their elimination should be justified, promoting transparency and accountability in the assessment process.

Secondly, our examination highlights the importance of thoughtfully selecting and applying MCDM/A methods. The diversity of methodologies used in previous studies reflects the complexity of assessing sustainability in the built environment. However, many of these studies lack clear explanations of decision-makers' rationality and preference structures, which poses a challenge to the reliability and validity of social sustainability assessments. Another aspect regarding choosing the correct method is that, when talking about social sustainability, depending on the method used, we cannot compensate for a bad performance with a good one. For instance, having a bad occupational safety and health performance during the construction phase cannot be justified with an excellent thermal comfort for final users. Thus, future studies should adopt methodological rigor when selecting MCDM/A methods. Researchers should prioritize clear and comprehensive explanations of decision-makers' rationality and preference structures, ensuring these critical aspects are meticulously integrated into the chosen methodologies.

Thirdly, given the prevalence of group decision-making scenarios, our examination underscores the importance of thoughtfully selecting and applying MCDM/A methods in group decision-making scenarios. The role of group dynamics in decision-making processes cannot be underestimated. Investigating methods that facilitate the effective aggregation of preferences while accounting for conflicts of interest and power dynamics within decision-making groups is essential. Researchers and practitioners must take a nuanced approach, considering the specifics of the decision context, the preferences, and the interactions among decision-makers. By doing so, we can advance more effective and inclusive strategies for achieving social sustainability in the built environment.

It is important to acknowledge certain limitations in this literature review, including the potential exclusion of relevant articles due to the search strategy, database restrictions, unavailability of certain papers, inherent limitations of the existing literature, and the omission of papers published after June 2023. These limitations were considered when interpreting the findings and drawing conclusions.

Lastly, while the 42 reviewed studies have made significant contributions, there is ample room for improvement when selecting criteria and applying MCDM/A methods to ensure a more sustainable and socially responsible built environment. This work presents significant benefits to researchers seeking to advance their understanding of the quantitative assessment of social sustainability. As the studies encompassed a wide array of criteria, this paper primarily concentrates on examining the utilization of multiple-criteria methods and the specific criteria considered. The aim is to provide guidance and support for researchers, enabling them to incorporate social sustainability effectively into various decision-making processes, including but not limited to choosing new construction projects and selecting suppliers and materials, as elaborated upon in this study. By incorporating the aforementioned aspects of MCDM/A, such as reducing the number of criteria, precise method selection, and considering groups of decision-makers appropriately, it not only enhances methodological rigor but also contributes to a more comprehensive assessment of social sustainability in the built environment. The findings from this study are intended to assist in the assessment of built environment sustainability, ultimately leading to the development of more sustainable environments that directly benefit society as a whole.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su152316231/s1 [82].

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