

**A FRAMEWORK FOR SUSTAINABLE DEVELOPMENT MANAGEMENT IN THE
CONSTRUCTION INDUSTRY**

by

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CONSTRUCTION INDUSTRY**

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Abstract

The most common way to deal with sustainable development in the construction industry is through sustainability-related standards and certifications that identify and systematize sustainable business practices in diverse fields. However, certifications often focus on the same or overlapping areas.

The construction industry is endeavouring to become more sustainable and spends extensive management and administrative effort to accomplish this through standards and certification processes. Notwithstanding, the business comprehension of achieving broad sustainability, the viability of accreditation as a system and administration practices of organizations remain under-developed and disconnected.

This research identifies gaps in the studies of sustainability management, contributing to a solution that defines the scope of sustainable development in the building construction industry. Moreover, it helps organizations implement sustainable development management at both the strategic and tactical levels. It formalizes sustainable development management practices into a body of knowledge framework and implementation templates.

The validation step of this research consists of an investigation based on multiple data sources, consolidating information in the current literature that partially addresses sustainability and sustainable development management.

As a qualitative research method, the epistemology of this research uses a document analysis method to consolidate a diverse source of information existing in the current literature, focusing on the three perspectives of sustainability—environmental, economic and social—and in business and project management. The research presents an in-depth analysis of the scope of sustainability for the construction industry and how to implement it, based on the participation of organizations from Canada and Brazil. They shared their current practices at the strategic management level.

The systematic review of the documentation provided background information to understand the construction industry's economic, social and environmental aspects and sustainable development management body of knowledge.

This research contributes to the field of construction management by (1) identifying the scope of sustainable development, introducing the 100 SDI—a consolidated list of sustainability targets for the building construction industry and their contribution to the UN-SDGs—and (2) the SDMBOK—a framework to

implement sustainable development at the strategic and tactical level and templates to assist in implementing the framework at the strategic level.

Lay Summary

This research identifies gaps in the management of sustainability within in the building construction industry and contributes a solution that defines the scope of sustainable development in the construction industry and that formalizes sustainable development management practices into a body of knowledge framework.

A systematic literature review provides background information to understand the economic, social and environmental aspects of the construction industry and a sustainable development management body of knowledge. In-depth analyses of the scope of sustainability for the building construction industry and of how to implement it contribute to an understanding of sustainable development management practices, including current practices collected from participating organizations from Canada and Brazil.

This research addresses a significant challenge that the construction industry faces to engage in sustainable development. The two main contributions are the consolidation of sustainable development targets available in the current literature and the codification of management process that allow a construction organization to implement sustainable development. The results are The 100 Sustainable Development Indices (The 100 SDI)—a consolidated list of sustainability targets for the building construction industry that are mapped to the United Nation’s Sustainable Development Goals—and the Sustainable Development Management Body of Knowledge (SDMBOK)—a framework and implementation templates for implementing sustainable development within an organization at both the strategic and tactical level.

Preface

A version of Chapter 2 has been published [Suzana C, N L. Espindola, T. M. Froese, What are the extent and opportunities of Sustainable Development in the Construction Industry?, 2nd International Conference on New Horizons in Green Civil Engineering, the University of Victoria (2020)]. I was the principal investigator, and executed the concept formation, data collection and analysis, as well as manuscript composition. Dr. Thomas Froese was the supervisory author on this project and was involved throughout the project in concept formation, oversight of the analysis and manuscript composition.

A version of Chapter 3 has been published [S. Carla, N L. Espindola, T. M. Froese, Development of a framework for sustainability management in the construction industry approaching both organizational structure and processes management, 1st International Conference on New Horizons in Green Civil Engineering, the University of Victoria (2018) 300–309.]. I was the principal investigator, executed the concept formation, data collection and analysis, as well as manuscript composition. Dr. Thomas Froese was the supervisory author on this project and was involved throughout the project in concept formation, oversight of the analysis and manuscript composition.

