Social Sustainability Considerations during Planning and Design: Framework of Processes for Construction Projects

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Abstract: This research identifies 50 processes and categorizes them into a framework for integrating and evaluating social considerations in construction projects. These processes focus on the planning and design phases because they offer the greatest potential for influencing project performance. The concept mapping research method was applied to develop this framework on the basis of input from 25 experts in academia, industry, and government. Multidimensional scaling and hierarchical cluster analyses were used to organize the experts' input into six categories defining social sustainability in construction projects: stakeholder engagement, user considerations, team formation, management considerations, impact assessment, and place context. Although previous research has recognized social sustainability as a series of processes, this study is the first to integrate them into a comprehensive framework. Practitioners can benefit from this framework, which will enhance existing sustainability assessment methods and help address the challenge of developing truly sustainable projects. This framework also provides academics with a tool for introducing students to social sustainability in construction projects. Future research could use this framework as a baseline, developing metrics using the processes included in the framework. **DOI:** 10.1061/(ASCE)CO.1943-7862.0000566.

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Introduction

Since the *Brundtland Report* in 1987, there has been an increasing awareness that the construction industry must support the sustainable development vision by including social considerations throughout the entire construction project life cycle [International Council for Building (CIB) 1999; Vanegas 2003; Trinius and Chevalier 2005; Levitt 2007; Boyle et al. 2010; WCED 1987]. A truly sustainable construction project needs to include not only social considerations for the final users but also considerations such as the project's impact on the surrounding community and the safety, health, and education of the workforce. Integrating these considerations will improve both long-term project performance and the quality of life for those affected by the project.

The definition of social sustainability that guides the research reported in this paper considers this concept as a series of processes for improving the health, safety, and well-being of current and future generations (Mihelcic et al. 2003; Herd-Smith and Fewings 2008; Dillard et al. 2009). Previous research has provided some indicators related to these considerations (Kibert 1994; Hill and Bowen 1997; Guy and Kibert 1998; Pearce 1999; Trinius and Chevalier 2005; Gilchrist and Allouche 2005; Surahyo and El-Diraby 2009). For instance, previous indicators include stakeholder satisfaction, traffic delays, noise levels, indoor air quality, and training of disadvantaged people.

However, an empirical and comprehensive framework defining these social sustainability processes in construction projects has yet to be clearly delineated. To address this challenge, this paper introduces an empirical framework that was developed by engaging experts from various perspectives in the construction industry. To do so, this study adapts a concept mapping research method that integrates idea generation, sorting, and rating tasks with multidimensional and cluster analyses to produce a well-defined quantitative set of conceptual maps (Trochim 1989). Before introducing the framework, the next section provides an overview of social sustainability in construction projects.

Social Sustainability in Construction Projects

Generally, researchers describe social sustainability as the engagement among employees, local communities, clients, and the supply chain to ensure meeting the needs of current and future populations and communities (Herd-Smith and Fewings 2008), a definition that more fully reflects the different perspectives of the stakeholders of a project. As the following discussion shows, the concept of social sustainability has various interpretations in the industry depending on the stakeholder's perspective and the phase of the project life cycle.

One perspective involves the community by estimating the impact of construction projects in relation to where users live, work, play, and engage in cultural activities (Burdge 2004). These estimates are normally embedded in the environmental impact assessments required by government agencies. It is during the planning and design phase that community involvement approaches such as public hearings are used by external stakeholders and governmental agencies to influence design decisions [Shepherd and Bowler 1997;

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Sanoff 2000; U.S. Department of Transportation (USDOT) 2002; Innes and Booher 2004; Solitare 2005]. Community experts indicate that although these social benefits maybe intangible to developers, they are as important as financial and environmental ones (Hammond and Peterson 2007; Hammer 2009).

Another perspective of social sustainability, this one from construction or real-estate firms, relates to the application of corporate social responsibility practices (Lamprinidi and Ringland 2008) that consider how the organization can meet the needs of stakeholders affected by its operations (Kolk 2003; Olander and Ladin 2005; Mathur et al. 2008). Other elements that should be considered include the impact of temporary users such as the workforce and vendors based on the analysis of the social life cycle of products and materials (Benoit and Mazijn 2009). This analysis could predict the performance of the project in terms of time, cost, and the perception of the community.

In addition, social sustainability also relates to such design perspectives required to ensure inclusion by considering underrepresented groups (e.g., accessibility for the elderly and the disabled). For instance, evidence-based design is currently being used to provide a better understanding of human behavior through scientific explanation (Hamilton 2003; Brandt et al. 2010). This design perspective also includes understanding the social interrelations embedded in the process of designing, constructing, and operating construction projects (Rohracher 2001) and improving the decisions-making process by using approaches such as transparency (Kaatz et al. 2005; Klotz et al. 2009). A related perspective involves the designers, government agencies, and construction companies that advocate for worker safety by eliminating potential safety hazards from the work site during the design phase [Gambatese 1998; Hinze and Wilson 2000; Construction Industry Institute (CII) 2002, 2003; Behm 2005; Gambatese et al. 2008; Toole and Gambatese 2008; Schulte et al. 2008].

