Development of a Framework for Sustainability Management in the Construction Industry Approaching Both Organizational Structure and Processes Management

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Abstract:
The construction industry faces considerable challenges with sustainability issues due to the significant contribution to environmental and social impacts of this field. The diversity of standards, certifications, and other materials for helping to consolidate and approach sustainable practices in this area makes task management arduous and affects the way that construction projects are managed. Moreover, it is challenging to translate broad sustainability goals into specific and clear targets in the construction field. This study considers two levels of project management: the level of organizational strategy—called Sustainability Organizational Practices, *SOP*, in this research—and the level of specific management practices—called Sustainability Management Processes*, SMP,* here. First, to assist translating the broad sustainability goals into specific targets, this research performed a meta-analysis study considering a large number of rating systems and international sustainability organizations framework for identifying the sustainability indicators in the construction field. The indicators were analyzed according to the Sustainable Development Goals of the United Nations and categorized according to the quadruple perspectives of sustainability management: economic, environmental, social and ethical. Second, to develop a framework for sustainability management for the construction industry, this research analyzed various management models such as business models, project management models, construction management models, sustainability management models, sustainability management standards, and sustainability rating systems. Third, to identify the connection between the SOP and SMP, this research interviewed eight professionals from four different construction organizations. In conclusion, this study provides an understanding of sustainable impacts of the construction field through sustainability indicators and a framework for sustainability management for the construction industry approaching both organizational structure and process management.

Keywords:
Sustainability management framework, sustainable development goals of the construction industry, sustainability organizational practices, sustainability construction indicators, sustainability management model for the construction industry.

1 Introduction

Since the United Nations Conference on the Human Environment, held in Stockholm in 1972, sustainability has been a major focus of discussion. The term has become a political and ethical argument for addressing the ecological and social crises of the world. The constant observation of these ecological and social crises demonstrates the connection between the environment and human beings (behaviour). The World Commission on Environment and Development (WCED) presented in 1983 the most popular sustainable development interpretation: to meet the needs of the present generation without compromising the ability of future generations to meet their needs [1].

Now, sustainable development engages further complex issues such as economic development models, the world food supply, poverty reduction, justice, and also nature conservation [2].

The way an organization addresses sustainability issues impacts, not just the environment, but also employees, nearby communities, clients, and material sources. Consequently, a focus on sustainability management is important to all types of organizations.

Moreover, although the initiative to implement sustainability in daily operations starts with a desire to impact the world positively, organizations are detecting the benefits of sustainable practices such as to reduce costs and to improve corporate image [3].

Furthermore, there is an excessive number of articles and standards that describe different interpretations of sustainability and sustainability practices across diverse fields. However, the diversity of studies makes it hard to consolidate an approach, justifying the lack of understanding and yet the difficulty of implementing sustainability management into the daily operations of the organization.

Hence, collecting and implementing the different approaches have become an increasingly burdensome management task.

Construction projects are very complex. They require the involvement of many different stakeholders and contribute significantly to the environmental impacts [4]. Consequently, to address the complexity of

sustainability management in construction, it is essential to apply a management system approaching: an understanding of the responsibilities' distribution; identification of the key positions; identification of the management levels; and a definition of the relationship of the departments [5].

The first objective of this study is identifying the impacts and sustainability indicators relevant to the construction industry through an extensive literature review of sustainability issues and a meta-analysis study of sustainability indicators in the construction field. The second objective is developing a framework for sustainability management in the construction industry approaching both organizational structure and processes management (in this research, we call these two layers Sustainability Organizational Practices—SOP—and Sustainability Management Processes—SMP—respectively). The third objective is identifying the connection between these two levels through interviews with four different organizations.

Fig 1: Sustainability Construction Management. The figure represents the sustainability construction management system evaluated in this study.

This study approached normative documents such as the international standards for environmental management (ISO 14000 family) [6], the general principles of sustainability in building construction (ISO 15392) [7], the guidance on social responsibility (ISO 26000) [8], and assessment management standard (ISO 55000 family) [7]. It also studied the sustainability rating systems such as Leadership in Energy and Environmental Design (LEED) [9], and Rating System for Sustainable Infrastructure (ENVISION) [10]. Management systems such as PMBOK [11], sustainability management MBA, sustainability assessment, organizational structure, and stakeholders' management are also the focus of the literature review.