Data used in Chapter 3, the case studies, is undertaken with ethics approvals obtained by UBC Ethics Certificate number H17-00271.

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List of Abbreviations

ABNT	Associação Brasileira de Normas Técnicas
BEA	Building Environment Assessment
BREEAM	Building Research Establishment Environmental Assessment Method
BSC	Balanced ScoreCard
CDSB	Climate Disclosure Standards Board
CERES	Coalition for Environmentally Responsible Economies
ENVISION	Certification of Institute for Sustainable Infrastructure
ERM	Enterprise Risk Management
ESG	Environmental, Social and Governances
FSL	Freight Share Lab.
GRI	Global Reporting Initiative
GSSB	Global Sustainability Standard Board
ICC	International Chamber of Commerce
ISA	International Sustainability Alliance
ISO	International Organization for Standardization
LBC	Living Building Challenge
LEED	Leadership in Energy and Environmental Design
LEEP	Low Emissions Economy Partnership
MDG	Millennium Development Goals
NCS	Natural Climate Solutions
OECD	Organization for Economic Co-operation and Development
PDD	Purpose-Driven Disclosure
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
SBSC	Sustainability Balanced ScoreCard
SBT4 Buildings	Science-Based Targets for Buildings and Construction Sector
SCC	Standards Council of Canada
SCF	Soft Commodities Forum
SD	Sustainable Development
100-SDI	100 Sustainable Development Indices
SDM	Sustainable Development Management
SDMBOK	Sustainable Development Management Body of Knowledge
SMP	Sustainability Management Processes
SOP	Sustainability Organizational Practices
SPeAR	Sustainable Project Appraisal Routine
TCFD	Task Force on Climate-related Financial Disclosure
TUM	Transforming Urban Mobility
UN	United Nations
UN-SDGs	United Nations Sustainable Development Goals
UNEP	United Nations Environment Programme
UNGPs	United Nations Guiding Principles on Business and Human Rights
WASH	Water, Sanitation, and Hygiene
WBCSD	World Business Council for Sustainable Development
WBS	Work Breakdown Structure
WCED	World Commission on Environment and Development
WFMS	Workflow Management System

Glossary

This glossary includes the new terms defined by this research and important nomenclatures for a better understanding of the document:

Taxonomy is a science of orderly classification of items (related to one another in an actual or presumed manner) into distinct groups (WebFinance Inc., 2019). For this research, it is the base knowledge of the pattern that consists of the implementation of the management process, and it is based on the literature review.

A *framework* is a broad overview, outline, or skeleton of interlinked items that support a particular approach to a specific objective. It serves as a guide that can be modified as required by adding or deleting items (WebFinance Inc., 2018). For this research, it is the skeleton of the arrangement of the pattern that consists of the implementation of the management process based on the existing management models and practices, including the inputs, tools and techniques, output and templates.

100 Sustainable Development Indices (100 SDI) is a consolidated list of 100 SD targets based on the current literature review.

Input is the information needed to determine the tools and techniques to implement a particular task (Project Management Institute, Inc., 2008).

Tools and Techniques is a procedure for implementing/ managing a particular task determining the steps needed to achieve the specific results, output (Project Management Institute, Inc., 2008).

Output is the results obtained by the procedures (Project Management Institute, Inc., 2008).

A *template* is a pre-set format used as a pattern for processes that serve as a model for others to copy (Oxford University Press, 2015). For this research, it is a collection of forms with methods or procedures based on the literature review and case studies to help the organization to implement SDM.

SDMBOK—Sustainable Development Management Body of Knowledge for the construction industry is a supporting structure of sets and subsets of activities to assist the construction industry in initiating, planning, executing, controlling, monitoring, and reporting sustainable activities of its operations. The framework is a combination of two modules; SOP—Sustainability Organizational Practices and SMP—Sustainability Management Processes.