On the basis of the literature, this research divides social sustainability into four conceptual areas: community involvement emphasizes public constituencies in governmental and private decisions, corporate social responsibility considers the accountability of an organization in caring for all of the stakeholders affected by its operations, safety through design ensures worker safety by eliminating potential construction/operation safety hazards during the design phase, and social design focuses on improving the decision-making process of the design team and the intended use of the project by the final users (Valdes-Vasquez and Klotz 2010). These four conceptual areas helped guide the development of the empirical framework of social sustainability processes in construction projects reported in this paper.

Because the concept of social sustainability is still evolving, this is an important time to begin defining the social sustainability processes that should be integrated during the planning and design phases of construction projects. However, attempting to create a model based solely on the previous literature will be limited by the individual bias of the researchers. The understanding of social sustainability processes could be enhanced by engaging experts in developing a general framework, a critical first step in creating awareness about this topic in construction projects. Specifically, the four conceptual areas served as a base line for inviting experts to be part of this study, for the interpretation of the maps generated, and for the creation of the practical guide resulting from this research.

Research Method

After the review of the previous knowledge on social sustainability, two general phases, each involving multiple steps, were followed to develop the empirical framework: gathering data from experts through the concept mapping method and developing the framework based on the analysis of the results obtained from the concept mapping method. In general, the concept mapping method integrates the structured group tasks of idea generation, sorting, and rating with two-dimensional scaling and cluster analyses to determine a well-defined quantitative set of results as developed by Trochim (1989) and Kane and Trochim (2007), which helped to categorize the social sustainability processes in construction projects in this research.

During the first phase, by using an expert-based approach, 50 processes were identified on the basis of the judgment of the 19 experts who participated in the idea generation step. These experts have experience in one or more of the following areas: construction safety and health, sustainability, community development, construction management, and related research and teaching at the college level.

Next, these preliminary processes generated by experts were evaluated to eliminate as many redundancies as possible, creating a draft list of processes for final selection. Two focus groups reviewed the initial ideas posted by the experts. These groups helped narrow the list of processes through revisions to avoid repetition of the ideas, eliminate conceptual misunderstanding, clarify the language for each process, and provide operational definitions when required. For instance, the focus groups helped to reduce the input from the experts to the 50 processes included in this study as well as suggesting such operational definitions as health impact assessment, social life cycle assessment, partnering, and postoccupancy evaluation. In addition, these focus groups helped eliminate the individual bias of the researcher in the selection of the processes, enhancing the validity of the results. This revision step was important so that the experts could focus their full attention on the subsequent sorting and rating steps. To ensure that each social sustainability process was considered independently of the others, each was given a random number from 1 to 50 as shown in the final list of processes in the Appendix. In addition, the randomization of the processes prevented those with similar meanings from being listed together to minimize influencing the results.

These 50 processes served as units of analysis that were sorted by a total of 16 experts, 10 of whom participated in the idea generation step. Next, these 16 experts rated each social sustainability process on its importance, using a five-point Likert scale. The participants' input during the sorting and rating was obtained using a web-based approach. The qualifications of the 16 experts who completed both the sorting and rating steps are presented in Table 1. This group of experts represents more than 300 years of experience in academia, industry, and government. The majority of the experts focus on several, not just one, conceptual areas of social sustainability and phases of construction projects. In general, these experts were prompted to provide their responses on the basis of what is best for society as a whole rather than what is best for a single group, company, or institution. Experts were encouraged to base their input on their past and current projects.

The second general phase consisted of developing the social sustainability framework. The central decision in interpreting the results was determining the number of clusters and which processes should be included in each. Specifically, the following steps were used: the multidimensional scaling (MDS) analysis of the sorted data, the cluster analysis of the MDS coordinates to determine a final cluster solution, and the selection of the cluster names (Kane and Trochim 2007).

Two quantitative techniques are used in concept mapping to help understand the relationships among concepts. The first is MDS, which was used to assess perceived similarities and

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Table 1. Experts' Qualifications

Criteria	Expert 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bachelor's degree or higher	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
At least five years of professional experience in the construction industry	x	x	x	x	x		x	x	x	x	x		x		x	x
Professor or researcher at an accredited higher education institution or government agency						x	x		x			x	x	x	x	x
Sustainability director or manager in a Top 100 design or contracting Firm	x	x	x	x				x		x						
Member or chair of a sustainability-related committee	x	x	x		x		x				x					
Primary or secondary author of at least two peer-reviewed journal articles on any of the topics covered in the literature review						x			x			x		x	x	
Author or editor of a book or book chapter related to sustainability topics	x				x				x			x			x	

differences among processes. In other words, processes judged to be similar in meaning will fall close together in two-dimensional space, while those considered unrelated will be farther apart. Based on the individual clustering, the Core Concept System software (version 4.0.175, Concept Systems Incorporated, Ithaca, NY) was used to generate individual binary matrixes for each expert; then, all of these matrices were combined to create an aggregated matrix serving as the input into MDS. A two-dimensional map of distances among the processes was then determined, resulting in the best representation of the aggregated matrix. This point map presents each of the 50 processes in a geometric configuration, positioning similar processes close together. In MDS, the important diagnostic statistic is the stress index, which ranges from 0 to 1, with former representing the perfect fit and the latter the worst (Kruskal and Wish 1978). This study had a stress index of 0.257 based on 24 interactions, which is a value similar to those found in other concept mapping studies using the same number of participants (Trochim 1993).