2 Sustainability Construction Indicators

The Global Sustainability Standards Board (GSSB) suggests that indicators provide information on the performance of an organization that reflect the social, economic, and environmental impacts. Also, the indicators provide information to influence and assist decision of stakeholders [12].

Initially, this research conducted a study of normative documents and sustainability rating systems of measuring sustainable practices that the construction industry can influence, impact, and manage.

Followed by a meta-analysis of documents such as Sustainability Impact Assessment-SIA [13], International Chamber of Commerce-ICC [14], Sustainable Master Business Administration (MBA) [3], Agenda 21 [1], Sustainable Development Goals-SDG [15], World Business Council for Sustainability Development (WBCSD) [16], Leadership in Energy and Environmental Design (LEED) [9], ENVISION [10], Green Globes [17], Sustainable Project Appraisal Routine-Spear Arup [18], ISO family [7], and Global Reporting Initiative [12].

From these references, this study collected a total 105 indicators among environmental, social, economic and ethical categories. Through mapping these indicators to the 17 international Sustainable Development Goals - SDGs (United Nations, 2015), we reduced the list to 99 indicators.

In summary, this research identified 99 sustainability indicators in the construction field correlated to the United Nations' SDG and categorized into the Economy/Environment/Society/Policy quadruple of construction sustainability management.

3 Framework for Sustainability Management in the Construction Industry

Construction management activities can be organized into six hierarchical levels: organizational, project, activity, operation, process, and work task level [19].

Moreover, there is more than one way for a company to define its strategies, objectives, structure, and processes. However, it is crucial to create a framework that helps the organizations achieve their objectives based on basic patterns [20].

This research conducted a study of management systems through a literature review to identify the main system levels to elaborating the proposed framework.

Based on the sustainability management investigations, a conceptual model was developed focusing on both an organizational structure and a

process management for sustainability management in construction, illustrated in figure 2. Section 3.1 describes the SOP elements of the framework while section 3.2 discussed the SMP components.

Fig 2: Sustainability Management Framework for the Construction Industry. The figure represents the proposed framework for sustainability management.

3.1 Sustainability Organizational Practices - SOP

At the organizational level, we evaluate from a business management perspective. The definition of the organization's mission and its purpose can define objectives of key areas. The balance of these objectives converts objectives into concrete strategies and resources' allocation [21].

The organizational structure arises from an ongoing process of evaluating the organization purposes – questioning, verifying, and redefining the manner of interaction with its environments [22]. Hence, the idea of the SOP is to introduce the main processes that the organizations can focus on and repeatedly update for articulating their sustainability goals and establishing mechanisms for achieving them. The following sections organize these processes into four broad categories: Drivers/Goals, Targets (objectives), Team, and Policies/Practices. Each process is described regarding its inputs, tools, and outputs.

3.1.1 Drivers / Goals

As sustainability issues have evolved, sustainability practices have increased their needs and value. Clear and simple organizational drivers (rather than just intuition) allow organizations to endure and grow for a long time. Only a precise definition of *drivers* and purpose of the organization makes possible clear and realistic organization's objectives [21].

The SOP divides the drivers and goals of the organization into three parts: definition, promotion, and reporting. Table 1 describes the inputs, tools and outputs of these elements.

Definition

Defining the organization's drivers will help to identify the organization's goals, including people, knowledge, and conditions (such as market forces) that initiate and support activities for which the business was designed [23].

Promotion

The internal communication establishes a service orientation focusing on achieving effective internal exchanges between the organization and its employees [24]. Moreover, internal communication

Table 1: Drivers and Goals – Input, Tools, and Output

Drivers and Goals: Definition		
Inputs • Market: client types • Knowledge & values: market's sustainability requirements.	**Tools -** Sustainability Practices Analysis • Categories: sustainability practices by category • External regulations and policies • UN sustainability goals • Organization's sustainability focus.	**Outputs** • General Sustainable Goals (GSG): for each category

Drivers and Goals: Promotion		
Inputs • General Sustainable Goals (GSG)	**Tools -** Sustainability Promotion Analysis • The content of the information • Recipients • Format of divulgation	**Outputs** • Organizational Sustainability Values Promotion (OSVP)

Drivers and Goals: Reporting		
Inputs • General Sustainable Goals (GSG)	**Tools -** Sustainability Values Reporting Analysis • Organization's Activities Impact/Influence • Yardstick Measurement • Objective/ Strategy • Report Frequency • Results – presentation format	**Outputs** • Sustainability Organizational Report (SOR)

affect employee work attitude [25], promoting awareness of its environment, a sense of belonging to the organization, an understanding of its evolving aim, and a commitment to the organization [26].