SOP—Sustainability Organizational Practices is conceptual modelling that involves investigating the requirements of the stakeholders, and developing a specification of the future system, the conceptual schema for the design process of the system modelling.

Corporate Sustainability Strategy is the process of documenting the actions necessary to identify, promote, and report the sustainability organization strategy and its general sustainable goals, considering its market, values, external regulations, external and internal initiatives, and its primary sustainability focus.

Corporate Sustainability Objectives is the process of documenting the actions necessary to identify the priority sustainability objectives of the organization based on the stakeholders' analysis and stakeholders' management strategy.

Corporate Sustainability Structure is the process of documenting the actions necessary to define the way activities are allocated, coordinated and supervised to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives. It focuses on the required sustainability knowledge, skills, training, certifications, roles, and department for managing sustainability practices.

Sustainability Knowledge and Skills Analysis is the process of identifying and documenting the technical expertise and the required tools to enhance the sustainability performance determined by the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The Sustainability Knowledge and Skills Analysis identifies the sustainability skills, knowledge, and competencies for managing the Corporate Sustainability Strategy and Corporate Sustainability Objectives.

Sustainability Work Breakdown Structure is the process of identifying and documenting the sustainability work package from the general division to its smallest components identifying and dividing the sustainability activities to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The Sustainability Work Breakdown Structure identifies the roles and responsibilities for managing the sustainability activities of the organization to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives.

Corporate Sustainability Policies and Procedures is the process of documenting the actions necessary to determine the corporate sustainability principles, rules, and guidelines for the organization based on the Corporate Sustainability Strategy and Corporate Sustainability Objectives.

SMP—Sustainability Management Processes is conceptual modelling that specifies the requirements to implement a working system. The SMP assists the organization in identifying its sustainability working

system, identifying the tasks and the methodology to implement, manage, control, and report the sustainability activities of the organization.

Corporate Sustainability Tasks is the process of documenting the actions necessary to evaluate the organization's activities, the Corporate Sustainability Strategy, and the Corporate Sustainability Objectives, identifying the methods of managing them considering the planning, communication, execution, assessment, and reporting.

Sustainability Operations Management is the process of identifying and documenting the work breakdown structure of the activities that provide sustainability management in the construction phase and help the organization to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The Sustainability Operations Management identifies specific sustainability activities and sustainability processes, assisting an organization goes from general or ethical goals to tangible and practical actions.

Sustainability Indicators and Assessment Management is the process of identifying and documenting a reliable mechanism to identify and manage the sustainability measures indicators. The Corporate Sustainability Tasks—Sustainability Indicators and Assessment Management assists the organization in determining a reliable tool to measure, monitor and control the performance of the organization's sustainability goals.

Sustainability Reporting Management is the process of identifying and documenting the format to report sustainability practices of the organization and disclose sustainability performance, including the progress and measurements of the Corporate Sustainability Strategy and Corporate Sustainability Objectives.

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Dedication

I honour and glorify God for this accomplishment. During this journey, I could grow in faith and see His provision. I live for what I believe, having faith that we can all make a difference, and being patient when things were confusing or did not go as expected. Having faith in God, in the name of Jesus, gives me the strength I needed each day to push myself just a little bit more.

I dedicate this work to my family and friends, and if I could give an advice based on this Ph.D. journey experience, I would say:

- Live for what you believe.
- Believe you have a purpose in this life.
- Have faith that moves you to keep the journey even though it seems very hard.

Chapter 1: Introduction and Context

1.1. Introduction to the Research Topics and Questions

With over 40% of the global greenhouse gases arising from the built environment (25% from electricity and heat production, 14% from transportation, and 6% from buildings) (EPA - United States Environmental Protection Agency, 2019), *Sustainable Development (SD)* is becoming an increasingly important part of the construction industry. Not only are construction companies adopting SD goals, technologies, and processes—or *SD construction practices*—but they are also spending an increasing amount of time and effort in managing these practices—i.e., *Sustainable Development Management (SDM)*.