The second technique used in concept mapping is cluster analysis, which helps to group similar concepts. To do so, the coordinates obtained from the MDS are used to group concepts based on their proximity by computing their Euclidean distance. The Ward's algorithm (1963) is applied to the point map coordinates to cluster the processes based on similarity. The labeling and the subsequent interpretation are based on the insight of the researcher, the analysis of the information collected from the experts, and the literature review. In addition, the analysis of the resulting framework drove the development of a practical guide, i.e., a synthesized representation of social sustainability in construction projects. A discussion of this social sustainability framework and the resulting practical guide are introduced in the next section.

Results and Analysis of the Concept Mapping

Based on Trochim (1989) and Kane and Trochim (2007), MDS coordinates and the Ward's algorithm were combined to yield nonoverlapping cluster solutions, providing interpretable maps. As a result, the clusters are developed sequentially as seen in Fig. 1.

As the dendogram, or tree diagram, in this figure illustrates, the iteration of sequence clustering began with each of the 50 processes individually and continued until all of them were integrated into just one cluster. The benefit of this diagram is that one can follow when each of the 50 processes clustered. For instance, processes 6 and 11 were the first two to be grouped in Cluster A, while processes 12 and 32 were the last ones to become part of Cluster C.

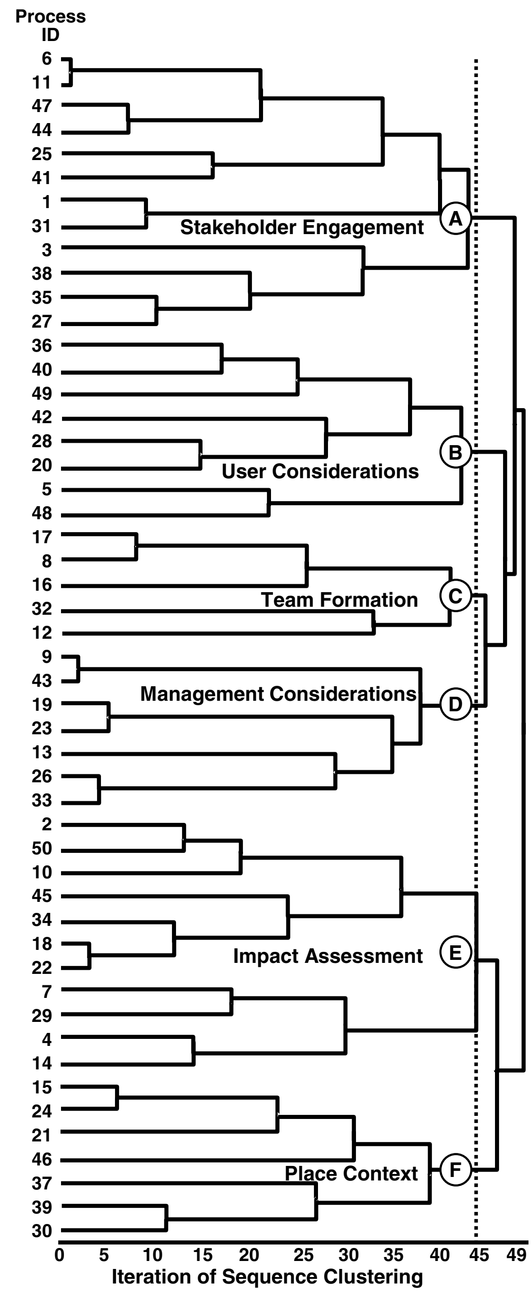

Fig. 1. Dendogram of the 50 social sustainability processes using cluster analysis

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The segmented vertical line in the figure indicates the point at which the clustering solution best represents the data based on the analysis of the researcher. Using the review processes described by Trochim (1989), from eight to four clusters were analyzed to determine an appropriate cluster solution for categorizing the 50 processes of social sustainability. To select the number of clusters that best fit the data, the researcher's judgment was informed by the literature review because there is no mathematical criterion that can be applied (Trochim 1989). This decision was also based on keeping a logical conceptual representation. For the research presented in this paper, the selected number of clusters was six, labeled A–F in Figs. 1 and 2.

In interpreting these cluster maps, it is important to remember that these figures also indicate the processes in each cluster, each represented by a point accompanied by their identification number (ID). For example, Cluster C (Team Formation) contains the processes 8, 12, 16, 17, and 32. The proximity of these clusters indicates how similar these processes were considered to be by the experts, meaning they were sorted together more often than those that are farther apart. In addition, the distance between the clusters is the meaningful indication of their relationship, not the location of each cluster on the map, for example, at the top left or bottom right.

The next step in the analysis was to identify the names that best identify each cluster. This selection of names began by reviewing the cluster names created by the experts. Then to ensure an inclusive name representing all the processes in each, a series of discussions with two people with expertise in social sustainability were held to minimize the researchers' personal bias. Future research could include another round of input from all of the experts to enhance these interpretations.