Reporting

The sustainability report demonstrates the economic, environmental and social impacts caused by the organization's activities and present the organization's values and governance model, linking its strategy and its commitment to a sustainable global economy [12].

3.1.2 Target

The objectives of an organization need to be performance objectives aimed at doing rather than at good intentions [21]. A clear definition of what the organization desires to achieve is essential for organizing its structure and strategies. Therefore, this research focused on the stakeholder's analysis to identify the sustainability targets of the organization.

The SOP divides the effecting of the target of the organization into three parts: stakeholders' identification, approach, and goals. Table 2 describes the inputs, tools and outputs of these elements.

Stakeholders' Identification

To identify and prioritize the stakeholders of an organization is a very important tool to determine its targets. The framework for stakeholder's identification based on three attributes—power, legitimacy, and urgency—can help the organization to determine the priority of its stakeholders [27]. This research considered the power (importance) and legitimacy (influence) to determine the priority stakeholders.

Stakeholders' Approach

The stakeholder analysis determines the qualitative and quantitative information to take into consideration to identifying the interests, expectation, and influence of the stakeholders [28].

Stakeholders' Goals (Sustainability Goals)

Following the sustainability stakeholders approach, the organization can determine its sustainability goals/ target and their target date.

3.1.3 Team

The analysis of work consists of four steps. First, to identify all operations necessary to produce a known end. Second, to elaborate a rational organization of the sequence of the operations and workflow making it more manageable, smoother, and more economical. Third, to analyze the individual operation including the appropriate tools, the required information, and materials. Fourth, to integrate the operations into individual jobs [21].

The SOP divides the effecting of the team analysis into three parts: knowledge and skills, roles, and organizational structure. Table 3 describes the inputs, tools and outputs of these elements.

Knowledge and Skills

The roles and responsibilities will provide information for defining the positions, skills, knowledge, and competencies needed to assist the human resources to identify, and eventually release team members [29].

Table 2: Target – Input, Tools, and Output

Target: Stakeholders' Identification		
Inputs • Categories: sustainability practices by category (economic, environmental, social, and ethical) • Geographic Sphere: market location • Stakeholders List	**Tools -** Stakeholder's Identification Analysis • Stakeholder Matrix: to identify the importance of each stakeholder • Priorities Stakeholder	**Outputs** • Organization's Sustainability Stakeholders (OSS)

Target: Stakeholders' Approach		
Inputs • Organization's Sustainability Stakeholders (OSS)	**Tools -** Stakeholder's Approach Analysis • Potential strategies • Limitations • Chosen Objectives	**Outputs** • Organization's Sustainability Stakeholders Strategy (OSSS)

Target: Stakeholders' Goals (Sustainability Goals)		
Inputs • Organization's Sustainability Stakeholders Strategy (OSSS)	**Tools -** Organization's Sustainability Goals Analysis • Target • Target Milestone • Target Review	**Outputs** • Organization's Sustainability Targets (OST)

Table 3: Team – Input, Tools, and Output

Team: Knowledge and Skills		
Inputs • Organization's Sustainability Targets (OST)	**Tools** Knowledge and Skills Analysis: • Required knowledge/Training/Certifications • Required Tools/ Activities	**Outputs** • Sustainability Organizational Knowledge and Skills Document (SOKS)

Team: Roles		
Inputs • Organization's Sustainability Targets (OST) • Sustainability Organizational Knowledge and Skills (SOKS)	**Tools** Sustainability Roles Analysis: • Role/Level of the position • Department Analysis: a new department is needed? • Departments Interrelationship Analysis	**Outputs** • Sustainability Organizational Team Document (SOTD)

Team: Organizational Structure		
Inputs • Sustainability Organizational Knowledge and Skills (SOKS) • Sustainability Organizational Team Document (SOTD)	**Tools** • Sustainability Organizational Chart	**Outputs** • Sustainability Organizational Chart (SOC)

Roles

The objective is to ensure that each work package has an owner and all team members have a clear understanding of their roles and responsibilities [29].