As a relatively new area of concern within the construction industry, SD construction practices and SDM are in the early stages of emerging as established construction practices, with much less consensus and formalization than other areas within the industry. To a large degree, SD construction practices are becoming formalized using codes and certification systems, such as *Leadership in Energy and Environmental Design (LEED)*, the current green building rating system most used (U.S. Green Building Council, 2020). But these contribute little to the formalization of SDM.

Management frameworks such as the *Project Management Body of Knowledge (PMBOK)* (Project Management Institute, Inc., 2017) and the *Construction Extension to the PMBOK Guide* (Project Management Institute, Inc., 2003), on the other hand, provide frameworks for management practices across most of the areas of concern such as project risk management for the construction industry, but they do not specially address SDM.

The goal of this research is to address the gap between SD codes and standards and management frameworks by investigating SDM within building construction companies and developing a management framework—a *Sustainable Development Management Body of Knowledge (SDMBOK)*.

To pursue this goal, this research addresses the following research questions (see Figure 1-1. Research roadmap diagram that illustrates the summary of the research activities identifying the research questions, objectives, points of departure, methodologies, and contributions.):

1. What is the scope of SDM?

This research question asks what should be included within an approach to SDM, both in terms of breadth of possible topic areas and depth of specific topics. How can this scope be expressed and how does it relate to other important SD frameworks such as the UN SDGs?

2. How to implement SDM?

Once we understand the scope of SDM by answering question 1, this question asks how can SDM be carried out within the construction industry? Answers to this question should address both generality—providing a widely-applicable approach or framework—and practicality—specific tools and techniques for implementing SDM.

To address these two research questions, the following research objectives are established:

1. Define the scope of SDM.
 - a. Develop a set of sustainability targets that can be used to assess the construction industry's impact on Sustainable Development.
 - b. Identify the impact that these targets (which represent the scope of SDM) have on achieving the United Nations Sustainable Development Goals (UN-SDGs).
2. Develop an approach for implementing SDM.
 - a. Identify and organize a knowledge base for SDM into a framework.
 - b. Develop tools and techniques to facilitate the construction industry's implementation of the UN-SDGs into their strategic and tactical management.

Research	1. What is the scope of SDM?		2. How to implement SDM?	
Objectives	1. Define the scope of SDM		2. Develop an approach for implementing SDM	
	1.a. Develop a set of sustainable targets that can be used to assess the construction industry's impact on Sustainable Development	1.b. Identify the impact that these targets (which represent the scope of SDM) have on achieving the United Nations Sustainable Development Goals (UN-SDGs)	2.a. Identify and organize a knowledge base for SDM into a framework	2.b. Develop tools and techniques to facilitate the construction industry's implementation of the SDGs into their strategic and tactical management
Points of Departure	Many standards and certifications 	UN SDG's 	Knowledge base of SDM 	Structure of the SDM-BoK framework 
Methods	Meta-analysis of Standards/Certifications	Mapping Diagraming	Literature Review Conceptual Modeling	Case Studies
Contributions	The 100 SDI 	Mapping Diagrams of the contribution of each SDI to the SDGs 	Framework of Knowledge Areas 	Framework of Current Practices and Templates 
Vaidations	Table with the approximately 1000 indicators studied and validation from a specialist		Method Evaluation Model: validation of the acceptance by specialist - CEO, Project Manager, Sustainability Manager, Academy	

Figure 1-1. Research roadmap diagram that illustrates the summary of the research activities identifying the research questions, objectives, points of departure, methodologies, and contributions.

The two questions that this research addresses are connected but independent. The first question—How to scope SDM for the construction industry—relates to consolidating current approaches of the three pillars of sustainability for the building construction industry, informing the possible sustainable development targets that can be analyzed and selected by the framework developed to address the second question—how to implement SDM in construction.