Social Sustainability Framework

The resulting names for each of the six clusters originating from this analysis as well as the content of each are as follows:

- Cluster A: Stakeholder Engagement consists of the 12 processes that address collaboration among the various stakeholders, fundamental for obtaining a sustainable project. Determining the expectations and perceptions of the owner, designers, and public is critical early in the project. This allows for the generation of a stakeholder management plan, which includes provisions for communicating the outcomes, constraints, and deliverables of the project. This plan helps to respond to stakeholder concerns in a timely manner. In addition, the requirements for encouraging local government and neighborhood engagement allow decision makers to understand and anticipate their needs. This cluster also involves educating the public about the planning and design phases as well as future processes such as the commissioning one. Another important aspect is to document and share the lessons learned during the planning and design phases with all stakeholders. Finally, the importance of having such strategies as partnering in place for resolving conflicts among stakeholders is emphasized in this cluster.
- Cluster B: User Considerations involves eight processes focusing on productivity, safety, health, and security of the final users, key components of the social sustainability concept. These components can be determined by using an evidence-based design method. This cluster includes minimization of the disruption caused in the construction phase, e.g., traffic congestion, dust, and noise. Furthermore, the construction project should be designed to consider the job skills of the women, young people, unemployed, and other minority groups in the surrounding community. Finally, the planning and design phases should include provisions for monitoring incidents of corruption ranging from stealing and misuse of information to requesting special treatment in a contract, which is related to the sustainability principle of transparency.
- Cluster C: Team Formation is composed of five processes concerning the selection of design and construction firms that have a sustainability focus. This design team should be composed of various professions, genders, races, and firm sizes, including local designers. In addition, this cluster emphasizes forming a team with knowledge about health topics that can analyze the health impact on the final users and the community. Using an integrated design—construction process is also included to improve project performance.

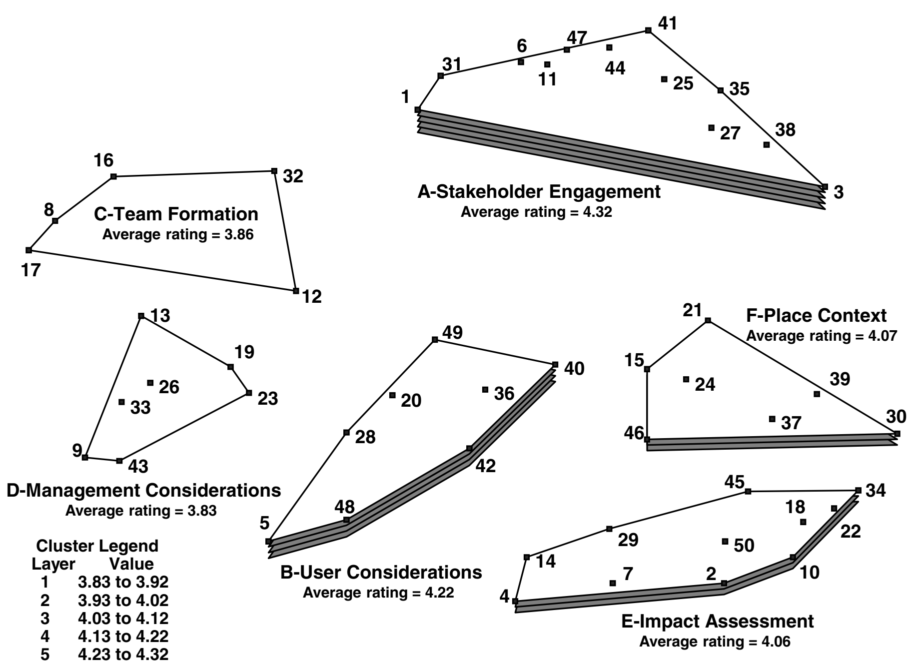

Fig. 2. Cluster rating map representing the framework of social sustainability processes

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- Cluster D: Management Considerations involves seven processes influencing the health, safety, and productivity of the temporary and final users by including prevention techniques to minimize occupational hazards and risks during the construction and operation phases. To do so, this cluster considers training designers on future hazards and prevention techniques during the construction and maintenance phases of the project. In addition to training designers, this cluster considers future education, training, counseling, prevention, and risk-control programs to assist workforce members, their families, or community members affected by serious diseases resulting from the execution of the project, e.g., the removal of asbestos. Another component of this cluster considers the use of local construction labor and local materials/product suppliers to invest in the surrounding community. Because it focuses on considerations required to administrate the processes included in the User Considerations and the Team Formation clusters, it is seen as the bridge between these two.
- Cluster E: Impact Assessment involves 11 processes that are divided into two subgroups, one considering the social impact assessment on the surrounding community and the second on the health impact assessment of the users. These assessments allow for understanding the needs of the various stakeholders such as the future community infrastructures resulting from the construction project. These assessments range from physical considerations (the access to public transit and green spaces) to resources (cultural, historical, and archeological) as well as changes in populations based on introducing new social classes, ethnic groups, and seasonal population, all of which affect socioeconomic patterns. In addition, this cluster includes a health assessment of materials and products that can affect workforce safety and health based on the life cycle approach. A postoccupancy evaluation of similar projects supports this health assessment. More importantly, the results of these various assessments should be incorporated into a return on investment analysis, translating these effects into costs and schedules in the documentation of the project.
- Cluster F: Place Context encompasses seven processes related to analyzing the location of the project in terms of the user needs. This cluster includes the need for creating a design that instills pride in ownership for the users and the surrounding community such as maintaining and restoring natural habitat. It includes privacy considerations and human interaction for the final users as well as assessing the planning and zoning decisions of organizations and institutions with jurisdiction over the proposed project area. In addition, the asset-based design analysis of the surrounding community helps to convert social liabilities into assets. Finally, it includes a plan for the ongoing evaluation of the effect of the project on the surrounding communities during its execution and operation. For instance, monitoring the integration of the use of space will help to improve future designs and to incorporate measures to reduce social inequalities. This cluster relates to the Stakeholder Engagement, User Considerations, and Impact Assessment clusters because it emphasizes the impact of the project on the users and the community.

