Environmental Impact Assessment Review 89 (2021) 106581

Contents lists available at ScienceDirect

Environmental Impact Assessment Review

journal homepage: www.elsevier.com/locate/eiar

An integrated method for the assessment of social sustainability in public-works procurement

Laura Montalbán-Domingo *, Eugenio Pellicer, Tatiana García-Segura, Amalia Sanz-Benlloch

Construction Project Management Research Group, Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia, Spain

A R T I C L E I N F O

Keywords:
Social sustainability
Construction project
Indicator
Public procurement
Social criteria
Corporate social responsibility

A B S T R A C T

Today, critical deficiencies hinder the effective inclusion of social criteria in public-works procurement. The primary reasons for this are the lack of information and objective social assessment methods in the construction industry. Hence, this paper proposes a method to assist agencies in including indicators and objective assessments of social sustainability in public-works procurement. This method applies to civil engineering projects in the infrastructure life-cycle construction stage using design-bid-build delivery. Eight social categories and 22 factors are organized into two organizational levels (project and company). Quantitative and semi-quantitative indicators are proposed to assess the social commitment of construction companies in their organizations and projects. Additionally, two aggregation formulas are established as assessment criteria in public-works procurement. The results highlight that the indicators' importance in assessing social commitment in a project can be defined depending on the local context. Moreover, the method to assess corporate social responsibility can also measure and compare a company's performance, regardless of size. The proposed method can be used in procurement procedures, helping public-works procurers develop transparent decision processes.

1. Introduction

The construction industry is one of the first sectors to require specific attention to addressing sustainability (Bratt et al., 2013). In this industry, sustainability should achieve a win-win outcome contributing to improving the environment and advancing society while construction companies gain competitive advantages and economic benefits (Goel et al., 2020a; Shen et al., 2010). Nevertheless, construction firms primarily focus on cost, schedule, and quality to maintain competitiveness (Rohman et al., 2017). Although companies must respond to sustainability challenges and become socially and environmentally responsible, the focus on empowering sustainability practices in construction firms has been limited, hindering the industrial transformation to sustainability (Afzal et al., 2017; Lu and Zhang, 2016; Murphy and Eadie, 2019). Therefore, several authors have claimed that public procurement's role is to integrate sustainability initiatives into construction practices (Adetunji et al., 2003; Sierra et al., 2018a).

Public contracts represent more than 16% of the gross domestic product of the European Union (EU) (Gade and Opoku, 2020). In public procurement, project team selection must be based on a regulated system where fair and objective competition is required (Ballesteros-Pérez et al., 2016). Thus, avoiding subjectivity in bid-selection processes using quantitative or semi-qualitative indicators is essential for transparency, objectivity, and equitability (Park et al., 2015). The procurement procedure criteria focus on characterizing involved companies concerning their economic and financial standing and technical and professional ability to perform the contracted work or services (European Commission, 2018). However, environmental and social criteria must be included as assessment criteria in procurement procedures to promote sustainable development in the construction industry (Brown et al., 2012; Walker et al., 2012; Mansell et al., 2020; Rohman et al., 2017; Schmidt-Traub, 2015).

Moreover, social issues are typically underestimated and overshadowed by the other dimensions (Loosemore, 2016). Through the 2014 directives, the EU promoted a different approach to boost social sustainability to solve this issue (IHRB, 2015). Contracting authorities currently have the means to include social considerations in the design and execution of public tenders, allowing member states to define national mechanisms (IHRB, 2015; Sanchez-Graells, 2018). Nevertheless, crucial limitations still exist in integrating social criteria into procurement. Thus, this research aims to propose a method to assess social sustainability in public-works procurement.

* Corresponding author.
E-mail addresses: laumondo@upv.es (L. Montalbán-Domingo), pellicer@upv.es (E. Pellicer), tagarse@upv.es (T. García-Segura), asanz@upv.es (A. Sanz-Benlloch).

https://doi.org/10.1016/j.eiar.2021.106581
Received 30 July 2020; Received in revised form 4 March 2021; Accepted 4 March 2021
Available online 15 March 2021
0195-9255/

This paper is structured in the following way to fulfill this goal. A review of the existing literature relevant to this study is included in Section 2. The factors to assess social sustainability are defined in Section 3. Section 4 details the integrated method. Section 5 explains the validation of the method and presents an example of its application. A discussion of the research findings comprises Section 6. Finally, Section 7 displays the concluding remarks, limitations, and future work.

2. Literature review

2.1. Social assessment in the construction industry

Numerous classifications of social criteria can be found in the literature to assess social sustainability in the construction industry. The United Nations Environment Programme (UNEP, 2009) established a classification of social criteria based on stakeholders: workers, the local community, society, consumers, and value chain actors. Valdes-Vasquez and Klotz (2013) claimed that social sustainability has various interpretations in the construction industry depending on the project life-cycle stage and stakeholder perspectives. In this regard, Montalbán-Domingo et al. (2018) identified different classifications of social criteria depending on (a) the assessment of construction projects in the planning, feasibility, and design stages; (b) the assessment of construction company performance; (c) supplier evaluation procedures; (d) social life cycles of products and materials; and (e) decision-making processes for designing, constructing, and operating construction projects. Additionally, research has highlighted the lack of a clear definition of the criteria that should be considered to assess social sustainability in the construction industry because only a limited number of social aspects are typically considered (Sierra et al., 2018b).

However, three main theoretical frameworks can assess social sustainability: the social life cycle assessment, sustainability certification systems, and corporate sustainability systems (Rahdari and Rostamy, 2015). According to the guide published by UNEP (2009, p. 100), "social life cycle assessment is a social impact assessment technique that aims to assess the social aspects of products and their positive and negative impacts along their life cycle." Moreover, UNEP (2009) established the basis to perform social life-cycle assessments. Research has addressed the sustainable design of buildings and civil engineering infrastructures in the construction industry to improve decision-making concerning the infrastructure life cycle's feasibility and design stages. However, although rapid development in social life-cycle assessment studies has occurred over the last decade, many methodological deficiencies still exist (Tsalis et al., 2017). These deficiencies are primarily in selecting appropriate data, social indicators, and impact assessment methods and the lack of information associated with each country's cultural and economic particularities (Benoît et al., 2010; do Carmo et al., 2017). Therefore, many authors have remarked that social life-cycle assessment is still immature, and plenty of chances for progress exist (Eizenberg and Jabareen, 2017).

Various certification systems and rating tools have emerged to measure infrastructure project sustainability (Clevenger et al., 2016). These tools guide and assess individual infrastructure projects, offering design teams and contractors a set of sustainable priorities and a method to analyze their performance (Clevenger et al., 2016; Griffiths et al., 2017). Certification systems assess performance against defined sustainability categories. Within each category, a set of associated criteria are defined, and weights are allocated for each individual depending on the relative sustainability impact and performance level (Griffiths et al., 2015). However, a lack of transparency exists connected to the definition of the weights in most certification systems (Muench et al., 2016). Pocock et al. (2016) and Griffiths et al. (2017) stated that no current rating system fully develops the social aspect of sustainability. Finally, Ugwu and Haupt (2007) and Lim (2009) indicated that the coverage of the construction and operation stages in the infrastructure life cycle is inadequate because certification systems focus on the feasibility and design stages. In contrast, little research has focused on the construction stage.

During the last decade, significant efforts have focused on analyzing the extent companies incorporate economic, environmental, and social factors into their activities and how their actions affect the environment (Dočekalová and Kocmanová, 2016; Rahdari and Rostamy, 2015). Accordingly, normative frameworks, management systems, reporting guidelines, and rating systems have emerged to integrate sustainability management into business organizations (Lee and Saen, 2012). However, numerous barriers are highlighted in the literature. Rahdari and Rostamy (2015) stated that, although these developments gather a voluntary set of principles designed to promote a more sustainable business environment, most of them are not consistent. Different agents developed them with various perspectives and objectives. Moreover, the numerous existing indicators and the fact that these indicators are measured in very different units make performance assessment and decision-making difficult (Dočekalová and Kocmanová, 2016).

2.2. Point of departure: research gap and theoretical approach

Loosemore (2016) stated that the study of social procurement has barely been addressed. In this line, Montalbán-Domingo et al. (2018, 2019) analyzed 451 tendering documents from 10 countries, concluding that: (1) the inclusion of social criteria in the procurement procedures varies notably depending on the country and contract size; (2) only social criteria related to health and safety aspects are globally accepted; (3) a lack of metrics exists to assess social sustainability in public procurement; (4) the importance level of each social criterion should be affected by the project characteristics and social context; and, (5) the inclusion of social criteria as exclusion grounds, selection criteria, and/or award criteria in the procurement procedure is essential to reflect client needs and sustainable project objectives.

Significant limitations exist to integrate social issues in each construction contract for the following reasons. First, the construction industry lacks coherence and clear and practical definitions of social sustainability (Almahmoud and Doloi, 2018; Sierra et al., 2018b). Second, the factors that should define it are unclear (Barraket and Weissman, 2009; Kadam and Devalkar, 2016; Lingard et al., 2019). Finally, how social sustainability in this industry should be measured and assessed is unclear (Doloi, 2012; Murphy and Eadie, 2019; Sutherland et al., 2015; Montalbán-Domingo et al., 2019). These facts are crucial, considering that each country inconsistently addresses the assessment of social issues in its activities and operations (Montalbán-Domingo et al., 2018, 2019), and a low inclusion of social terms in public procurement procedures exists (IHRB, 2015). Therefore, a method to assist agencies in the effective inclusion and objective assessment of social criteria in public-works procurement is needed.

Two different types of delivery methods can be identified (Montalbán-Domingo et al., 2019). First, traditional delivery uses the design-bid-build method, where the design and construction stages are undertaken by separate entities with separate contracts (Pellicer et al., 2016). Second, integrated delivery includes design-build, integrated project delivery, construction manager at risk, construction manager as the general contractor, public-private partnerships, and other concessionaire alternatives. In these delivery approaches, the contractor team is partially (or entirely) responsible for the design, construction, operation, and maintenance of the facility (Mollaoglu-Korkmaz et al., 2013; Pellicer et al., 2016).

Such authors as Berry and Shaun (2011), Broesterhuizen et al. (2014), and Naoum and Egbu (2016) have claimed the importance of integrated delivery to boost sustainability in the construction industry. However, the traditional design-bid-build method is still dominant. Therefore, the inclusion of social sustainability in this delivery approach must be addressed (Pellicer et al., 2016; Montalbán-Domingo et al., 2019).

Public procurement includes civil engineering projects and building projects. Nevertheless, compared to building projects, civil engineering projects cause significant disturbances to the existing communities and environment (Ugwu and Haupt, 2007; Abdel-Raheem and Ramsbottom, 2016). Civil engineering projects are usually critical infrastructure projects due to their complexity, high budgets, frequent occurrence, and inevitable disturbance they cause (Abdel-Raheem and Ramsbottom, 2016). For that very reason, Chang et al. (2017) claimed that applying sustainability principles in this type of project requires a broad interpretation of the construction process, where sustainable construction must be practiced across the project life cycle (Shen et al., 2010). In line with this, considering the four stages of the infrastructure life cycle, feasibility, design, construction, and operation (Ugwu and Haupt, 2007; Alshubbak et al., 2015), most studies have focused on the feasibility (Shen et al., 2010; Sierra et al., 2017a, 2017b, 2018a; Goel et al., 2020b) and design stages (Ugwu and Haupt, 2007; Lu and Zhang, 2016; Navarro et al., 2018; Hossain et al., 2018). Although the activities of the construction stage have a significant influence on the social dimensions of the project (Ugwu and Haupt, 2007; Sierra et al., 2016), scarce research has addressed the social dimensions of civil engineering projects in the construction stage (Abdel-Raheem and Ramsbottom, 2016), positioning it as a need to be resolved.

Consequently, the previous paragraphs highlight a research gap that requires defining an innovative method to assess social sustainability in public-works procurement. Three constraints limit this approach. First, it uses the design-bid-build (or traditional) delivery. Second, it applies to civil engineering projects, and third, it focuses on the construction stage of the infrastructure life cycle. Consequently, this work aims to propose an integrated set of indicators and aggregate formulas to assess social criteria in public-works procurement for civil engineering projects to bridge this gap.