The scope of sustainable development and its mapping to the UN-SDGs are valuable contributions to the construction field. They help an organization move from a subjective and "personal experience or value" analysis to a more objective analysis of the sustainable development targets related to a specific organization's reality.

The sustainability scope of this study is focused on sustainability targets for the building construction industry, benefiting stakeholders such as construction managers and contractors. The 100 SDI can help the

building construction industry to identify the main sustainable development targets for new solutions, assessment management, and reporting. The government also has an essential role in delivering a sustainable future by providing informed decision-making mechanisms and developing and maintaining strategies and policies that will help sustainable practices implementation. The 100 SDI can help a government to identify the sustainability impact of the building construction industry and manage the effect through policies and assessment of sustainability targets for this industry.

Figure 1-2 illustrates the connection between the two main objectives of this research.

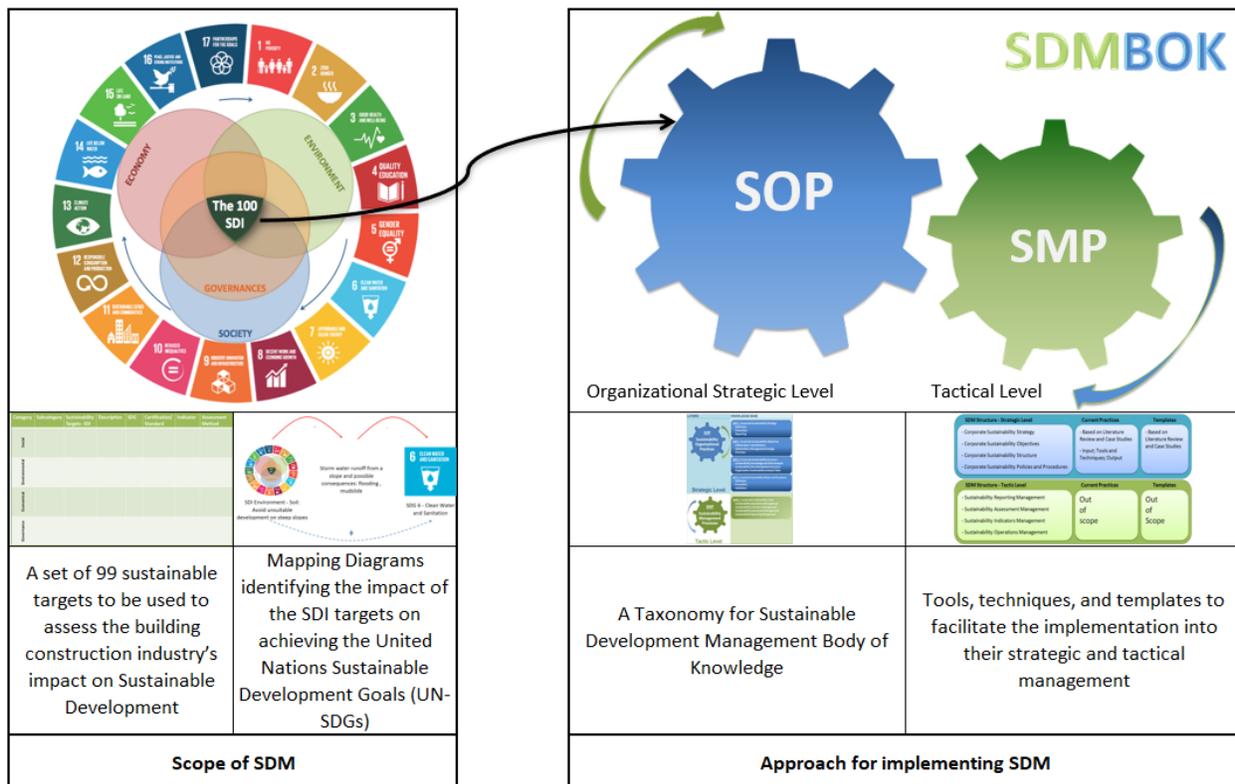


Figure 1-2. The relationship between the research objectives: the results of objective 1, The 100 SDI, defines the scope of SD, which provides the context for objective 2, the SDMBOK framework.