Cluster Rating Analysis

Experts also rated the importance of the 50 social sustainability processes for inclusion during the planning and design phases of a construction project by using a Likert-type scale, with 1 indicating little importance and 5 high importance. The experts were asked to rate these processes considering what is best for society as a whole rather than what is best for a single group, company, institution, or industry. The Appendix shows the resulting rating of the six social sustainability clusters proposed by this research. The rating results indicate that 92% of the processes have an average rating above 3.4, meaning that most of the expert ratings were above 3 on a Likert-scale of 1 to 5.

The average rating of each process was calculated by first averaging the ratings given to each process by the 16 experts; then to obtain the cluster rating, the average rating of each process within a cluster was added and divided by the number of processes in that particular cluster. For instance, Cluster A includes 12 processes with an average rating of 4.32, which is graphically displayed as a third dimension in a cluster rating map as seen in Fig. 2.

In this figure the importance of the cluster is shown by the number of layers it has. These layers range from one to five because that is the typical representation of importance in the concept mapping method. The more layers in a cluster, the more important it is based on the experts' ratings. The legend in the lower left corner of this figure indicates the importance of these layers, which were selected based on the lowest and highest rated clusters. For example, a cluster with three layers, such as Clusters E and F, exhibits an average rating between 4.03 and 4.13 on the importance scale. It is important to remember that the average represented by the layers is the result of averaging across all of the experts and all of the processes in each cluster. The rating cluster map shows that the two highest clusters are Cluster A (Stakeholder Involvement) and Cluster B (User Considerations) with an average of 4.32 and 4.22, respectively.

These results reinforce the need to have all these processes integrated during the planning and design phases of construction projects. The selection of the most relevant processes could involve considering other factors such as selecting those processes relevant for accomplishing social sustainability outcomes and appropriateness for the type of construction project. Thus, future research could be conducted to select these factors. In addition, future studies could investigate the effect of focusing on those processes receiving the highest ratings to accomplish social sustainability goals in a construction project.

Proposed Practical Guide of Social Sustainability for Planning and Design Phases

The categorization of the social processes into six clusters was taken one step further by examining the regional positioning of the data (i.e., maps) based on the conceptual interrelationship among them. In other words, a region on the cluster map illustrates those processes that can be meaningfully grouped more strongly than they can be with others (Jackson and Trochim 2002). Because this new categorization relies on the research knowledge of the topic, this grouping becomes a practical guide that can aid in future investigations to better communicate social sustainability to practitioners and academics as well as lay audiences.

To create the practical guide, the content and the relationship among the six-cluster solution were again analyzed to form these new regions. Most importantly, this analysis includes maintaining the geometric configuration obtained from the multidimensional scaling analysis. Another important factor considered was that this new representation must keep the relationship among the regions without any overlapping of the processes, meaning that each process must be part of one specific region. In addition, this analysis considers the bridging values, which range from 0 to 1, indicating how often a process was sorted with others on the map. Lower bridging values suggest a cohesive relationship with other concepts in the vicinity (Jackson and Trochim 2002). Processes with higher bridging values indicate that the meaning is related across other parts of the map more often than those that have lower values.

The Appendix also contains the specific bridging values of the processes for each of the six clusters. The bridging values for each were obtained after adding the bridging values of each process within a cluster and dividing by the number of processes in that specific cluster. Clusters with higher bridging values are more likely to bridge between other clusters on the map than those that have low bridging values, which are usually more cohesive, representing better the content in that specific part of the map.

In particular, the results show that there is more cohesiveness in Cluster E (Impact Assessment) than in Cluster C (Team Formation). In other words, those processes in Cluster E are more related to their own area. However, the processes in Cluster C have more connectivity with some of the processes nearby such as those in Clusters A, B, and D. This type of information helps in the interpretation of previous results when deciding if a cluster should remain separated or combined with others. Based on this information, three regions were formed, Approach, Assessment, and Desired Results.

The first integrated region, Approach, includes Clusters A, C, and D as well as Processes 5 and 48 from Cluster B. Process 5 relates to the use of evidence-based design and Process 48 includes the consideration of job skills of such groups as women, young people, unemployed, and ethnic minority groups. These processes are grouped because all of them help to establish the preliminary project scope before any type of assessment is conducted and subsequent revisions are determined. Specifically, Cluster A (Stakeholder Engagement) was included in this region because the processes within it were rated the highest by the various experts. Owners and designers need to identify the key stakeholders in the early phases and establish a stakeholder management plan that will allow for collaboration among them throughout the project. This collaboration approach should allow for reflection by explaining the project goals to those constituencies that may enhance the design or have reservations about the proposed project.