3. Factors assessing social sustainability in public procurement procedures

The first step of this study is to define the factors to assess social sustainability in public-works procurement using the design-bid-build method during the construction stage of civil engineering projects. Montalbán-Domingo et al. (2019) defined eight broad categories to assess social sustainability in the construction industry: cultural heritage, employment, health and safety, local development, professional ethics, public participation, training, and user impact. Moreover, Montalbán-Domingo et al. (2020) determined 24 factors to assess social sustainability in the construction industry through an in-depth literature review (Table 1).

Table 1
Categories and factors assessing social sustainability in construction (Montalbán-Domingo et al., 2020).

Categories	Factors
Cultural heritage	Cultural heritage appraisal and management plan
	Collaboration with historical or cultural preservationists
Employment	Employment creation
	Job stability
	Industry participation plan
Health and safety	Work health and safety management officer
	Occupational health and safety performance
	Workplace health and safety management plan
	Social benefits and social security
Local development	Local preference
	Local employment using local products and services
	Social value
Professional ethics	Nondiscrimination and equal opportunities
	Fair wages and fair income distributions
	Child labor
	Forced labor
	Freedom of association and collective bargaining
	Corruption
	Respect for indigenous rights
	Respect for intellectual property rights
Public participation	Community relations program
Training	Technical training
	Sustainability training
User impact	Effects on neighbors

As the research scope focuses on the construction stage of civil engineering projects, the list of factors was adjusted. The concept of social sustainability is still evolving (Valdes-Vasquez and Klotz, 2013), and social sustainability is a multidimensional concept that contains complex implications (Yu et al., 2017). Thus, deciding what social factors should be considered based solely on the previous literature is limited by the individual bias of the researchers (Valdes-Vasquez and Klotz, 2013). A group of experts was involved in the decision-making procedure about which factors to consider to overcome this limitation.

Two techniques have been highlighted in the literature to involve experts in decision-making procedures: the focus group and the Delphi method. The focus group technique is a qualitative research method to integrate the different opinions of various stakeholders. This technique is based on encouraging interactive discussions and knowledge sharing between a group of experts to generate new ideas and knowledge and define a consistent and holistic viewpoint (Xenarios and Tziritis, 2007; Yu et al., 2017). This technique can also help acquire a large amount of information within a relatively short period (Yu et al., 2017).

The Delphi method is a research technique focused on obtaining judgment of a panel of independent experts on a specific topic (Hallowell and Gambatese, 2010). This method is based on performing two or more rounds of structured surveys. In the first round, the facilitator conducts individual surveys with each expert. In the second round, the facilitator provides an anonymous summary of the experts' input from the first round. The participants are encouraged to review the anonymous opinion of the other panelists and consider revising their previous responses (Hallowell and Gambatese, 2010). The objective of this process is to decrease the variability of the responses until a consensus is reached (Sierra et al., 2017a).

Brüggen and Willems (2009) analyzed and compared the effectiveness of these two research techniques. They found that focus group results have the highest depth and breadth and are the most efficient, leading to high-quality outcomes. Furthermore, considering that the concept of social sustainability encompasses complex terms (Landorf, 2011; Nikolaou et al., 2019) and needs to be analyzed from different perspectives (UNEP, 2009), the focus group was the selected technique for this research.

According to Brüggen and Willems (2009), heterogeneity between the focus group members guarantees a broad spectrum of experiences, perceptions, and opinions. It avoids a strictly homogeneous group that could generate a redundant discussion. Therefore, following Yu et al. (2017) and Valdes-Vasquez and Klotz (2013), three profiles of experts were identified depending on the following areas of knowledge:

- Profile 1: public procurement procedures and project delivery methods,
- Profile 2: construction of civil engineering projects, and
- Profile 3: social sustainability in the construction industry.

The focus group was formed by 12 members with extensive experience in the established profiles (Table 2).

Additionally, the expert criteria (Hallowell and Gambatese, 2010) were as follows:

A. at least 10 years of professional experience,
B. an advanced degree,
C. primary or secondary author of at least three peer-reviewed journal articles,
D. manager in a private company,
E. faculty member, and
F. doctoral degree.

Table 2
Years of experience of each expert in each profile.

Expert	Profile 1	Profile 2	Profile 3
1	25		
2	27		
3	25		
4	28		
5		26	
6		16	
7		25	
8		28	
9			10
10			28
11			43
12			45

Every member has broad expertise in any of the established profiles and held at least a civil engineering degree (Table 3).

The focus group meeting protocol was consistent with the suggestions of Morgan (1997) and Yu et al. (2017). First, a table with the social categories and 24 factors was presented to each focus group participant. The facilitator interviewed each expert to determine his/her personal experience associated with each social factor. Finally, the factors were analyzed during the meeting. The participants were encouraged to conduct an open discussion about the convenience of considering each factor to assess social sustainability during the procurement procedure for civil engineering construction projects. Modifications were made until these interviewees reached an agreement on the factors list. The facilitator led this process.

Additionally, to manage the inclusion of social factors in public procurement, a holistic approach was demanded by considering four organizational levels (Pellicer et al., 2013): individual, project, company, and country. The individual level concerns the environmental psychology of people, which is beyond the scope of this paper (Moser, 2009). The project level focuses on the social commitment of construction companies to each project, that is, a specific contract in this context (IHRB, 2015). At the company level, corporate social responsibility must be considered because the assessment of the daily commitment is key to measuring the social progress of construction companies (Krajnc and Glavič, 2005). Finally, human rights must be addressed at the country level to ensure compliance with human rights and social and labor law obligations by the bidders (IHRB, 2015). Therefore, the final list of factors was adjusted by the experts according to these organizational levels.

The results of the focus group center on the category of "local development." Experts decided that factors of "local preference" and "local employment using local products and services" should not be considered in the procurement procedure of civil engineering construction projects. The reasons were that "local preference" represents assigning better scores to national companies than foreign companies or limiting participation in the procurement procedure to national companies. Therefore, the experts decided that the inclusion of this factor, its importance level, and how it is included in the procurement procedure should depend on government decisions according to the established national, regional, and local policies (Burke and King, 2015; Nijaki and Worrel, 2012). Alternatively, inclusion should also depend on the industry features in each country or region, ensuring that the preference of the local industry does not detract from the final project quality (NCHRP, 2015a).

In addition, the factor "local employment using local products and services" was discerned from "local products" and "local services." The decision about the inclusion of local products in the project should be determined in the design stage because the selection of materials must depend on economic, environmental, and social aspects, which also should be considered in the design stage (Navarro et al., 2018). Thus, experts decided to exclude local products from consideration in the construction stage. The experts stated that local services were already considered within the employment category in the factor "industry participation plan." Consequently, this was also excluded to avoid overlap between factors.

Twenty-two final factors were selected and sorted into three organizational levels to address the assessment of social sustainability in the procurement procedure of civil engineering construction projects (Table 4). The experts decided that the individual level should be addressed through the encouragement of the other three. The factors related to human rights are not under the project level because the lack of human rights should not be tolerated; therefore, these factors were assigned at the country level. The company level includes factors essential to assess the corporate social responsibility of construction companies involved in the procurement procedure. Finally, the project level collects factors linked to the project and depicts the construction companies' commitment in the project.

4. Method

An integrated method for assessing social sustainability in public-works procurement of civil engineering construction projects is introduced in this section. This integrated method aims to assess the global commitment from a social perspective of each company that participates

Table 3
Percentage of experts satisfying the criteria per profile.

Criteria	Profile 1	Profile 2	Profile 3
A	100%	100%	100%
B	100%	100%	100%
C	25%	75%	75%
D	50%	100%	0%
E	50%	50%	75%
F	50%	50%	75%

Table 4
Levels, categories, and factors assessing social sustainability in public-works procurement.

Level	Category	Factor
Country: Human rights	Professional ethics	Child labor
		Forced labor
		Freedom of association and collective bargaining
		Corruption
		Respect for indigenous rights
		Respect for intellectual property rights
Company: Corporate social responsibility	Employment	Employment creation
		Job stability
	Occupational Health and Safety	Social benefits and social security
		Occupational health and safety performance
	Local Development	Social value
	Professional Ethics	Nondiscrimination and equal opportunities
		Fair wages and fair income distributions
	Training	Technical training
		Sustainability training
Project: Social commitment in the project	Cultural Heritage	Cultural heritage appraisal and management plan
		Collaboration with historical or cultural preservationists
	Employment	Industry participation plan
	Occupational Health and Safety	Workplace health and safety management plan
		Work health and safety management officer
	Public Participation	Community relations program
	User Impact	Effects on neighbors

in the procurement procedure. In line with this aim, several researchers have previously developed methods to assess sustainability in public procurement. For instance, Claeson-Jonsson et al. (2013) developed a sustainability assessment method for procurement in bridge projects based on performance criteria; this method only considers social issues related to worker safety during construction and resident safety, prioritizing environmental issues over social ones. Sowerby et al. (2014) defined a method for national road administrations, which assessed social sustainability from a project perspective without considering the corporate social responsibility of the construction company performing the contract. This approach is analogous to that developed by Rosén et al. (2015) but focused on projects on contaminated land remediation. Finally, Dolla and Laishram (2020) developed a bid-selection model based on sustainability indicators; this model gathered economic, social, environmental, and institutional criteria, but most of the indicators were defined qualitatively and focused only on the project level.

These methods do not fulfill all the needs of a comprehensive and precise social assessment for the following reasons. First, the current social sustainability appraisal methods entail a high subjectivity level because they focus on qualitative assessments (Bueno et al., 2015; Ek et al., 2019). Second, social indicators must be tailored to the national and social contexts of the project (Montalbán-Domingo et al., 2018; Sierra et al., 2018b). Finally, the assessment of social sustainability in public procurement should consider a holistic approach that ensures the global commitment of the contractors in terms of social responsibility at different organizational levels (Dočekalová and Kocmanová, 2016; Montalbán-Domingo et al., 2020). Therefore, the proposed method aims to assess social sustainability using an integrated approach through three organizational levels (country, company, and project) to assess the social dimensions comprehensively, guaranteeing the rigor and transparency demanded by the procurement procedures.

At the country level, the method must guarantee that every procurement procedure considers human rights requirements. Thus, the method ensures that every involved construction company knows and complies with each human rights factor. Therefore, each offeror must submit a signed human rights declaration covering the six factors to be declared suitable for assessment in any public-works bid.

Indicators and aggregation formulas were defined to assess social commitment at the company and project levels (Fig. 1). The company level aims to assess the corporate social responsibility of the contractors in their daily activities. These indicators must reflect the company attitude and assess the entire company (Dočekalová and Kocmanová, 2016). Otherwise, analyzing only the company linked to the project could imply a bias (Krajnc and Glavič, 2005). At the project level, the aim is to assess the contractor's social commitment during project execution. Consequently, indicators must be tailored to the assessment of each specific project because the social impact of the project depends on the geographical and social contexts (Ugwu and Haupt, 2007; Valdes-Vasquez and Klotz, 2013; Abdel-Raheem and Ramsbottom, 2016; Yu et al., 2017).