Organizational Structure

It is essential to identify sustainability management within the corporate structure: the roles, knowledge and skills required to determine the organization's sustainability model. To design the structure of an organization, Drucker [21] suggests responding to four questions. The first question is to identify the units of the organization. The second one is to determine the components that join together, and what components are apart. The third one is to define the size and shape of the different components. The fourth is to identify the appropriate placement and relationship of different units.

3.1.4 Policies & Practices

Policies delineate, specify, and authorize the methods that any institution is administered [30]. The policies assist the guidance of behaviours, transactions, initiatives, and protocols [31].

The SOP divides the effecting of the policies and practices into three parts: definition, promotion, and validation. Table 4 describes the inputs, tools and outputs of these elements.

Definition

Bandow and Hunter [32] identify several points that policymakers should consider when creating the policy. Some of these points are defining a committee member to evaluate the policy frame. Also, to determine the expected behaviour, to identify the related local, state, and federal law, to describe the expected behaviour and responsibilities of managers and employees, and to determine the informal and formal complaint procedures.

Promotion

The implementation of any policy by all relevant parties in an organization is as important as the creation of that policy.

Validation

It is essential to evaluate the effect and receptivity of the team for each policy making sure it is applicable.

Table 4: Policies & Practices – Input, Tools, and Output

Policies & Practices: Definition		
Inputs • General Sustainability Goal (GSS)	**Tools** Sustainability Committee Analysis • Committee of sustainability policies analysis • Member's Roles: policy-maker, implementers, beneficiaries, evaluators, executors (to identify the department directly affected by the policy) Values and Practices Analysis: • Values / Policy Goals • Departments related • Expected Behaviors and responsibilities • Remedies (in case of conflict) • Routinization: basic and daily behavior for each goal	**Outputs** • General Policy Document (GPD)

Policies & Practices: Promotion		
Inputs • General Policy Document (GPD)	**Tools** - Stakeholders' Analysis • Stakeholders • Stakeholder's description –level of knowledge GPD's Promotion Plan • GPD's Plan • GPD's Validity • Communication Plan • Feedback Plan	**Outputs** • GPD Promotion (GPDP)

Policies & Practices:		
Inputs • General Policy Document (GPD) • Feedback Plan	**Tools** - Policies Validation Analysis • Frequency Evaluation • Assessment Methodology • Improvements Plan • Policy Review	**Outputs** • GPD Validation (GPDV)

3.2 Sustainability Management Processes - SMP

Engineers and Geoscientists BC's Code of Ethics requires integrating sustainability considerations into professional practices. It requires holding paramount the safety, health, welfare of the public, the protection of the environment, and promoting health and safety within the workplace [33]. Nevertheless, many certifications and regulations are requiring the implementation of sustainable practices.

The SMP determines the processes an organization may implement and repeatedly update, if necessary, on each project for articulating its sustainability goals and mechanism for achieving them.

3.2.1 SMP - Task Management

The following sections organize the processes into six categories of task management: processes, indicators, policies, communication, processes, assessment, and report management. Table 5 describes each feature of the SMP regarding its inputs, tools, and outputs.

Processes

Sustainability processes allow the organization to go from abstract or ethical goals to tangible and practical actions. Applying sustainability practices into process management contributes to the progress of the society, economy, and environment [34].

Indicators

Project management requires a reliable mechanism to ensure that the performing agencies monitor and control the project plan's objectives [35].

Policies

The International Chamber of Commerce (ICC) created the Green Economy Road Map to assist business in the development of sustainable policies and reinforce the importance of innovation, collaboration, and governance from both bottom-up and top-down [14].

Communication

A communication plan is vital to motivate, inspire, and guide employees [36].

Assessment

Assessment management involves reporting the sustainability performance and the progress of the organization. It is also a valuable tool to aid in the shift towards sustainability [37].