The high average bridging values of Clusters C (Team Formation) and D (Management Considerations) imply that they were judged to have fundamental connections across clusters. In particular, a diverse design team knowledgeable about sustainability and local requirements is considered to be key for enhancing the planning and design phases. In addition, the results indicate the need to communicate with stakeholders regarding serious diseases by analyzing risk-control programs.

The use of an integrated design construction method that allows having cross-disciplinary teamwork is fundamental. Proposed catalysts for integrative design include design–build (Korkmaz 2007; Gransberg et al. 2010) and integrated project delivery [American Institute of Architects (AIA) 2007; Erickson 2010] to ensure a consistent design and protect from costly disputes (Yudelson 2008). But perhaps they also can help in the development of social sustainable outcomes such as the successful recruitment of local individuals or firms, resulting in community satisfaction by enhancing the human and economic capital.

Finally, Processes 5 and 48 relate to early decisions made during the planning and design phases because they focus on approaches such as evidence-based design (Hamilton and Watkins 2009) and the consideration of assessing various job skills. This region integrates processes that encourage development of a comprehensive scope of the project.

The second region, Assessment, combines Clusters E and F except for Processes 21 and 39, which have the highest bridging vales in these two clusters. Process 21 involves creating pride in ownership of the users and surrounding community, while Process 39 addresses the need to develop ongoing evaluation plans of the impact of the project once it is in operation. This region focuses on the various processes available for assessing the impact of the project at the user and community levels. When focusing on the users, it is important to consider their safety, health, security, and productivity. For instance, one variable to consider is avoiding death and injury during the execution or operation of a project, or as a result of design failure, i.e., the inadequate selection of materials/equipment or failure in structural calculations (Martland 2011). In addition, on the community level, impact assessment includes such variables as the formation of attitudes toward the project, population change, institutional structures stability, and community infrastructure needs. Some specific variables to consider are the disruption of the community caused by the project such as traffic, air pollution, loss of privacy, and relocation of people (Burdge 2004).

The identification and mitigation of these impacts require an understanding of both the users and the surrounding community affected by the proposed project. In other words, owners and designers need to identify the stakeholders that will be affected and collect information about their current conditions to establish a baseline for evaluating those changes in the future. These assessments can be identified through appropriate methods, techniques, and input from the stakeholders, generating comprehensive information for addressing issues and allocating resources to the project as well as further supporting the need to have a stakeholder management plan emphasized in the previous region.

The final region, Desired Results, includes Processes 21 and 39 from Cluster F (Place Context) as well as the six remaining processes in Cluster B (User Considerations).

This region is seen as the core of social sustainability in construction projects because it is aligned with sustainability outcomes such as health, safety, and transparency. Particularly, Processes 21 and 39 are included in this region because they are more aligned with sustainability outcomes such as pride in ownership and monitoring. Furthermore, these two processes have the highest bridging values within their cluster, supporting their high connections with the processes in Clusters A and B. For instance, Process 21 is aligned with the overarching social goal of having a design that instills pride in ownership among the users and the surrounding community. Process 39 is also considered a link to the execution and operation phases because it calls for an ongoing evaluation plan of the impact of the project. In other words, this process supports the need for the social effects to be monitored, ensuring that mitigation plans are created to identify further potential effects (Burdge 2004).

The remaining six processes in Cluster B are also aligned with the overarching goal of sustainable construction projects, which is to improve the health, safety, productivity, and the security of current and future users and the surrounding community by monitoring its desired results and maintaining transparent communication among stakeholders. For example, Process 49 assists in this transparency by monitoring and reporting incidents of corruption, which have been determined as a key social performance indicator in the Global Reporting Initiative.

The proposed model of these three regions shown in Fig. 3 can serve as a practical guide, a checklist for the implementation of social sustainability in construction projects during the planning and design phases. The representation of the life cycle of a construction project as a linear approach has been widely used in the construction industry; thus, the same linearity is used in this paper for this new representation of the regions. However, although it focuses on individual regions, the reality is this application operates as an integrated combination, representing a system perspective. For this reason feedback loops have been included in the

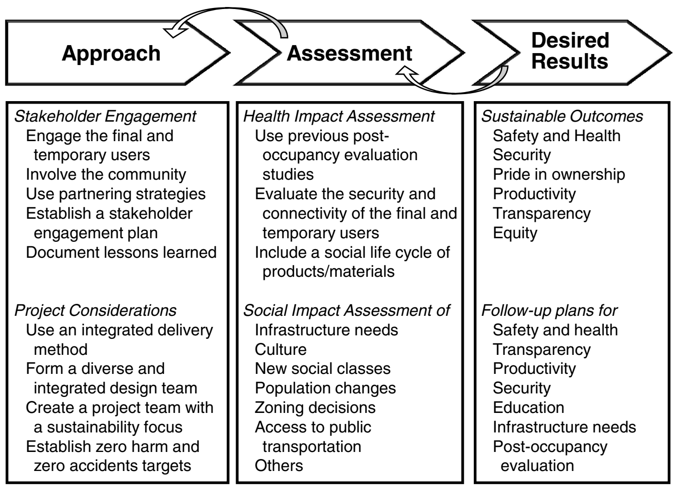

Fig. 3. Practical guide of social sustainability in construction projects

diagram to represent the influence of one region on the others, allowing for adjustment in implementation and self-monitoring.