1.2. Research Methodology

To address the research objectives, the research encompasses the following methodologies and contributions:

1. Define the scope of SDM.

- 1.a. A meta-analysis of the existing SD standards and certification system is conducted to produce a master list of targets for SD in the construction industry, the 100 Sustainable Development Indices (100 SDI).
- 1.b. The interrelationships between targets and the UN SD goals is analyzed to link the 100 SDI to the UN SDGs.
2. Develop an approach for implementing SDM.
 - 2.a. A literature review of the management domain is conducted to produce a taxonomy of knowledge areas relevant to SDM, providing the underlying structure of the SDMBOK framework.
 - 2.b. Industry case studies are conducted to collect current practices to populate the SDMBOK, also leading to a series of implementation templates.

As a qualitative research contribution, this study identifies significant gaps in the sustainability management approach of the construction industry, understand the scope of sustainable development, contribute to the UN-SDGs and provide a taxonomy of a sustainability management body of knowledge.

Utilizing the Design Science Research (DSR) method as a means of document analysis and the Technology Acceptance Model (TAM) as a process of validation, this thesis defines the scope of sustainable development for the building construction industry (in the form of the 100 SDI) and a taxonomy of a Sustainable Development Management Body of Knowledge (the SDMBOK). Chapter 2: provides more detail about the research methodology while Chapter 5: includes additional detail about the validation results.

As illustrated in Figure 1-2, the two main contributions of this research are independent but connected. To better introduce the two parts of this research, this document is organized as illustrated in Figure 1-3.

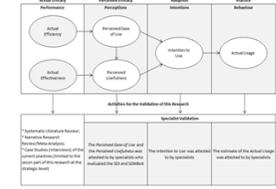
	Research Objective	Results	Chapter
	1. What is the scope of SDM?	The 100 Sustainable Development Indices (the 100 SDI)	Chapter 3 Presents the challenges, methodology and contributions of the first objective of this research—the scope for SDM—organized into six sections: introduction to the main topic; the point of departure for sustainability and sustainable development; the research activities; the contribution; the validation; and the conclusions from this part of the work.
	2. How to implement SDM?	The Sustainable Development Management Body of Knowledge (the SDMBOK)	Chapter 4 Presents the challenges, methodology and contributions of the second objective of this research—the implementation of SDM—again, in six sections: introduction to the main topic; the point of departure for project management, project and construction management, sustainable development management; the research activities; the contribution; the validation; and the conclusions.
	Research Validation	Validation methodology of the research	Chapter 5 Presents the research design and validation process with the final conclusions.

Figure 1-3. Thesis Structure. Diagram showing the way the research is organized on this thesis.

1.3. Sustainable Development

Society’s understanding of sustainability has been changing for the last three decades and has expanded to engage a range of complex issues. The focus of sustainability from 1960 to 1970, 1990 to 2000, and 2010 to the present day have expanded from air & water pollution to safety & consumer protection to climate change, respectively (Rosenberg, 2015).

Since the United Nations Conference on the Human Environment held in Stockholm in 1972, sustainability has been a significant focus across a broad range of human activities. In 1983, the World Commission on Environment and Development (WCED) introduced the most popular definition of SD: *to meet the needs of the present generation without compromising the ability of future generations to meet their needs* (United Nations, 1997).

Sustainability is commonly conceptualized as involving the three pillars: social, environmental, and economic—and SD must address all three of these domains (Circular Ecology Ltd, 2019).

Furthermore, our understanding of SD has expanded to engage in complex issues such as economic development models, world food supply, poverty reduction, justice, and nature conservation (maribus gGmbH, 2017). Sustainability issues and the ways that organizations address them impact not just the

environment, but also employees, nearby communities, clients, and material sources. Consequently, a focus on sustainability is increasingly important and complex for all types of organizations.