Each organizational level contains a group of factors. These factors represent the primary social issues to be assessed. The indicators measure the factors, and each factor at the organizational level is assessed using quantitative or semi-quantitative indicators, allowing for internal and external verification. This premise is essential, considering that a procurement procedure must guarantee fair, transparent, and objective competition (Schöttle and Arroyo, 2017). Furthermore, measuring social sustainability in a quantitative or semi-quantitative form is a crucial

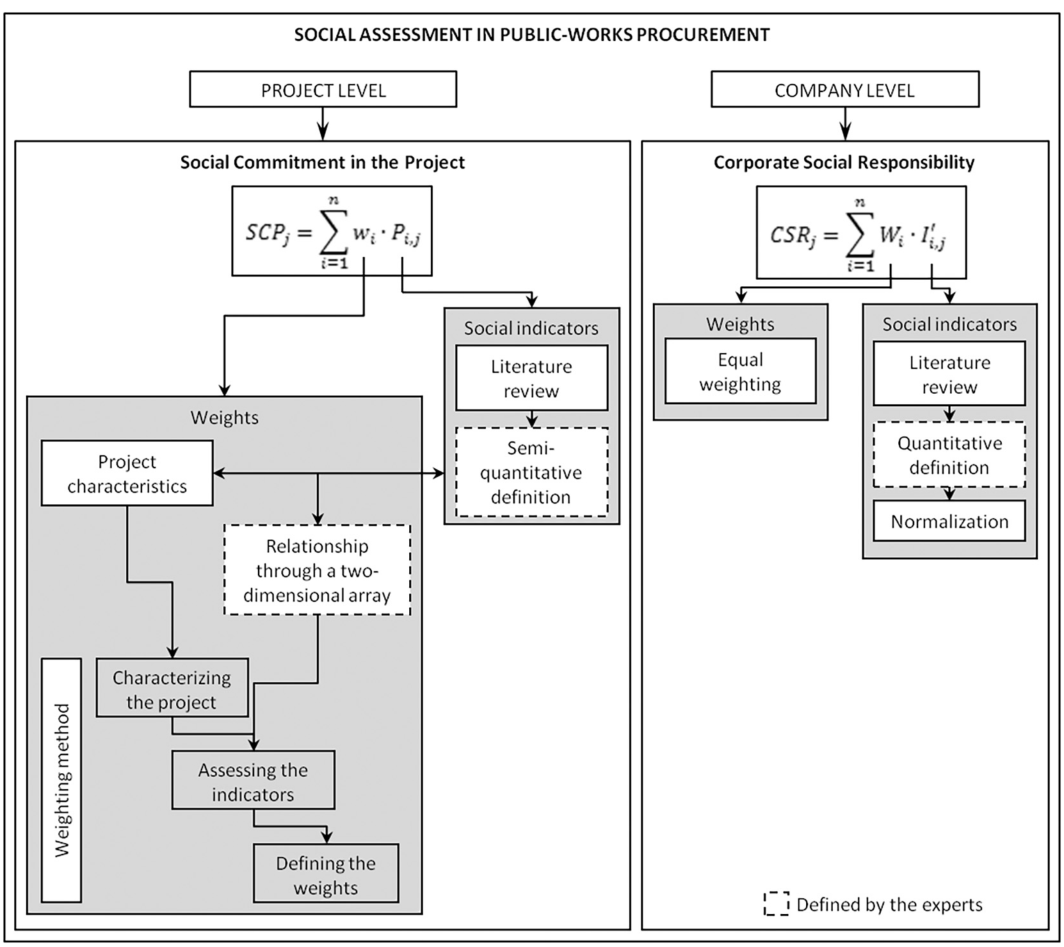

Fig. 1. Proposed method.

goal for future developments (Afzal et al., 2017; Goel et al., 2020b; Krajnc and Glavič, 2004; Popovic et al., 2018). Therefore, a top-down approach was performed to evaluate and select the indicators. First, a literature review was performed, and 214 indicators were gathered and classified according to 22 factors. Subsequently, a 'theoretical' assessment was undertaken to evaluate indicators following a set of quality criteria. Finally, the focus group performed a 'practical' assessment to determine the indicators to assess each factor.

Through the theoretical assessment, 141 indicators (see Supplementary Material) were selected based on the following quality criteria (United Nations, 2008):

- Comparability: Metrics must be compared over time and between enterprises to identify and analyze a company's evolution.
- Relevance: This represents the importance of a specific metric to explain a problem under analysis, depending on whether its omission or misstatement could influence users' decisions.
- Understandability: The information must be understandable to the reader, and the manner of the presentation should be concise, explaining the unknown terms.
- Reliability and verifiability: Information must be free from material error and bias and must provide an accurate, complete, and balanced view of the actual situation.

Following the recommendations of Cook et al. (2017) and the (Joint Research Centre-European Commission, 2008) to minimize subjectivity, the expert panel used the focus group technique for the final selection and adjustment of the 141 selected indicators. The protocol for the focus group meeting was consistent with suggestions by Yu et al. (2017). In one session, the focus group defined by consensus the indicators, from the 141 indicators satisfying the four quality criteria, to assess the 22 social factors. The process that they followed was: first, the experts individually selected five indicators to assess each factor; second, the results of the first task were shared and discussed in the focus group. Finally, the indicators were assigned and adjusted to each factor by consensus. Once the indicators were determined, the methods to establish the weights were addressed.

Establishing weights in the social assessment of products, projects, or companies is a critical issue due to the subjectivity of the tasks (UNEP, 2009). The most widely accepted methods are based on assigning equal weight or using expert judgment to establish the weight of each factor (Fan et al., 2016; Hosseinijou et al., 2014; Opher et al., 2017). Regarding corporate social responsibility, several authors recommend using equal weighting to establish the level of importance of these indicators (do Carmo et al., 2017; Rahdari and Rostamy, 2015). However, the assessment of social sustainability at the project level must be adapted to the specific context of the project (Montalbán-Domingo et al., 2018). Kraft and Molenaar (2015) and Yu et al. (2017) highlighted that defining the importance of qualitative or semi-quantitative indicators according to the project characteristics is essential to help practitioners in decision-making for procurement procedures. Additionally, UNEP (2009) indicated the need to involve expert judgment to aggregate qualitative indicators. Therefore, at the project level, the focus group determined the importance level for each indicator depending on the project characteristics. By defining a two-dimensional array, the focus group established the weights of each indicator based on the relationship between each indicator and the project characteristics.

4.1. Social commitment to the project

4.1.1. Selection of project characteristics

Project characteristics represent the features of specific projects to analyze their influence over the inclusion of social criteria in procurement. For this research, the following five project characteristics were defined, and three levels were established for each of them:

- Contract size is defined as the initial budget of the construction project (Lines and Miao, 2016): (1) below 1,000,000€; (2) between 1,000,000€ and 10,000,000€; and (3) over 10,000,000€.
- Project complexity is perceived as a condition associated with project difficulty and risk (NCHRP, 2015b). Compared to the average project awarded by the procurer, (1) low indicates the project is not complex, (2) medium indicates a complex project, and (3) high indicates a highly complex project.
- The cultural environment considers the distance to areas where historical, architectural, archeological, or paleontological resources may be found (Domínguez-Rodrigo et al., 2017). Previous studies have determined the following levels: (1) a low risk of damaging historical resources or no discovery in the project region, (2) a medium risk level or a discovery in the project region, and (3) a high risk of damaging historical resources with several discoveries in the project region or protected areas.
- Industry competence refers to industry characteristics or abilities associated with local firms' competence in this project type (NCHRP, 2015b). The level of competence of the local industry to perform the required task is categorized as (1) low (or the procurer does not have the technical capabilities), (2) medium, or (3) high.
- Territory involves the project distance to residential areas where the construction work can produce adverse effects (Wang et al., 2016). The construction work produces the following adverse effects in the territory during the development of the project: (1) low (hardly any), (2) medium (some), and (3) high (significant) effects.

4.1.2. Definition of social indicators

Based on the indicators from the literature review, the experts established indicators to assess social commitment in a project. To move the construction industry toward a greater commitment to social sustainability, the procurer must be aware of the current needs in social matters, and the contractor must address the management of the work to maximize the social benefits of the contract. Public work procurement can adjust the governance of construction companies to maximize the social benefits of the contract. Based on this, Table 5 presents definitions containing subindicators representing information that each procurer can request in the procurement procedure to assess each company's social commitment for each indicator. The selection of subindicators in the procurement procedure depends on the needs associated with each context.

Additionally, the experts also established an evaluation method to minimize subjectivity in the process. Each indicator contains a set of subindicators, and five levels were defined to assess and score each subindicator compared to other companies:

1) excellent (scored as 1.00), defined as outstanding;
2) good (scored as 0.66), defined as equal to or greater than;
3) moderate (scored as 0.33), assessed as well defined, but improvements are needed;
4) poor (scored as 0.00), indicating the definition requires significant improvements; and
5) none (scored as *X*) when nothing is shown regarding the subindicator.

Finally, the total score of an indicator is calculated as the average of the scores obtained for each subindicator. If a subindicator is assessed at the none level (*X*), the total score of the indicator is zero.

4.1.3. Definition of the relationship between indicators and project characteristics

To help practitioners define weights, Kraft and Molenaar (2015) recommended project characteristics to determine the importance of qualitative indicators. The experts determined the importance level of each indicator using the focus group technique. Following the recommendations of previous researchers, such as Migliaccio et al. (2014) and

Table 5
Indicators to assess social commitment in a project.

Factor	Indicator	Subindicator	Source
Cultural heritage appraisal and management plan	P_1: Cultural heritage appraisal and management plan	• P_{11}: Review of previous cultural environment investigations • P_{12}: Scope of cultural environment mitigation • P_{13}: Methodology of archeological mitigation • P_{14}: Definition of protection measures • P_{15}: A plan to address unanticipated discoveries • P_{16}: Means of communication • P_{17}: Training plan • P_{18}: Publicity	CEEQUAL (2010); Muench et al. (2011)
Collaboration with historical or cultural preservationists	P_2: Cultural environment professional	• P_{21}: Curriculum vitae • P_{22}: Years of experience • P_{23}: Definition of responsibilities	CEEQUAL (2010); FHWA (2012)
Industry participation plan	P_3: Industry participation plan	• P_{31}: Community employment needs • P_{32}: Opportunities for local participation • P_{33}: Communication strategy • P_{34}: Ratio of participation of local firms	CEEQUAL (2010); AG (2001); NTG (2019)
Workplace health and safety management plan	P_4: Workplace health and safety management plan	• P_{41}: Management structure and responsibilities • P_{42}: Workplace health and safety risk assessment • P_{43}: Proposal for inspections at worksites • P_{44}: Communication	ISI (2015)
Work health and safety management officer	P_5: Work health and safety management officer	• P_{51}: Curriculum vitae • P_{52}: Occupational health and safety regulations • P_{53}: Responsibilities	ISI (2015)
Community relations program	P_6: Community relations program	• P_{61}: Responsible for communicating with stakeholder groups • P_{62}: Project decision-making processes	CEEQUAL (2010); FHWA (2012); IDOT (2012)
Effects on neighbors	P_7: Effects on neighbors	• P_{71}: Traffic management plan • P_{72}: Control measures • P_{73}: Measures to improve user safety	CEEQUAL (2010); FHWA (2012); CEEQUAL (2019); IDOT (2012)

NCHRP (2015a, 2015b), the method was based on defining a two-dimensional array to represent the relationship between each project-characteristic level and the indicators (Table 6).

The expert panel assessed the relationships according to the following three ratings (NCHRP, 2015a): "-" represents that the indicator does not influence the project success, "+" indicates that the indicator can be recommended, and "++" indicates that the indicator should be strongly recommended. To guide experts to perform this task correctly, they received the following information: (a) the focus group goal, (b) indicator definitions, (c) project-characteristic definitions, (d) the rating method to assess the relationships, and (e) a brief explanation of how to complete the two-dimensional array. Finally, to guarantee their understanding, the final objective of the two-dimensional array was explained. Subsequently, once each member defined the two-dimensional array, their assessments were compiled, and the focus group meeting was performed in one session. The results were discussed, and the two-dimensional array was established by consensus. The protocol was consistent with that by Morgan (1997) and Yu et al. (2017).

Table 6
Relationships between the indicators and each project-characteristic level.

Project Characteristics	P_1	P_2	P_3	P_4	P_5	P_6	P_7
Contract size							
> 10,000,000€	+	−	++	++	++	+	+
1000,000€ - 10,000,000€	+	−	+	++	++	+	+
< 1000,000€	−	−	+	+	+	+	+
Project complexity							
High	+	−	+	++	++	+	+
Medium	+	−	+	++	++	+	+
Low	−	−	++	+	+	+	+
Cultural environment							
High	++	++	−	−	−	−	−
Medium	+	+	−	−	−	−	−
Low	−	−	−	−	−	−	−
Industry competence							
High	−	−	++	+	+	−	−
Medium	−	−	+	+	+	−	−
Low	−	−	+	++	++	−	−
Territory							
High	−	−	−	−	−	++	++
Medium	−	−	−	−	−	++	++
Low	−	−	−	−	−	+	+

4.1.4. *Weighting procedure*

The NCHRP (2015a, 2015b) defined the following process to determine the weighting procedure: characterizing the project, rating the indicators based on project characteristics, and defining weights for each indicator. For each specific project, the procurer must select the level of each project characteristic to characterize the project in the first step. The indicator rating for each project characteristic is extracted from the two-dimensional array (second step) based on these levels. Each indicator obtains a rating for each project characteristic. The maximum rating of each indicator is used for its assessment. As this rating is the most restrictive score for each indicator, in the third step, the maximum rating obtained for each indicator was converted into a numerical score, where "-" represents the value of 0, "+" represents the value of 1, and "++" represents the value of 2. Finally, the indicator weight is obtained as its proportional value to the total score results. Eq. (1) represents the social commitment of company *j* in the project, where w_i is the weight assigned to indicator *i*, and $P_{i,j}$ is the value of indicator *i* for construction company *j*:

$$SCP_j = \sum_{i=1}^{n} w_i \cdot P_{i,j} \tag{1}$$

4.2. *Corporate social responsibility*

4.2.1. *Definition of the social indicators*

Table 7 presents the quantitative indicators defined by the experts to assess the company level regarding corporate social responsibility. The

Table 7
Indicators to assess the corporate social responsibility of construction companies.