Reporting

Reporting performance is the process of collecting and disclosing performance information including the status report, progress measurements, and forecast. It considers the management plan, the performance information, the measurement methodology, the estimates and progress assets [28].

4 Interviews

This study interviewed four organizations and eight different professionals at different management levels. The profile of the organizations were as follows.

- Company A

This research interviewed the project manager, project coordinator, construction superintendent, and site safety officer. The organization applies LEED if

Table 5: SMP – Input, Tools, and Output

Tasks Management: Processes		
Inputs • Activities Definition • General Sustainable Goals (GSS) • Organization's S. Targets (OST) • Sustainability Organizational Team Document (SOTD)	**Tools -** Sustainability Processes Analysis • Stakeholders - internal and external • Self Assessment - sustainability impact of each activity • Indicators • Tools - physical (equipment), intellectual (specialist), or technological (system) necessary to execute the activity • Benchmarking/ Performance Case	**Outputs** • Sustainability Process Document (SPD)

Tasks Management: Indicators		
Inputs • Activity • Sustainability Indicators	**Tools -** Sustainability Indicators Analysis • Indicators Identification: the intent, description, level of achievement, metric and the document of evidence for the performance	**Outputs** • Sustainability Indicator Document (SID)

Tasks Management: Policies		
Inputs • Sustainability Process Document (SPD) • General Policy Document (GPD)	**Tools -** Policies Analysis • Conditions – To develop short and clear high level of conditions for each sustainability process of each activity • Actions Plan • Collaborative Actions –internal and external stakeholders • Principles - best practices	**Outputs** • Sustainability Practices Document (SPrD)

Tasks Management: Communication		
Inputs • Sustainability Practices Document (SPD)	**Tools** - Sustainability Communication Analysis • Communication Plan: clear and consistent message to educate the employees	**Outputs** • Sustainability Practices Communication (SPC)

Tasks Management: Assessment		
Inputs • Sustainability Indicator Document (SID)	**Tools** - Sustainability Assessment Analysis • Analysis –proposal and scope of the indicator • Delineation –methodology to assess the indicator • Impact Analysis – to identify the impact and conflicts of each indicator • Optimization – to elaborate a mitigation plan	**Outputs** • Sustainability Assessment Document (SAD)

Tasks Management: Reporting		
Inputs • Organization's Sustainability Targets (OST) • Sustainability Indicator Document (SID)	**Tools -** Sustainability Report Analysis • General Standard Disclosures – organizational profile, strategy and analysis, opportunities and limitations, stakeholders engagement. • Specific Disclosure – to identify the indicators, their approach and the desirable performance	**Outputs** • Sustainability Report Document (SRD)

the client requires, otherwise it implements regulatory mandated sustainability practices. Although the company has sustainability policies, they are not promoted to the construction team. Only the project manager was trained with the organization's sustainability values and policies but did not expand to the rest of the team.

- Company B.

This research interviewed the project manager and LEED coordinator. The organization has a specific sustainability department to manage the sustainability practices of the projects. However, it is limited to LEED indicators and methods.

- Company C

This research interviewed the project manager. The organization applies LEED in its projects and has sustainability values and policies. Although there is no formal training, the sustainability values and policies are promoted to the construction team through messages in the intranet and formal documents

- Company D

This research interviewed the project manager. The organization does not have any sustainability policy and follow the practices required by law, only.

For this research, the interviews were conducted and analyzed with the objective of identifying the way the organizational structure (SOP) can influence the professional's behaviours (SMP).

The questions intended to identify the way the organizations require sustainability practices and the way the professionals reacted to or perceived the importance of sustainable practices.

Furthermore, the questions were divided into two categories: the organizational structure and the processes management. The objective was, first, to identify if the organization has sustainable policies and the way these are promoted to the construction team. Second, to determine the way the interviewee responded to the sustainable practices.

The primary results are discussed on the next topic.

5 Results and Discussion

First, this research identified 99 sustainability indicators from the meta-analysis study highlighting the way the construction industry can contribute to the sustainable development goals. These 99 sustainability indicators are categorized according to the quadruple of sustainability management and contribution to the 17 development goals [38], represented in Figure 3.