Williams et al. (2004) refers to SD as a large, diverse and rapidly expanding field of enquiry populated by various discourses, multiple approaches and a variety of recommendations.

The 2030 Agenda for SD, adopted in 2015 by the United Nations and committed to by more than 193 countries, contains 17 *Sustainable Development Goals (SDGs)* as follows (United Nations, 2015):

- SDG 1—No Poverty
- SDG 2—Zero Hunger
- SDG 3—Good Health and Well-Being
- SDG 4—Quality Education
- SDG 5—Gender Equality
- SDG 6—Clean Water and Sanitation
- SDG 7—Affordable and Clean Energy
- SDG 8—Decent Work and Economic Growth
- SDG 9—Industry, Innovation and Infrastructure
- SDG 10—Reduced Inequalities
- SDG 11—Sustainable Cities and Communities
- SDG 12—Responsible Consumption and Production
- SDG 13—Climate Action
- SDG 14—Life Below Water
- SDG 15—Life and Land
- SDG 16—Peace, Justice, and Strong Institutions
- SDG 17—Partnerships for the Goals

For this research project, the definition of SD consists of sustainable practices that are involved in achieving sustainability objectives as understood by the three pillars of sustainability and as detailed by the United Nations with the 17 SDGs.

1.4. Sustainable Development in the Construction Industry

The United Nations acknowledges the construction industry as having an essential role in delivering the SDGs and their associated targets (Building Research Establishment Ltd, 2018). The contribution includes significant economic, environmental and social impacts and benefits associated with construction products, buildings and infrastructure throughout their lifecycles.

Although efforts to implement sustainability in daily operations start with a desire to impact the world positively, organizations are detecting the benefits of sustainable practice in many ways, such as reduced costs and liabilities, and improved corporate image (Weybrecht, 2014). Conversely, some managers are not convinced that sustainable conduct is a priority for their business. According to Weybrecht (2014), this belief comes from the lack of information or understanding of the advantages of implementing sustainable practices in the organization and of how to measure it.

There is no single and transparent approach to achieving sustainable practices in the construction industry. Sources of information are abundant, but these approach the issue from many perspectives and span a vast spectrum of topics and technologies. Moreover, sustainability can require high levels of expertise in diverse areas such as climate change, air and water pollution, and solid waste management (Antweiler, 2014), as well as social responsibility, environmental economics, and sustainability policies. As a result, there is a lack of understanding of how to make the construction industry more sustainable despite the wealth of information.

To the extent that a common approach to SD is emerging within the construction industry, it most commonly takes the form of sustainability-related standards and certifications. There are many standards, certifications, and other materials for helping to capture and codify sustainable practices in business, building performance and other fields. Certifications often focus on the same or overlapping areas, such as LEED, *Building Research Establishment Environmental Assessment Method (BREEAM)* (BRE Global Ltd., 2017), *International Organization for Standardization (ISO) 14000 - Environmental Management Standards* (ISO - International Organization for Standardization, 2009), *World Business Council for Sustainable Development (WBCSD)* (WBCSD - World Business Council for Sustainable Development, 2019).

The standards and certifications are increasingly common in the construction industry. Moreover, they are unquestionably impacting the industry by creating a substantially new type and volume of management and administrative tasks to complete the certification process.

A *Project Management Institute (PMI)* research statement supports the above observation: "green structure" can require the utilization of unusual materials and building practices to accomplish sustainability, and extensive documentation and reporting if environmental certification is a project goal (Project Management Institute, Inc., 2008). PMI also recognizes the need for adjustments in the traditional management practices and that these adjustments reflect an increased demand for cross-disciplinary coordination in the early life cycle of the project.

These observations about the management of SD practices within construction suggest that a clear distinction can be made between the SD construction practices and the management of those practices, or SDM.