Factor	Indicator	Metric	Source	Type
Employment creation	I_1: New staff hiring	Total number of new staff hiring in the company divided by the maximum number of workers	GRI (2016a)	Maximization
Job stability	I_2: Employee turnover	Maximum number of leaving workers divided by the maximum number of workers	Rahdari and Rostamy (2015); Dočekalová and Kocmanová (2016)	Minimization
	I_3: Temporary contracts	Total number of temporary workers divided by the maximum number of workers	GRI (2016a)	Minimization
Social benefits and social security	I_4: Investment in the health of employees	Annual investment in the health of employees divided by revenue	United Nations (2008); Popovic et al. (2018)	Maximization
	I_5: Parental leave	The number of employees who returned to work after parental leave ended, who were still employed 12 months after their return to work, with respect to the number of employees that were entitled to parental leave over last two years	United Nations (2008); Rahdari and Rostamy (2015)	Maximization
Occupational health and safety performance	I_6: Training on health and safety	Total number of hours of staff time used for giving or receiving formal training on health and safety aspects of construction with respect to the total number of worked hours	Veleva and Ellenbecker (2001); GRI (2018)	Maximization
	I_7: Certificates health and safety	1 If the company is currently certificated by OHSAS 18001, ISO45001:2018 or equivalent; otherwise, 0	Rahdari and Rostamy (2015); GRI (2018)	Maximization
	I_8: Fatalities	Number of fatalities over last year divided by the total number of worked hours	Rahdari and Rostamy (2015); GRI (2018)	Minimization
	I_9: Accidents	The number of accidents involving sick leave divided by the total number of worked hours * 1000,000,000	GRI (2018); SASB (2018)	Minimization
	I_{10}: Occupational disease	The number of occupational diseases with respect to the total number of workers * 200,000	Rahdari and Rostamy (2015); GRI (2018)	Minimization
	I_{11}:Working days lost	The number of working days lost due to sick leave accidents registered with respect to the total number of worked hours * 1000	GRI (2018); SASB (2018)	Minimization
Social value	I_{12}: Social value	Total number of hours that employees spent on social programs and voluntary activities during working hours	GRI (2015)	Maximization
Nondiscrimination and equal opportunities	I_{13}: Women in executive management positions	Percentage of women in executive management positions	GRI (2016b)	Maximization
	I_{14}: Female labor force participation	Total number of female employees divided by the maximum number of workers	Rahdari and Rostamy (2015); GRI (2016b)	Maximization
	I_{15}: Disabled people	Total number of workers registered as disabled with respect to the maximum number of workers	Rahdari and Rostamy (2015); GRI (2016b)	Maximization
	I_{16}: Wage gap	Difference between basic salary and remuneration of male and female employees: $I_{16} = \frac{1}{n} \cdot \sum_{i=1}^{n} \left(\frac{max(a,b)_i - min(a,b)_i}{max(a,b)_i} \right)$ For: $a = S_{W\ i}/H_{w\ i}$ • $S_{W\ i}$: Total of basic salary and remuneration of female employees in the i job category • $H_{w\ i}$: Number of worked hours by female employees in the i job category $b = S_{M\ i}/H_{M\ i}$ • S_{Mi}: Total basic salary and remuneration of male employees in the i job category • $H_{M\ i}$: Number of worked hours by male employees in the i job category i: job categories in a company. Both women and men employed must be considered in n categories. Categories: (1) senior management, (2) executive and managers, (3) graduates, (4) administrative, and (5) operatives.	GRI (2016b); Popovic et al. (2018)	Maximization
Fair wages and fair income distributions	I_{17}: Salary distribution	Annual total compensation of the highest-paid individual divided by the median annual total compensation for all employees except the highest-paid individual	Azapagic and Perdan (2000); GRI (2015)	Minimization
Technical training	I_{18}: Technical training	Annual investment in workers technical training per the maximum number of workers	Dočekalová and Kocmanová (2016); GRI (2016c)	Maximization
Sustainability training	I_{19}: Social ethics, social awareness, and human rights	Total hours of staff time used for giving or receiving formal training on code of ethics, social awareness, human rights, and social aspects of construction divided by the maximum number of workers	GRI (2016d)	Maximization
	I_{20}: Research and Development	Annual investment in research and innovation projects divided by the revenue	Rahdari and Rostamy (2015); Popovic et al. (2018)	Maximization

following information is displayed for each indicator: metric, sources, and type of indicator (i.e., whether the minimum value is desirable [minimization] or the maximum value is desirable [maximization]). The indicators must be normalized.

According to Tokos et al. (2012) and Zhou et al. (2012), normalization using benchmarks ensures that all indicators are transformed transparently and comparably. Benchmarks must be established for each specific country, considering the particularities of the social context (Montalbán-Domingo et al., 2018, 2020). Benchmarks can be defined based on the values of measurements and standards in the construction industry, the local legal regulations, the Global Reporting Initiative (GRI) reports for the construction industry, or other relevant documents (Zhou et al., 2012). The GRI has become the most prominent framework for nonbinding reporting of nonfinancial performance and is one of the most credible sources for extracting corporate responsibility results (Rahdari and Rostamy, 2015). This research uses GRI reports because the GRI guidelines are the most widely used standardized sustainability reporting framework globally. Currently, obtaining available and reliable data on the social performance of construction companies is difficult (Roca and Searcy, 2012; Tokos et al., 2012; Zhang et al., 2020).

The equation to normalize indicators depends on the type of indicator. Following the recommendations by Tokos et al. (2012) and Zhou et al. (2012), indicators with a positive effect (maximization) are normalized using Eq. (2), and indicators with a negative effect (minimization) are normalized using Eq. (3):

$$I' = \frac{I}{\lambda}, \tag{2}$$

$$I' = 1 - \frac{I}{\lambda}, \tag{3}$$

where I denotes the value of an indicator, I' is the normalized value, and λ indicates the indicator benchmark.

4.2.2. Weighting procedure

Establishing weights in the social assessment of products, projects, or companies is a critical issue due to task subjectivity (UNEP, 2009). The most widely accepted procedures are based on assigning equal weight or using expert judgments to establish the weight of each category (Garrido et al., 2018). Expert perception can be limited because of the complexity of defining and understanding this sustainability dimension (Yu et al., 2017). Therefore, in this research, equal weighting was assigned to each indicator.

According to the Joint Research Centre of the European Commission (2008), the main aggregation techniques are linear and geometric methods. This research chose the linear aggregation method based on the recommendations by Zhou et al. (2012), who highlighted the simplicity, transparency, and easy understanding of this aggregation method. Therefore, Eq. (4) represents the corporate social responsibility performance of each company (CSR_j), where W_i is the weight assigned to indicator i, and $I_{i,j}'$ is the value of indicator i for construction company j:

$$CSR_j = \sum_{i=1}^{n} W_i \cdot I_{i,j}' \tag{4}$$

5. Implementation

This section demonstrates an application example and validation for the project and company levels. Regarding the project level, an application example is included to explain how to define the weights. As this procedure is the limiting and relevant part to guarantee the method's suitability, the validation focuses only on assessing the procedure's ability to adapt the weights to the project characteristics. For the company level, an application example about how to calculate the benchmarks is presented. The validation focuses on assessing and comparing the corporate social responsibility of construction companies to observe the method's ability to assess companies regardless of their size.

5.1. Social commitment in the project

5.1.1. An application example of the weighting procedure

This research identified a construction project in central Spain to demonstrate the procedure application to calculate weights. The aim of the project was to build a new road bridge. The project had a budget of between 1000,000€ and 10,000,000€. This project was complex compared to the average projects awarded by the procurer. Thus, the complexity level of the project was medium. Historical resources were discovered in the project region; therefore, the cultural environment level was medium. The level of competence of the local industry to perform the project work was also medium. Finally, the construction work development can produce substantial adverse effects in the territory, resulting in a territory factor with a high level (Fig. 2).

Once each project-characteristic level was selected, in the second step, the ratings of each indicator were extracted from the two-dimensional array. Each indicator obtained a rating for each project characteristic. The maximum rating of each indicator is its most restrictive score. Therefore, the maximum rating of each indicator was selected and transformed into numerical values. Finally, each indicator weight was obtained using the proportion of each indicator's score to the total score. For this project, the total score was 11; therefore, the weights of P_1, P_2, and P_3 were 0.091 (1/11), and the weights of P_4, P_5, P_6, and P_7 were 0.182 (2/11) (Table 8).

5.1.2. Validation

The validation focuses on analyzing the method's suitability to adjust weights according to project characteristics. A simulation process was performed to analyze a set of projects. These projects were obtained as a combination of the different levels of each project characteristic. As there are five project characteristics with three levels each, 243 (3^5) project scenarios can be defined if they are combined. Fig. 3 presents the variability of the weights for each indicator. These results depend on the level of importance established by the experts in the two-dimensional array.

The weights associated with P_1 and P_2 are the only indicators that received values equal to zero for some of the 243 analyzed project scenarios. According to the two-dimensional array, the zero value is because P_1 and P_2 are assessed as not recommendable (−) when there is no risk of damaging historical resources, the contract size is less than 1000,000€, and the project complexity is low. However, the remaining indicators were considered in every project scenario because these did not receive weights equal to zero for any project. These indicators did not obtain a score of '-' for any project-characteristic level in the two-dimensional array, guaranteeing their consideration.

5.2. Corporate social responsibility

5.2.1. Application example of the definition of the benchmarks

The first step to perform the method focuses on the definition of the benchmarks for a specific context. In this regard, the GRI reports on Spanish construction companies were reviewed to establish the benchmarks. Eight recent GRI reports from 2016 to 2017 on Spanish construction companies were identified and reviewed. The reports were read to identify the indicator data, and indicators presented in the text or performance scorecards were recorded. Additionally, the information explained in charts and tables, framed, or in bold characters was reviewed, and any data associated with the indicators were collected. This data collection led to the development of a database of all the indicators.

Table 9 lists the information on the eight Spanish construction companies. This table presents the values extracted from the GRI reports (*R*: Real value), benchmarks, and normalized values for each indicator through Eqs. (2) or (3) (*N*: Normalized value). Empty cells in the table indicate that this information was not found in the reports, which occurs because the GRI guidelines are recommendations for assessing company sustainability using a set of indicators that are not mandatory. Therefore, the indicators can be excluded if the company decides not to measure them (Tokos et al., 2012).

The maximum value for each indicator was selected to define the benchmarks, except for the following indicators: parental leave, women in executive management positions, female labor force participation, and the wage gap. Regarding parental leave, no analyzed report offered this data, and the maximum was fixed at 1. the maximum value for female labor force participation in the GRI reports was 0.48. Thus, considering that the EU's goal is to achieve equality between women and men in the workforce, the normalization parameter was fixed as 0.50 (European Comission, 2016). The wage gap in the GRI reports was

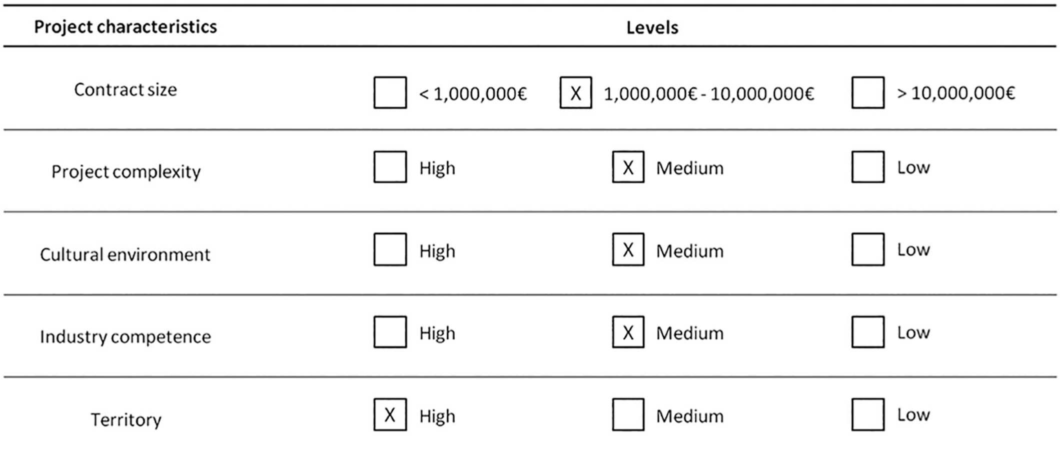

Fig. 2. Characterization of the project.