According to the type of project, processes may be more or less relevant. For instance, when considering infrastructure projects, such as highways or bridges, the range of stakeholders affected may be more extensive than for a commercial building; thus, community participation will be more significant in the former than in the latter. Even when considering the same type of projects and locations, different stakeholders will have various levels of understanding of the concept of sustainability and their needs, affecting the dynamics of the processes that should be applied at any given phase.

Both the framework with the six categories and the practical guide help define social sustainability for construction projects. The former is the primary result obtained by applying MDS and cluster analysis to the input obtained from the experts. The latter is the authors' interpretation of the framework, which was based on the results obtained from concept mapping and the literature review.

Summary and Conclusions

This study offers several contributions to the current body of knowledge by more fully defining the application of the social sustainability concept in construction projects. The 50 processes identified in this paper, based on a variety of perspectives from industry, academia, and government, served as units of analysis that then were sorted and rated by 16 experts. The framework determined by the concept mapping approach can be applied across the entire range of the construction industry. For instance, having a stakeholder management plan should be common to both horizontal and vertical projects. These plans may be applied slightly differently depending on the industry sector, but keeping the processes at this level provides the most broad applicability without sacrificing the ability to adapt this framework to specific projects as needed.

The resulting framework of six categories—Stakeholder Involvement, User Considerations, Team Formation, Management Considerations, Impact Assessment, and Place Context—reveals that social sustainability focuses on the users, appealing to the needs of those who will utilize the project during its life cycle. This concept requires the assessment of the impact of the project both at the user (final and temporary) and community levels, emphasizing its broader obligation to others. The actions of the various stakeholders motivate such aspects of construction projects as investing in local communities and reducing the depletion of natural habits; therefore, social sustainability, which is about people, is essential to achieving environmental and economic goals.

Although User Considerations and Stakeholder Involvement are the top-rated categories on the basis of the input of the experts, the most important finding for the authors is the need to integrate and consider all of them. The six categories are important, which is why they are part of the framework. The feasibility of selecting the most relevant category could involve considering other factors such as selecting those processes relevant for accomplishing social sustainability outcomes and appropriateness for the type of construction project.

The implications of this study move forward the concept of social sustainability in construction projects by providing guidance in addressing social sustainability principles such as health, safety, and well-being. For the practitioner audience, this social sustainability framework serves as important scaffolding for future discussion among those organizations and institutions that aim to assess a comprehensive sustainable construction project. For instance, sustainability rating systems such as LEED, Greenroads, and envision could incorporate the findings of this study into their current deliberations and future revisions of their rating systems. Specifically, the LEED rating system could be modified to include points to reward such considerations as the evaluation of the design for worker safety and health, the involvement of the community during the design processes, and the requirements of implementing follow-up plans to access the productivity of the final users. In addition, these findings can shape sustainability reporting frameworks such as the Global Reporting Initiative for the construction and real estate sector. These results can also inform related frameworks developed in other cultures and contexts such as consulting, standards, and front-end planning. The findings of this study may also help decision makers to achieve organizational core values such as caring for employees and improving community relations.

For the academic community, this research provides educators with a framework to introduce the next generation of designers and builders to these social processes and their categories. By increasing the awareness of social considerations during the planning and design phases, the social pillar of sustainability will be better integrated with the environmental and economic ones. If these future professionals are not aware of or do not value the social impact of construction projects at the user and community levels, then they will tend to ignore these issues. For instance, social sustainability can be incorporated in various civil engineering courses that cover topics like project evaluation, sustainable construction, and capstone design. When social sustainability topics such as prevention through design, social impact assessment, and corporate social responsibility are incorporated into the curriculum, students will begin thinking about their roles in improving user/worker health, safety, and well-being during the life cycle of projects.

Finally, adapting the concept mapping has been a useful method in deducing how the concept of social sustainability is understood by the construction industry. However, the selection of other processes and the interpretation of the concept map results require further research to enhance the understanding of social sustainability in construction projects. Some of the most promising opportunities for future research include:

- Developing metrics for social sustainability based on the framework introduced in this paper. These measures could consider types of owners (public, private, and public-private partnership), infrastructure projects (highways, bridges, and utilities), and project delivery methods (design-build and

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construction management at risk). In addition, these studies can compare the implications of applying these processes on sustainability outcomes between new projects and renovations. For instance, case studies could document the details that determine the inputs, cost, and time required in the integration of these processes for both situations.
- Establishing effective teaching approaches and training efforts for sustainable leaders by increasing their awareness about social sustainability. This research could lead to a broad implementation of these processes in their organizations/institutions. Future research can investigate the different ways in which students experience or think about this concept. In addition, a parallel implementation of courses for continuing education of architecture, engineering, and construction professionals could support the development of truly sustainable construction projects.