Second, this research suggested a framework for sustainability management for construction industry approaching both the organizational structure and the processes management, called SOP and SMP respectively. The proposed framework considered important context from different models in the literature review identifying the way the organization can efficiently implement the sustainability management into these two management levels.

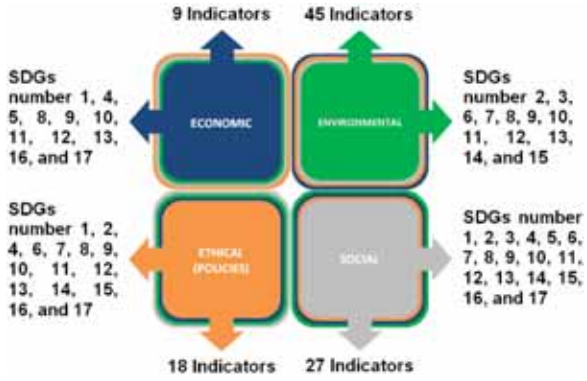

Fig 3: Quadruple of Sustainability Management in the Construction Field. The figure represents the four categories of the indicators and the addressed SDG.

Furthermore, the framework might also indicate the connection between the organizational structure and the processes management level. Once the conceptual model was carefully designed to identify the critical inputs and outputs for each feature of the framework, this research identifies a plausible connection between the SOP and the SMP. The information that the SOP provides to the SMP can illustrate this relationship. Figure 4 demonstrates these documents

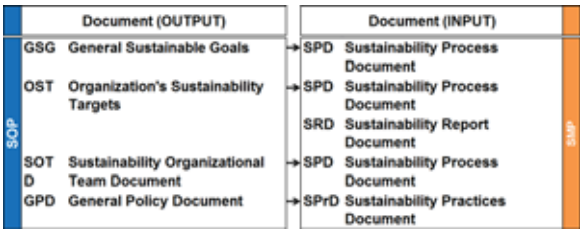

Fig 4: SOP and SMP's documents. The figure demonstrates the SOP documents that provide input to the SMP documents

Third, this research interviewed eight professionals in four different construction organizations to identify the way the organizational structure (SOP) can influence the professional's behaviours and processes (SMP). Based on the interviews, this research can highlight the following observations and hypotheses:

- In company A, the project manager received training and acknowledges the values and policies of the organization. Her sustainable behaviour was noticeable. However, the Project Coordinator, Construction Site Superintendent, and Site Safety Officer did not know the sustainability policies and sustainability values of the organization. They mentioned that they would follow the processes

that the project manager determined and that it was obligated. The principal researcher did not perceive a behaviour changing and a lack of involvement in the sustainable development and sustainable practices were visiable. The researcher observed the importance of having a transparent sustainability organizational structure and promoting the values and goals of the organization to implement sustainable behaviours into its employees at all levels. The SOP assists to do that.

- In company B, the organization has a specific department for controlling the sustainability practices of its projects. The group was structuring its sustainability practices, and it did not yet have well-defined values and policies following the LEED practices. However, it demonstrated that, although the employees acknowledge the standard, they did not recognize the organization's values. The lack of sustainability organization values demonstrated, again, the importance of the employees' involvement in the sustainable development and the promotion of the sustainability organizational structure to the team at all levels. SOP assists to do that.
- In company C, although the project manager did not have any specific training in sustainability or additional certification such as LEED membership, the professional was involved and desiring to improve the sustainable processes because the organization continually promote its values and policies. The researcher observed that, even though the professional did not have a sustainability background, the sustainability practices were incorporated into his behaviours because the organization's sustainability goals were transparent to the team. It demonstrated the impact of promoting the organizational sustainability values to the team at all levels. That is the purpose of the SOP and SMP.
- In company D, the organization did not have any sustainability policy or certification to follow. The project manager could not answer any question related to sustainability management other than the ones that are obligated by law.

6 Conclusions and Outlook

This research provides an understanding of sustainable impacts of the construction field through sustainability indicators demonstrating how the construction industry can efficiently and practically contribute to sustainable development. The proposed framework approaching both organizational structure and process management intends to assist the organization to elaborate its values, policies, procedures, and structure for sustainability management, creating a tangible model to implementing sustainability management in the construction industry.

Further studies are required to identify the best practices of each feature of the framework assisting the organization to implement sustainability management processes.

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