Table 8
Weight of each indicator in the project.

Project characteristics	Indicators							Total
	P_1	P_2	P_3	P_4	P_5	P_6	P_7	
Contract size	+	–	+	++	++	+	+	
Project complexity	+	–	+	++	++	+	+	
Cultural environment	+	–	–	–	–	–	–	
Industry competence	–	+	+	+	–	–	–	
Territory	–	–	–	–	++	++	++	
Maximum rating	+	+	+	++	++	++	++	
Scoring results	1	1	1	2	2	2	2	11
Weights	0.091	0.091	0.091	0.182	0.182	0.182	0.182	1

Notes: P_1: cultural heritage appraisal and management plans, P_2: collaboration with cultural preservationists, P_3: industry participation plan, P_4: workplace health and safety management plans, P_5: work health and safety management officer, P_6: community relations program, and P_7: effects on neighbors.

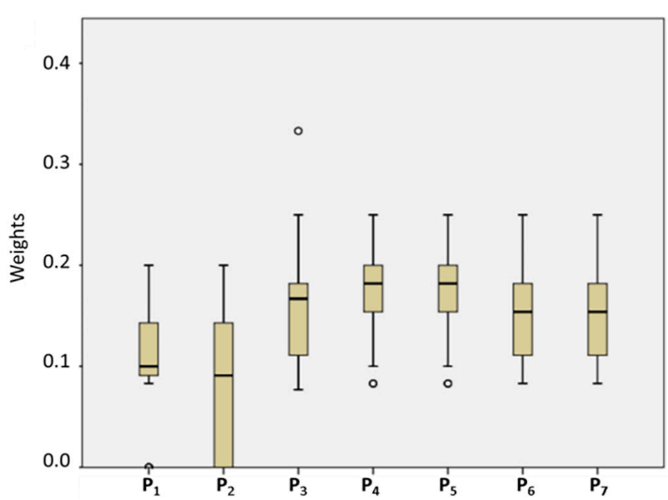

Fig. 3. Weight variability.

0.95. Thus, to achieve equality between women and men in the workforce, the normalization parameter was fixed at 1.00 (European Commision, 2014). Finally, the maximum value for women in executive management positions in the GRI reports was 0.36; however, to achieve equality between women and men in the workforce, the normalization parameter was fixed as 0.50 (European Comission, 2016).

5.2.2. Validation

A simulation process was developed to analyze the use of the aggregation formula to compare corporate social responsibility performance for construction companies. This validation aims to verify that corporate social responsibility can compare company performance regardless of size. Each indicator's normalized values (collected in Table 9) were used to calculate the corporate social responsibility of each company to perform the analysis. However, not all the information for the indicators was available in the GRI reports (see empty cells). Consequently, to perform the analysis, three performance alternatives were assigned to each empty cell: 1.00 to represent the best performance, 0.50 to represent medium performance, and 0.00 to represent the worst performance. However, the indicator "certificates health and safety: (I_7)" has only two possible options (1.00 or 0.00). The possible scenarios of the social behavior of each company can be calculated as a combination of the indicator values. For example, Table 10 presents the indicator values for Company 1. This company has 14 indicators with one value (1^{14}), one indicator with two values (2^1), and five indicators with three values (3^5). Therefore, the company has 486 possible social scenarios ($1^{14} \cdot 2^1 \cdot 3^5$).

Then, to calculate each construction company's corporate social responsibility, the Taguchi orthogonal array was used to calculate company social scenarios. These scenarios were defined using IBM SPSS Statistics (v. 23.0). Once the social scenarios of each company were obtained, corporate social responsibility was calculated using Eq. (4). The results are displayed in Fig. 4. The best performance corresponds with Company 1, a multinational enterprise leader in implementing corporate policies focused on social and environmental sustainability.

Table 9
Real values, normalized values, and benchmarks.

Indicator	Company 1		Company 2		Company 3		Company 4		Company 5		Company 6		Company 7		Company 8		Benchmark
	R	*N*	*R*	*N*	*R*	*N*	*R*	*N*	*R*	*N*	*R*	*N*	*R*	*N*	*R*	*N*	
I_1	0.35	1.00	0.01	0.04	0.10	0.28	0.25	0.72	0.01	0.02	0.05	0.15	0.04	0.12	0.00	0.00	0.35
I_2	0.05	0.63	0.06	0.54	–	–	0.13	0.00	0.05	0.64	0.04	0.70	0.03	0.80	0.00	1.00	0.13
I_3	0.18	0.75	0.71	0.00	0.56	0.21	0.23	0.67	0.34	0.52	0.23	0.68	0.26	0.64	0.00	1.00	0.71
I_4	–	–	0.06	1.00	–	–	0.04	0.67	–	–	–	–	–	–	–	–	0.06
I_5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
I_6	1.54E-03	0.37	–	–	–	–	4.15E-03	1.00	1.70E-03	0.41	–	–	5.30E-04	0.13	1.90E-03	0.46	0.004
I_7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
I_8	0.00	1.00	–		–		1.10E-08	0.70	–		1.89E-08	0.48	3,65E-08	0.00	0.00	1.00	3.65E-8
I_9	3.90	0.81	18.56	0.07	8.34	0.58	20.00	0.00	13.50	0.33	5.15	0.74	2.00	0.90	0.00	1.00	20
I_{10}	0.04	0.00	–	–	–	–	–	–	–	–	–	–	–	–	0.00	1.00	0.04
I_{11}	0.57	0.00	0.50	0.13	0.34	0.41	0.43	0.25	0.40	0.30	0.54	0.06	–	–	0.00	1.00	0.57
I_{12}	–	–	2.32E-06	0.01	–	–	–	–	2.80E-04	1.00	–	–	–	–	1.00	–	2.81E-4
I_{13}	0.31	0.61	0.11	0.22	0.36	0.73	0.29	0.58	0.17	0.33	–	–	0.20	0.40	0.33	0.67	0.5
I_{14}	0.68	0.68	0.80	0.80	0.26	0.26	0.58	0.58	0.65	0.65	0.95	0.95	0.69	0.69	0.40	0.40	0.5
I_{15}	0.04	1.00	0.03	0.85	–	–	–	–	0.03	0.85	0.03	0.85		–	0.00	0.00	0.04
I_{16}	0.95	0.95	–	–	–	–	–	–	–	–	–	–	–	–	0.91	0.91	1
I_{17}	–	–	–	–	–	–	28.83	0.00	–	–	–	–	–	–	1.24	0.96	28.83
I_{18}	840.32	1.00	513.10	0.61	233.54	0.28	–	–	–	–	–	–	–	–	–	–	840.32
I_{19}	3.19E-04	0.67	4.75E-04	1.00	–	–	–	–	3.90E-04	0.82	–	–	–	–	–	–	4.75E-4
I_{20}	2.76E-02	1.00	1.58E-03	0.06	3.61E-03	0.13	4.09E-03	0.15	2.00E-03	0.07	2.97E-03	0.11	3.13E-03	0.11	0.00	0.00	2.7E-2

Notes: *R*: real value (extracted from GRI reports); *N*: normalized value through Eqs. (2) or (3).

Table 10
Indicator values for Company 1.

Indicators	Values		
I_1	1.00		
I_2	0.63		
I_3	0.75		
I_4	0.00	0.50	1.00
I_5	0.00	0.50	1.00
I_6	0.37		
I_7	0.00	1.00	
I_8	0.00	0.50	1.00
I_9	0.81		
I_{10}	0.00		
I_{11}	0.00		
I_{12}	0.00	0.50	1.00
I_{13}	0.61		
I_{14}	0.68		
I_{15}	1.00		
I_{16}	0.95		
I_{17}	0.00	0.50	1.00
I_{18}	1.00		
I_{19}	0.67		
I_{20}	1.00		

The remaining companies exhibit a similar distribution of performance. These are large companies, except for Company 8, a small to medium-sized enterprise. Fig. 4 presents equivalent performance for these companies; thus, the method is valid to compare corporate social responsibility performance for construction companies, regardless of their size.

6. Discussion

The inclusion of social criteria in procurement procedures leads to critical benefits (Chang et al., 2017; Sierra et al., 2018a). It forces organizations to compete on social capabilities added to the economic, environmental, and technical features (Goel et al., 2020a; Luthra et al., 2017; Rohman et al., 2017). Companies concerned about their social performance attract and retain dedicated employees and have more loyal customers, achieving higher financial performance and creating value for their shareholders and other stakeholders in the long term (Dočekalová and Kocmanová, 2016; Doloi, 2012; Goel et al., 2020b; Murphy and Eadie, 2019). It allows laying out the needs and priorities identified by the procurer so that companies interested in participating in the procurement procedure can appropriately account for cost, risks, or staffing requirements (NCHRP, 2015a).

However, when these requirements are needed for a project, the project team makes the selection and definitions without guidance or a standardized and transparent decision process (Montalbán-Domingo et al., 2019, 2020; Troje and Gluch, 2020). Therefore, a holistic method to guide procurers on the inclusion of social criteria in procurement procedures is necessary (Ruparathna and Hewage, 2015). Thus, a collaboration with experts is essential to define the factors and indicators to assess social performance for construction companies (Dong and Ng, 2015) because social sustainability is a multidimensional concept with complex implications (Yu et al., 2017). Thus, deciding what social criteria should be considered in the construction stage of civil engineering projects based solely on the previous literature could be limited by the individual bias of the researchers (Valdes-Vazquez and Klotz, 2010). Therefore, experts' participation provides robustness to the method by defining quantitative or semi-quantitative, reliable, and verifiable indicators (Tsalis et al., 2017). This participation is a critical aspect of guaranteeing a fair, transparent, and objective competition and defining indicators whose data can be audited and verified by the procurer (Schöttle and Arroyo, 2017).