Appendix Social Sustainability Framework with Rating and Bridging Values

Identification number	Social sustainability process	Rating	Bridging value
Cluster A: Stakeholder engagement			
1	Determine the expectations of the owner, designer, and public early in the project	4.94	0.66
3	Respond quickly to community concerns and perceptions	4.25	0.75
6	Engage local governments in design so that decision makers can understand and anticipate their needs	4.44	0.41
11	Generate a stakeholder management plan that encourages interaction, integration, and collaboration among stakeholders	4.63	0.15
25	Inform stakeholders of the project constraints (e.g., budget, schedule, location, size, design, and construction standards)	4.50	0.20
27	Ensure participation of final users in design so that decision makers can understand and anticipate their needs	4.63	0.55
31	Establish partnering strategies for resolving interpersonal conflicts among project stakeholders	3.88	0.60
35	Educate the public about the planning/design progress	4.00	0.29
38	Encourage neighborhood engagement in the design		0.60
41	Document and share the lessons learned during the planning and design phases with all stakeholders	4.13	0.09
44	Communicate the deliverables and intended project outcomes with each stakeholder group	4.56	0.00
47	Communicate the rationale for the commissioning process to the stakeholders	3.81	0.10
	Average	4.32	0.37
Cluster B: User considerations			
5	Use an evidence-based design process, basing decisions about the built environment on valid and reliable research	4.06	0.97
20	Adopt designs that increase the wellness and productivity of the final users	4.31	0.27
28	Establish a plan to evaluate progress on zero harm or zero accident targets for the project	4.25	0.41
36	Include security considerations for the final users in the project design	4.38	0.26
40	Establish requirements to assess the impact of the project on the health and safety of the final users	4.38	0.36
42	Provide a plan to minimize disruption caused by the construction process (e.g., traffic congestion, dust, and noise)	4.50	0.35
48	Design to consider the job skills of the women, young people, unemployed, disadvantaged, racial, and ethnic minority groups in the area	3.56	0.59
49	Monitor and respond to incidents of corruption	4.31	0.53
	Average	4.22	0.47
Cluster C: Team formation			
8	Select a diverse design team including participants from various professions, genders, races, and firm sizes	3.69	0.82
12	Include health professionals in the design team to help analyze health impacts on the final users and the community	3.69	0.76
16	Select design and construction firms with a sustainability focus	4.25	0.86
17	Use local designers and professionals	3.31	0.89
32	Use an integrated design–construction process	4.38	0.84
	Average:	3.86	0.83
Cluster D: Management Considerations			
9	Design to enable the use of local construction labor	3.75	0.88
13	Train designers to help them address future hazards during the construction and maintenance phases of the project	4.06	0.77
19	Establish zero harm or zero accident targets for the project	4.50	0.50
23	Incorporate safety prevention techniques that prevent or minimize occupational hazards and risks during construction (e.g., the analysis of the sequence of construction activities and the use of prefabrication techniques)	4.44	0.36
26	Require a management plan for improving construction worker productivity	3.38	0.52
33	Require education, training, counseling, prevention, and risk-control programs to assist workforce members and their families or community members regarding serious diseases	2.81	1.00
43	Use local material/product suppliers for the project	3.88	0.80
	Average	3.83	0.69
Cluster E: Impact assessment			
2	Conduct a social impact assessment of the project	4.25	0.25
4	Conduct a social life cycle analysis of construction products and materials that considers workforce safety and health	3.75	0.55
7	Conduct a health impact assessment	4.13	0.34
10	Analyze the effect of the project on cultural, historical, and archeological resources	4.25	0.10
14	Incorporate social considerations (e.g., health, productivity, and quality of life) into a return on investment analysis (ROI)	4.06	0.51
18	Assess the impact of introducing new social classes into the surrounding community (e.g., a community in which low-income housing is proposed might perceive the new social class as a threat based on stereotypes and misconceptions)	3.88	0.10

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Appendix *(Continued)*

Identification number	Social sustainability process	Rating	Bridging value
22	Analyze new/additional community infrastructure needs resulting from the project (e.g., water, power, and emergency responders)	4.63	0.18
29	Assess the results from postoccupancy evaluation of similar projects	3.88	0.52
34	Analyze the impact of the project on the cultural and ethnic identity of the surrounding community	3.75	0.14
45	Assess seasonal population changes in the surrounding community and their effect on employment patterns, business practices, and community infrastructure	3.50	0.24
50	Analyze the impact of the project location on access to public transit, biking opportunities, safe walking routes, and green spaces	4.63	0.20
	Average	4.06	0.28
Cluster F: Place context			
15	Include privacy considerations for the final users	3.31	0.35
21	Create design features that instill pride in ownership of the users and the surrounding community	4.38	0.59
24	Include human interaction (connectivity) considerations for the final users in the project design	4.38	0.33
30	Perform an asset-based design analysis of the surrounding community so that design solutions can convert social liabilities into assets	3.88	0.44
37	Assess the planning and zoning decisions of organizations/institutions with jurisdiction over the proposed project area	4.38	0.53
39	Develop a plan for ongoing evaluation of the impact of the project on surrounding communities once it is in operation	3.81	0.57
46	Maintain and/or restore natural habitat important to the final users and the surrounding community	4.38	0.34
	Average	4.07	0.45

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