The method of assessing social sustainability in procurement emerges from the consideration of three organizational levels: project, company, and country (Pellicer et al., 2013) because the individual level

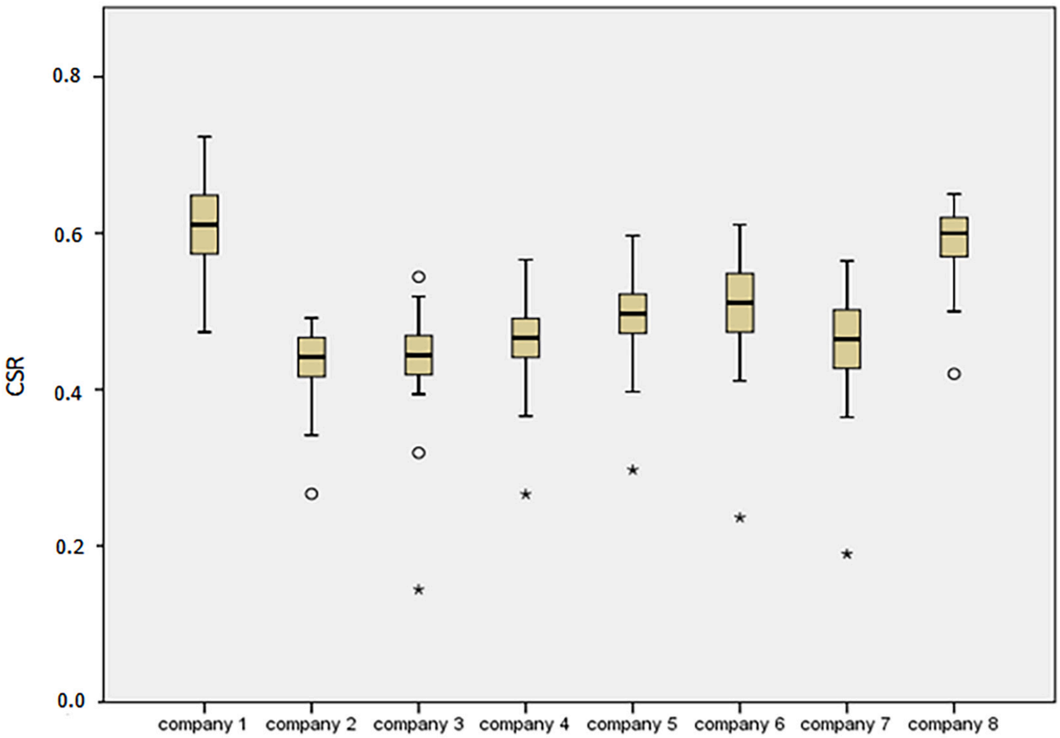

Fig. 4. Corporate social responsibility performance.

is achieved through the other three levels. At the country level, factors related to human rights are included. The protection of human rights through public contracts is just starting and needs to gain traction as a critical area of procurement policy and practical application by EU member states (IHRB, 2015; Sanchez-Graells, 2018). Additionally, each country's legislation may already cover many human rights factors, and the application of the law may be excellent (UNEP, 2009). Therefore, to guarantee that every procurement procedure considers requirements related to human rights and ensure that every involved construction company knows and complies with the human rights factors, a signed human rights declaration must be requested to be declared suitable for assessment in any public-works bid.

The use of project and company organizational levels allows adjusting the method to the construction industry in general and the specificities of public-works procurement, considering that: (1) the inclusion of social aspects in procurement must be addressed according to the country constraints (Montalbán-Domingo et al., 2018); (2) companies in the construction industry work and are managed by projects (Goel et al., 2020a; Yepes et al., 2012); (3) the social performance of companies must be part of business management (Dočekalová and Kocmanová, 2016; Goel et al., 2020a) involving the entire company to guarantee the correct attitude to raise their overall awareness (Krajnc and Glavič, 2004). Therefore, the study outcome reveals that a method can be outlined to assess social sustainability in public-works procurement of civil engineering construction projects.

The method proposes two aggregation formulas to assess the main social criteria that must be considered in the construction industry (Montalbán-Domingo et al., 2018) to compare the social performance of construction companies in specific contexts (Dong and Ng, 2015). These aggregation formulas represent a step toward the social assessment of construction companies and the construction industry overall (Glass, 2012; Montalbán-Domingo et al., 2020). This fact is highly relevant considering that the social dimension currently attracts insufficient attention in public procurement (Montalbán-Domingo et al., 2019; Murphy and Eadie, 2019). Moreover, no methods exist to evaluate social performance in this industry (Dong and Ng, 2015; Troje and Gluch, 2020). In addition, the definition of social indicators and aggregation formulas enables assessing and monitoring performance, benchmarking, identifying trends, and setting social policy priorities (Tokos et al., 2012).

Finally, in public-works procurement, three types of assessment criteria can be used to choose the winning tender (European Commission, 2018; Montalbán-Domingo et al., 2019): (1) exclusion grounds to exclude unsuitable bidders from the procurement procedure; (2) selection criteria to determine the suitability of tenderers to carry out the contract, and (3) award criteria to determine which tenderer developed the most economically advantageous proposal that delivers the expected results and should be awarded the contract.

According to the award criteria, two main procurement procedures can be differentiated (European Commission, 2018; Molenaar and Johnson, 2003): the low bid and the best value. The low bid is used to maximize savings and is based on the price or cost only as award criteria, whereas the best value is usually proposed for complex projects, in which the expertise of the construction company, among other aspects, is critical to guaranteeing project success (Ballesteros-Pérez et al., 2016). The best value is based on the best price-to-quality ratio, using qualifications, quality, and design alternate parameters, among others, to choose the best tenderer (NCHRP, 2006).

Regarding the inclusion of social criteria as assessment criteria in procurement procedures, factors related to human rights (country level) must be included as exclusion grounds in the procurement procedures of civil engineering construction projects. Thus, procurers exclude bidders due to noncompliance with social or labor law obligations. The aggregation formula to assess corporate social responsibility (company level) must be included as selection criteria regardless of the procurement procedure, selecting those candidates with the best performance or minimum performance depending on the procurer's minimum threshold (Brammer and Walker, 2011). Additionally, the social commitment in a project (project level) must be considered to be award criteria in best-value procurement procedures or selection criteria in low bids (Palmujoki et al., 2010). This consideration makes the method adaptable to the procurement procedure requirements, depending on the local constraints (Goel et al., 2020b; UNEP, 2009) and project features (Sierra et al., 2017a, 2017b; Yu et al., 2017).

7. Conclusions

This paper proposes an integrated method for assessing social sustainability in public-works procurement. Two formulas were defined to assess the offerors' social commitment in a project and their corporate social responsibility. Regarding the assessment of social commitment in a project, semi-quantitative indicators were defined, and a weighting procedure was designed to assign the importance level of each indicator, depending on the project characteristics. The procedure adapts to project characteristics, guaranteeing the minimum weight for each indicator, depending on the relationships between the indicators and project characteristics. An expert panel validated quantitative indicators to assess the corporate social responsibility of bidders. Benchmarks were extracted from GRI reports to normalize the indicators, and the weighting procedure was based on assigning equal weights. The results of the indicators and aggregation formula demonstrate the method's ability to compare construction companies regardless of company size.

Regarding the study limitations, the aggregation formulas capture most key social criteria for the construction industry. However, the method was designed for application to public-works procurement using the design-bid-build method during the construction stage of civil engineering projects. Therefore, specific research should be performed to apply the formulas in the social assessment of various stages of the infrastructure life cycle.

Future research is needed to perform a reflective observation of the corporate social responsibility of construction companies to adjust indicators to the industry needs in each country. Additionally, industry-based national indices could be defined to assess the social performance of the construction industry. The weights for corporate social responsibility could be defined depending on the social weaknesses in each country.

Finally, data from the GRI reports on Spanish construction companies were collected to perform a sensitivity analysis of the corporate social responsibility group. In the social commitment at the project level, all project scenarios were assessed in the sensitivity analysis. However, this research does not extend the proposed method to a specific real case study. In future research, this extension could provide insight for validating and improving the methodology.

Author statement

This paper represents a result of teamwork. All of the authors jointly worked on the conceptualization, methodology, results, and discussion. Laura Montalbán-Domingo, Tatiana García-Segura, and Amalia Sanz jointly drafted the manuscript. Finally, Eugenio Pellicer reviewed and edited the manuscript. All authors have read and agreed to the published version of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors acknowledge the financial support of the Valencian Regional Government (Project No. 05TUI/2020/126904) and the Spanish Ministry of Economy and Competitiveness, along with the European Regional Development Fund (Project No. BIA2017-85098-R). The authors are grateful to the expert panel for their participation in this research.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eiar.2021.106581.

References

Abdel-Raheem, M., Ramsbottom, C., 2016. Factors affecting social sustainability in highway projects in Missouri. Procedia Eng. 145, 548–555. https://doi.org/10.1016/j.proeng.2016.04.043.

Adetunji, I., Price, A., Fleming, P., Kemp, P., 2003. Sustainability and the UK construction industry—a review. Proc. Inst. Civ. Eng. - Eng. Sustain. 156, 185–199. https://doi.org/10.1680/ensu.2003.156.4.185.

Afzal, F., Lim, B., Prasad, D., 2017. An investigation of corporate approaches to sustainability in the construction industry. Procedia Eng. 180, 202–210. https://doi.org/10.1016/j.proeng.2017.04.179.

AG, 2001. Australian Industry Participation National Framework. Australian Government. Department of Industry, Innovation and Science.

Almahmoud, E., Doloi, H.K., 2018. Assessment of social sustainability in construction projects using social network analysis. J. Int. Bus. Res. Mark. 3, 35–46. https://doi.org/10.18775/jibrm.1849-8558.2015.21.3003.

Alshubbak, A., Pellicer, E., Catalá, J., Teixeira, J., 2015. A model for identifying owner's needs in the building life cycle. Journal of Civil Engineering and Management 21 (8), 1046–1060. https://doi.org/10.3846/13923730.2015.1027257.

Azapagic, A., Perdan, S., 2000. Indicators of sustainable development for industry: a general framework. Process. Saf. Environ. Prot. 78, 243–261. https://doi.org/10.1205/095758200530763.

Ballesteros-Pérez, P., Skitmore, M., Pellicer, E., Zhang, X., 2016. Scoring rules and competitive behavior in best-value construction auctions. J. Constr. Eng. Manag. 142 https://doi.org/10.1061/(asce)co.1943-7862.0001144, 04016035.

Barraket, J., Weissman, J., 2009. Social Procurement and its Implications for Social Enterprise: A Literature Review, [Working Paper No. CPNS48]. The Australian Centre for Philanthropy and Nonprofit Studies, Brisbane, Australia.

Benoît, C., Norris, G.A., Valdivia, S., Ciroth, A., Moberg, A., Bos, U., Prakash, S., Ugaya, C., Beck, T., 2010. The guidelines for social life cycle assessment of products: just in time. Int. J. Life Cycle Assess. 15, 156–163. https://doi.org/10.1007/s11367-009-0147-8.

Berry, C., Shaun, Mccarthy, 2011. Guide to sustainable procurement in construction. In: CIRIA report. CIRIA, London.

Brammer, S., Walker, H., 2011. Sustainable procurement in the public sector: an international comparative study. Int. J. Oper. Prod. Manag. 31, 452–476. https://doi.org/10.1108/01443571111119551.

Bratt, C., Hallstedt, S., Robèrt, K.-H., Broman, G., Oldmark, J., 2013. Assessment of criteria development for public procurement from a strategic sustainability perspective. J. Clean. Prod. 52, 309–316. https://doi.org/10.1016/j.jclepro.2013.02.007.

Broesterhuizen, E., Vellinga, T., Taneja, P., van Leeuwen, L.D., 2014. Sustainable procurement for port infrastructure projects. In: Springer, C., Gheorghe, A., Masera, M., Katina, P. (Eds.), Infranomics. Topics in Safety, Risk, Reliability and Quality, pp. 11–26. https://doi.org/10.1007/978-3-319-02493-6.

Brown, K., Furneaux, C., Gudmundsson, A., 2012. Infrastructure transitions towards sustainability: a complex adaptive systems perspective. Int. J. Sustain. Dev. 15, 54–71. https://doi.org/10.1504/IJSD.2012.044034.

Brüggen, E., Willems, P., 2009. A critical comparison of offline focus groups, online focus groups and e-Delphi. Int. J. Mark. Res. 51, 363–381. https://doi.org/10.2501/S1470785309200608.

Bueno, P.C., Vassallo, J.M., Cheung, K., 2015. Sustainability assessment of transport infrastructure projects: a review of existing tools and methods. Transp. Rev. 35, 622–649. https://doi.org/10.1080/01441647.2015.1041435.

Burke, C., King, A., 2015. Generating social value through public sector construction procurement: A study of local authorities and SMEs. In: Procs 31st Annu. ARCOM Conf. 7–9 Sept. 2015. Assoc. Res. Constr. Manag, Lincoln, UK, pp. 387–396.

CEEQUAL, 2010. The Assessment and Awards Scheme for Improving Sustainability in Civil Engineering and the Public Realm. CEEQUAL Ltd, The United Kingdom.

CEEQUAL, 2019. CEEQUAL. Version 6. Technical Manual. International Projects. CEEQUAL Ltd, The United Kingdom.

Chang, R.-D., Zuo, J., Soebarto, V., Zhao, Z.-Y., Zillante, G., 2017. Dynamic interactions between sustainability and competitiveness in construction firms: a transition perspective. Eng. Constr. Archit. Manag. 24, 842–859. https://doi.org/10.1108/ECAM-01-2016-0025.

Claeson-Jonsson, C., Sebastian, R., Di Giulio, R., Pasquale, A., Meertins, D., 2013. Performance-Based Procurement Method for Urban Infrastructure - Appendix C: Decision Making from the contractor's Side: Case Study Rotebro (Pantura Project).

Clevenger, C.M., Ozbek, M.E., Simpson, S.P., Atadero, R., 2016. Challenges in developing a transportation sustainability rating system that meets the preferences of a department of transportation. J. Transp. Eng. 142 https://doi.org/10.1061/(ASCE)TE.1943-5436.0000830, 04016005.

Cook, D., Saviolidis, N.M., Davíðsdóttir, B., Jóhannsdóttir, L., Ólafsson, S., 2017. Measuring countries' environmental sustainability performance—the development of a nation-specific indicator set. Ecol. Indic. 74, 463–478. https://doi.org/10.1016/j.ecolind.2016.12.009.

do Carmo, B.B.T., Margni, M., Baptiste, P., 2017. Customized scoring and weighting approaches for quantifying and aggregating results in social life cycle impact

assessment. Int. J. Life Cycle Assess. 22, 2007–2017. https://doi.org/10.1007/s11367-017-1280-4.
Dočekalová, M.P., Kocmanová, A., 2016. Composite indicator for measuring corporate sustainability. Ecol. Indic. 61, 612–623. https://doi.org/10.1016/j.ecolind.2015.10.012.
Dolla, T., Laishram, B., 2020. Enhancing sustainability in public-private partnership projects through bid selection model. Transp. Res. Procedia 48, 3896–3907. https://doi.org/10.1016/j.trpro.2020.08.031.
Doloi, H., 2012. Assessing stakeholders' influence on social performance of infrastructure projects. Facilities 30, 531–550. https://doi.org/10.1108/02632771211252351.
Domínguez-Rodrigo, M., Cobo-Sánchez, L., Uribelarrea, D., Arriaza, M.C., Yravedra, J., Gidna, A., Organista, E., Sistiaga, A., Martín-Perea, D., Baquedano, E., Aramendi, J., Mabulla, A., 2017. Spatial simulation and modelling of the early Pleistocene site of DS (Bed I, Olduvai Gorge, Tanzania): a powerful tool for predicting potential archaeological information from unexcavated areas. Boreas 46, 805–815. https://doi.org/10.1111/bor.12252.
Dong, Y.H., Ng, S.T., 2015. A social life cycle assessment model for building construction in Hong Kong. Int. J. Life Cycle Assess. 20, 1166–1180. https://doi.org/10.1007/s11367-015-0908-5.
Eizenberg, E., Jabareen, Y., 2017. Social sustainability: a new conceptual framework. Sustainability 9, 68. https://doi.org/10.3390/su9010068.
Ek, K., Mathern, A., Rempling, R., Rosén, L., Claeson-Jonsson, C., Brinkhoff, P., Norin, M., 2019. Multi-criteria decision analysis methods to support sustainable infrastructure construction. In: IABSE Symp. Guimaraes 2019 Towar. A Resilient Built Environ. Risk Asset Manag. - March 27–29, 2019, Guimaraes, Port.
European Comission, 2016. Strategic Engagement for Gender Equailty 2016-2019. Publications Office of the European Union, Luxembourg. https://doi.org/10.2838/722771.
European Commision, 2014. Recommendation on strengthening the principle of equal pay between men and women through transparency (2014/124/EU). Off. J. Eur. Union.
European Commission, 2018. Public Procurement Guidance for Practitioners. Publications Office of the European Union, Luxembourg. https://doi.org/10.2776/461701.
Fan, L., Pang, B., Zhang, Y., Zhang, X., Sun, Y., Wang, Y., 2016. Evaluation for social and humanity demand on green residential districts in China based on SLCA. Int. J. Life Cycle Assess. 23, 640–650. https://doi.org/10.1007/s11367-016-1166-x.
FHWA, 2012. INVEST - Sustainable Highways Self-Evaluation Tool. U.S. Department of Transportation, Federal Highway Administration.
Gade, A.N., Opoku, A., 7-8 Sept. 2020. Challenges for implementing the sustainable development goals in the Danish construction industry: Building owners' perspective. In: Scott, L., Neilson, C.J. (Eds.), Proc. 36th Annu. ARCOM Conf. Assoc. Res. Constr. Manag., UK, pp. 615–624.
Garrido, S.R., Parent, J., Beaulieu, L., Revéret, J.-P., 2018. A literature review of type I SLCA—making the logic underlying methodological choices explicit. Int. J. Life Cycle Assess. 23, 432–444. https://doi.org/10.1007/s11367-016-1067-z.
Glass, J., 2012. The state of sustainability reporting in the construction sector. Smart Sustain. Built Environ. 1, 87–104. https://doi.org/10.1108/20466091211227070.
Goel, A., Ganesh, L.S., Kaur, A., 2020a. Benefits formulation in construction projects: an exploratory study through a social sustainability perspective. IIM Kozhikode Soc. Manag. Rev. 9, 162–176. https://doi.org/10.1177/2277975219896510.
Goel, A., Ganesh, L.S., Kaur, A., 2020b. Social sustainability considerations in construction project feasibility study: a stakeholder salience perspective. Eng. Constr. Archit. Manag. 27, 1429–1459. https://doi.org/10.1108/ECAM-06-2019-0319.
GRI, 2015. G4 sustainability reporting guidelines. Reporting principles and standard disclosures. In: Global Reporting Initiative. Global Reporting Initiative, Amsterdam, the Netherlands.
GRI, 2016a. GRI 401: Employment. Global Reporting Initiative, Amsterdam, the Netherlands.
GRI, 2016b. GRI 406: Non-Discrimination. Global Reporting Initiative, Amsterdam, the Netherlands.
GRI, 2016c. GRI 404: Training and Education. Global Reporting Initiative, Amsterdam, the Netherlands.
GRI, 2016d. GRI 412: Human Rights Assessment. Global Reporting Initiative, Amsterdam, the Netherlands.
GRI, 2018. GRI 403: Occupational Health and Safety. Global Reporting Initiative, Amsterdam, the Netherlands.
Griffiths, K.A., Boyle, C., Henning, T., 2015. Infrastructure sustainability rating tools – How they have developed and what we might expect to see in the future. In: IPWEA 2015: Sustainable Communities Sharing Knowldge, 7–11 Jun 2015. Rotorua, New Zealand.
Griffiths, K.A., Boyle, C., Henning, T.F.P., 2017. Comparative assessment of infrastructure sustainability rating tools. In: Transportation Research Board 96th Annual Meeting, 8–12 January 2017. Washington.
Hallowell, M.R., Gambatese, J.A., 2010. Qualitative research: application of the delphi method to CEM research. J. Constr. Eng. Manag. 136, 99–107.
Hossain, M.U., Poon, C.S., Dong, Y.H., Lo, I.M., Cheng, J.C., 2018. Development of social sustainability assessment method and a comparative case study on assessing recycled construction materials. Int. J. Life Cycle Assess. 23, 1654–1674. https://doi.org/10.1007/s11367-017-1373-0.
Hosseinijou, S.A., Mansour, S., Shirazi, M.A., 2014. Social life cycle assessment for material selection: a case study of building materials. Int. J. Life Cycle Assess. 19, 620–645. https://doi.org/10.1007/s11367-013-0658-1.
IDOT, 2012. I-LAST. llinois-Livable and Sustainable Transportation Rating System and Guide. Illlinois Department of Transportation (IDOT), Illinois.
IHRB, 2015. Protecting Rights by Purchasing Right: The Human Rights Provisions, Opportunities and Limitations under the 2014 EU Public Procurement Directives. Institute for Human Rights and Business (IHRB), London.
ISI, 2015. ENVISION Rating System for Sustainable Infrastructure. Institute for Sustainable Infrastructure, Washington.
Joint Research Centre-European Commission, 2008. Handbook on Contructing Composite Indicators: Methodology and User Guide. Joint Research Centre (JRC) of the European Commission. OECD publishing. https://doi.org/10.1787/9789264043466-en.
Kadam, D.D., Devalkar, R.V., 2016. Construction industry survey and study the sustainable public procurement. Int. J. Res. Eng. Technol. 5, 106–109.
Kraft, E., Molenaar, K.R., 2015. Quality assurance organization selection factors for highway design and construction projects. J. Manag. Eng. 31, 04014069 https://doi.org/10.1061/(ASCE)ME.1943-5479.0000289.
Krajnc, D., Glavič, P., 2004. Indicators of Sustainable Production. Technological Choices for Sustainability. Springer, Berlin, Heidelberg. https://doi.org/10.1007/s10098-003-0221-z.
Krajnc, D., Glavič, P., 2005. A model for integrated assessment of sustainable development. Resour. Conserv. Recycl. 43, 189–208. https://doi.org/10.1016/j.resconrec.2004.06.002.
Landorf, C., 2011. Evaluating social sustainability in historic urban environments. Int. J. Herit. Stud. 17, 463–477. https://doi.org/10.1080/13527258.2011.563788.
Lee, K.-H., Saen, R.F., 2012. Measuring corporate sustainability management: a data envelopment analysis approach. Int. J. Prod. Econ. 140, 219–226. https://doi.org/10.1016/j.ijpe.2011.08.024.
Lim, S.K., 2009. Framework and Processes for Enhancing Sustainability Deliverables in Australian Road Infrastructure Projects. Ph.D. thesis. Queensland University of Technology, Brisbane.
Lines, B., Miao, F., 2016. Writing more competitive proposals: Content analysis of selected (and unselected) construction contractor technical proposals. In: Construction Research Congress 2016, 31 May - 2 June 2016. San Juan, Puerto Rico, pp. 457–466.
Lingard, H., Oswald, D., Le, T., 2019. Embedding occupational health and safety in the procurement and management of infrastructure projects: institutional logics at play in the context of new public management. Constr. Manag. Econ. 37, 567–583. https://doi.org/10.1080/01446193.2018.1551617.
Loosemore, M., 2016. Social procurement in UK construction projects. Int. J. Proj. Manag. 34, 133–144. https://doi.org/10.1016/j.ijproman.2015.10.005.
Lu, Y., Zhang, X., 2016. Corporate sustainability for architecture engineering and construction (AEC) organizations: framework, transition and implication strategies. Ecol. Indic. 61, 911–922. https://doi.org/10.1016/j.ecolind.2015.10.046.
Luthra, S., Govindan, K., Kannan, D., Mangla, S.K., Garg, C.P., 2017. An integrated framework for sustainable supplier selection and evaluation in supply chains. J. Clean. Prod. 140, 1686–1698. https://doi.org/10.1016/j.jclepro.2016.09.078.
Mansell, P., Philbin, S.P., Konstantinou, E., 2020. Delivering UN sustainable development goals' impact on infrastructure projects: an empirical study of senior executives in the UK construction sector. Sustainability 12, 1–29. https://doi.org/10.3390/su12197998.
Migliaccio, G.C., Bogus, S.M., Cordova-Alvidrez, A.A., 2014. Continuous quality improvement techniques for data collection in asset management systems. J. Constr. Eng. Manag. 140 https://doi.org/10.1061/(ASCE)CO.1943-7862.0000427. B4013008.
Molenaar, K.R., Johnson, D.E., 2003. Engineering the procurement phase to achieve best value. Leadersh. Manag. Eng. 3, 137–141. https://doi.org/10.1061/(ASCE)1532-6748(2003)3:3(137).
Mollaoglu-Korkmaz, S., Swarup, L., Riley, D., 2013. Delivering sustainable, high-performance buildings: influence of project delivery methods on integration and project outcomes. J. Manag. Eng. 29, 71–78. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000114.
Montalbán-Domingo, L., García-Segura, T., Sanz, M.A., Pellicer, E., 2018. Social sustainability criteria in public-works procurement: an international perspective. J. Clean. Prod. 198, 1355–1371. https://doi.org/10.1016/j.jclepro.2018.07.083.
Montalbán-Domingo, L., García-Segura, T., Sanz, M.A., Pellicer, E., 2019. Social sustainability in delivery and procurement of public construction contracts. J. Manag. Eng. 35 https://doi.org/10.1061/(asce)me.1943-5479.0000674, 04018065.
Montalbán-Domingo, L., Aguilar-Morocho, M., García-Segura, T., Pellicer, E., 2020. Study of social and environmental needs for the selection of sustainable criteria in the procurement of public works. Sustainability 12, 7756. https://doi.org/10.3390/SU12187756.
Morgan, D.L., 1997. Focus Group as Qualitative Research. SAGE Publications, Inc., California https://doi.org/10.4135/9781412984287.
Moser, G., 2009. Quality of life and sustainability: toward person-environment congruity. J. Environ. Psychol. 29, 351–357. https://doi.org/10.1016/j.jenvp.2009.02.002.
Muench, S.T., Anderson, J., Hatfield, J., Koester, J., Söderlund, M., 2011. Greenroads Manual v1. 5. University of Washington, Seattle, WA.
Muench, S.T., Kosonen, H., Veeravigrom, M., Yamaura, J., Lew, J., 2016. Quantifying the sustainability scope of roadway sustainability rating systems. In: Transportation Research Board 95th Annual Meeting, 10–14 January 2016. Washington DC, the USA.
Murphy, M., Eadie, R., 2019. Socially responsible procurement: a service innovation for generating employment in construction. Built Environ. Proj. Asset Manag. https://doi.org/10.1108/BEPAM-02-2018-0049.
Naoum, S.G., Egbu, C., 2016. Modern selection criteria for procurement methods in construction: a state-of- the-art literature review and a survey. Int. J. Manag. Proj. Bus. 9, 309–336. https://doi.org/10.1108/IJMPB-09-2015-0094.

Navarro, I.J., Yepes, V., Martí, J.V., 2018. Social life cycle assessment of concrete bridge decks exposed to aggressive environments. Environ. Impact Assess. Rev. 72, 50–63. https://doi.org/10.1016/j.eiar.2018.05.003.

NCHRP, 2006. Best-value procurement methods for highway construction projects. In: NCHRP Report 561, Best-Value Procurement Methods for Highway Construction Projects. National Academies of Sciences, Engineering, and Medicine, Washington DC, USA. https://doi.org/10.17226/13982.

NCHRP, 2015a. Alternative Quality Management Systems for Highway Construction. National Academies of Sciences, Engineering, and Medicine, Washington DC, USA. https://doi.org/10.17226/22127.

NCHRP, 2015b. Guidebook on Alternative Quality Management Systems for Highway Construction. The National Academies Press. National Academies of Sciences, Engineering, and Medicine, Washington DC, USA, Washington, DC. https://doi.org/10.17226/22128.

Nijaki, L.K., Worrel, G., 2012. Procurement for sustainable local economic development. Int. J. Public Sect. Manag. 25, 133–153. https://doi.org/10.1108/09513551211223785.

Nikolaou, I.E., Tsalis, T.A., Evangelinos, K.I., 2019. A framework to measure corporate sustainability performance: a strong sustainability-based view of firm. Sustain. Prod. Consum. 18, 1–18. https://doi.org/10.1016/j.spc.2018.10.004.

NTG, 2019. Building Northern Territory Industry Participation Policy. Northern Territory Government. Department of Business.

Opher, T., Shapira, A., Friedler, E., 2017. A comparative social life cycle assessment of urban domestic water reuse alternatives. Int. J. Life Cycle Assess. 23, 1315–1330. https://doi.org/10.1007/s11367-017-1356-1.

Palmujoki, A., Parikka-alhola, K., Ekroos, A., 2010. Green public procurement: Analysis on the use of environmental criteria in contracts. In: Rev. Eur. Community & Int. Environ. Law, 19, pp. 250–262.

Park, J., Ojiako, U., Williams, T., Chipulu, M., Marshall, A., 2015. Practical tool for assessing best value at the procurement stage of public building projects in Korea. J. Manag. Eng. 31 https://doi.org/10.1061/(ASCE)ME.1943-5479.0000337, 06014005.

Pellicer, E., Yepes, V., Ortega, A.J., 2013. Method for planning graduate programs in construction management. J. Prof. Issues Eng. Educ. Pract. 139, 33–41. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000120.

Pellicer, E., Sanz, M.A., Esmaeili, B., Molenaar, K.R., 2016. Exploration of team integration in spanish multifamily residential building construction. J. Manag. Eng. 32 https://doi.org/10.1061/(ASCE)ME.1943-5479.0000438, 05016012.

Pocock, J., Steckler, C., Hanzalova, B., 2016. Improving socially sustainable design and construction in developing countries. Procedia Eng. 145, 288–295. https://doi.org/10.1016/j.proeng.2016.04.076.

Popovic, T., Barbosa-Póvoa, A., Kraslawski, A., Carvalho, A., 2018. Quantitative indicators for social sustainability assessment of supply chains. J. Clean. Prod. 180, 748–768. https://doi.org/10.1016/j.jclepro.2018.01.142.

Rahdari, A.H., Rostamy, A.A.A., 2015. Designing a general set of sustainability indicators at the corporate level. J. Clean. Prod. 108, 757–771. https://doi.org/10.1016/j.jclepro.2015.05.108.

Roca, L.C., Searcy, C., 2012. An analysis of indicators disclosed in corporate sustainability reports. J. Clean. Prod. 20, 103–118. https://doi.org/10.1016/j.jclepro.2011.08.002.

Rohman, M.A., Doloi, H., Heywood, C.A., 2017. Success criteria of toll road projects from a community societal perspective. Built Environ. Proj. Asset Manag. 7, 32–44. https://doi.org/10.1108/BEPAM-12-2015-0073.

Rosén, L., Back, P.E., Söderqvist, T., Norrman, J., Brinkhoff, P., Norberg, T., Volchko, Y., Norin, M., Bergknut, M., Döberl, G., 2015. SCORE: a novel multi-criteria decision analysis approach to assessing the sustainability of contaminated land remediation. Sci. Total Environ. 511, 621–638. https://doi.org/10.1016/j.scitotenv.2014.12.058.

Ruparathna, R., Hewage, K., 2015. Sustainable procurement in the Canadian construction industry : current practices, drivers and opportunities. J. Clean. Prod. 109, 305–314. https://doi.org/10.1016/j.jclepro.2015.07.007.

Sanchez-Graells, A., 2018. Public procurement and 'core' human rights: A sketch of the EU legal framework. In: Public Procurement and Human Rights. Edward Elgar Publishing, Cheltenham, UK.

SASB, 2018. Engineering & Construction Services-Infrastructure Sector. Sustainability Accounting Standards Board (SASB), San Francisco, CA.

Schmidt-Traub, G., 2015. Investment Needs to Achieve the Sustainable Development Goals Understanding the Billions and Trillions (SDSN Working Paper).

Schöttle, A., Arroyo, P., 2017. Comparison of weighting-rating-calculating, best value, and choosing by advantages for bidder selection. J. Constr. Eng. Manag. 143 https://doi.org/10.1061/(ASCE)CO.1943-7862.0001342, 05017015.

Shen, L., Tam, V.W.Y., Tam, L., Ji, Y. bo, 2010. Project feasibility study: the key to successful implementation of sustainable and socially responsible construction management practice. J. Clean. Prod. 18, 254–259. https://doi.org/10.1016/j.jclepro.2009.10.014.

Sierra, L.A., Pellicer, E., Yepes, V., 2016. Social sustainability in the lifecycle of chilean public infrastructure. J. Constr. Eng. Manag. 142 https://doi.org/10.1061/(ASCE)CO.1943-7862.0001099, 05015020.

Sierra, L.A., Pellicer, E., Yepes, V., 2017a. Method for estimating the social sustainability of infrastructure projects. Environ. Impact Assess. Rev. 65, 41–53. https://doi.org/10.1016/j.eiar.2017.02.004.

Sierra, L.A., Yepes, V., Pellicer, E., 2017b. Assessing the social sustainability contribution of an infrastructure project under conditions of uncertainty. Environ. Impact Assess. Rev. 67, 61–72. https://doi.org/10.1016/j.eiar.2017.08.003.

Sierra, L.A., Yepes, V., García-Segura, T., Pellicer, E., 2018a. Bayesian network method for decision-making about the social sustainability of infrastructure projects. J. Clean. Prod. 176, 521–534. https://doi.org/10.1016/j.jclepro.2017.12.140.

Sierra, L.A., Yepes, V., Pellicer, E., 2018b. A review of multi-criteria assessment of the social sustainability of infrastructures. J. Clean. Prod. 187, 496–513. https://doi.org/10.1016/j.jclepro.2018.03.022.

Sowerby, C., Langstraat, J., Harmer, C., Folkeson, L., 2014. SUNRA - a sustainability rating system framework for National Road Administrations. In: Transp. Res. Arena 5th Conf. Transp. Solut. from Res. to Deployment, 14–17 May 2014, Paris, Fr.

Sutherland, V., McTier, A., Glass, A., McGregor, A., 2015. Analysis of the impact and value of community benefit clauses in procurement. In: Training and Employment Research Unit (TERU). University of Glasgow, Glasgow, United Kingdom.

Tokos, H., Pintarič, Z.N., Krajnc, D., 2012. An integrated sustainability performance assessment and benchmarking of breweries. Clean Techn. Environ. Policy 14, 173–193. https://doi.org/10.1007/s10098-011-0390-0.

Troje, D., Gluch, P., 2020. Beyond policies and social washing: how social procurement unfolds in practice. Sustainability 12, 4956. https://doi.org/10.3390/su12124956.

Tsalis, T., Avramidou, A., Nikolaou, I.E., 2017. A social LCA framework to assess the corporate social profile of companies: insights from a case study. J. Clean. Prod. 164, 1665–1676. https://doi.org/10.1016/j.jclepro.2017.07.003.

Ugwu, O.O., Haupt, T.C., 2007. Key performance indicators and assessment methods for infrastructure sustainability—a south African construction industry perspective. Build. Environ. 42, 665–680. https://doi.org/10.1016/j.buildenv.2005.10.018.

UNEP, 2009. Guidelines for Social Life Cycle Assessment of Products. United Nations Environment Programme, Paris, France https://doi.org/DTI/1164/PA.

United Nations, 2008. Guidance on Corporate Responsibility Indicators in Annual Reports. United Nations Conference on Trade and Development, New York, USA.

Valdes-Vasquez, R., Klotz, L.E., 2013. Social sustainability considerations during planning and design: framework of processes for construction projects. J. Constr. Eng. Manag. 139, 80–89. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000566.

Valdes-Vazquez, R., Klotz, L., 2010. Considering social dimensions of sustainability during construction project planning and design. In: The International Journal of Environmental Cultural Economic and Social Sustainability Annual Review.

Veleva, V., Ellenbecker, M., 2001. Indicators of sustainable production: framework and methodology. J. Clean. Prod. 9, 519–549. https://doi.org/10.1016/S0959-6526(01)00010-5.

Walker, H., Miemczyk, J., Johnsen, T., Spencer, R., 2012. Sustainable procurement: past, present and future. J. Purch. Supply Manag. 18, 201–206. https://doi.org/10.1016/j.pursup.2012.11.003.

Wang, Y., Han, Q., Vries, B., de Zuo, J., 2016. How the public reacts to social impacts in construction projects? A structural equation modeling study. Int. J. Proj. Manag. 34, 1433–1448. https://doi.org/10.1016/j.ijproman.2016.07.008.

Xenarios, S., Tziritis, I., 2007. Improving pluralism in multi criteria decision aid approach through focus group technique and content analysis. Ecol. Econ. 62, 692–703. https://doi.org/10.1016/j.ecolecon.2006.08.017.

Yepes, V., Pellicer, E., Ortega, A.J., 2012. Designing a benchmark indicator for managerial competences in construction at the graduate level. J. Prof. Issues Eng. Educ. Pract. 138, 48–54. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000075.

Yu, T., Shen, G.Q., Shi, Q., Zheng, H.W., Wang, G., Xu, K., 2017. Evaluating social sustainability of urban housing demolition in Shanghai, China. J. Clean. Prod. 153, 26–40. https://doi.org/10.1016/j.jclepro.2017.03.005.

Zhang, Q., Oo, B.L., Lim, B.T.H., 2020. Corporate social responsibility practices by leading construction firms in China: a case study. Int. J. Constr. Manag. 1–12 https://doi.org/10.1080/15623599.2020.1717107.

Zhou, L., Tokos, H., Krajnc, D., Yang, Y., 2012. Sustainability performance evaluation in industry by composite sustainability index. Clean Techn. Environ. Policy 14, 789–803. https://doi.org/10.1007/s10098-012-0454-9.