1.5. Management in the Construction Industry

Since construction projects are such large, complex, multi-party ventures, effective management is critical. Consequently, project management is a well developed and actively practiced discipline within the industry. Best practices have been mainly formalized in the form of project management standards, such as the PMBOK. The PMBOK is structured into a series of knowledge areas. For each knowledge area, the PMBOK defines a set of management processes. For each of these management processes, the PMBOK defines inputs to the process, tools and techniques that support the process and outputs of the process. The PMBOK does not include a knowledge area dealing specifically with SDM.

The PMBOK identifies several key components that interact with one another during a project's management. Those key components are placed in six sections: project life cycle—the phases a project passes through from its start to its completion, project phase—the related project activities that culminate in the completion of a deliverable, phase gate—a review at the end of a phase to continue to the next phase, project management processes—a systematic series of activities creating and input/output cycle, project management process group—a group of management inputs/tools and techniques/outputs of phases, and project management knowledge area—identified knowledge areas requirements described in terms of its components processes.

As a standard and guide, the PMBOK assists project management in ten knowledge areas: project integration management, project scope management, project schedule management, project cost management, project quality management, project resource management, project communication management, project risk management, project procurement management, and project stakeholder management.

The Construction Extension to the PMBOK Guide is an additional document that focuses on construction projects only. The guide details the business case, including the environmental impacts of the projects and enterprise environmental factors. However, as with any other standards and certification analyzed by this research, the assistance for the organization to implement sustainable development management initiating at the organizational/strategic level and connecting to the tactical level (project management level) is yet not clear, and it is the objective of this study.

1.6. Sustainable Development Management and Formalization Systems in the Construction Industry

The discussion in section 1.5 introduces systems that are used to formalize practices within the construction industry. As illustrated in Figure 1-4, building codes, standards, and regulations are examples of systems that formalize construction practices across all the domains within the construction industry. Within the area of SD specifically, certification systems such as LEED are common for formalizing sustainable construction practices. Meanwhile, management practices are formalized by project management frameworks and standards, such as the PMBOK. The gap among these systems is the lack of solutions that formalize management practices (as opposed to construction practices) specifically for the domain of SD.

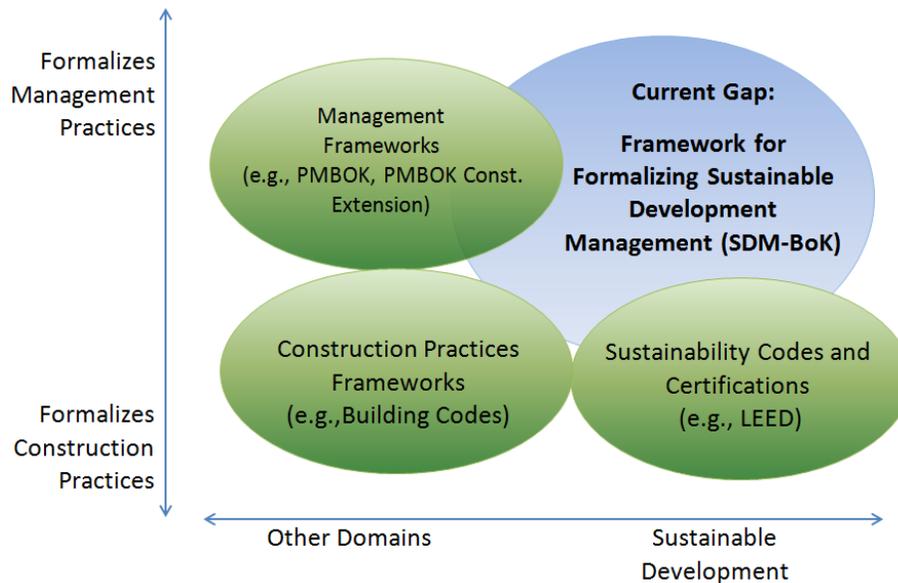


Figure 1-4. Systems (frameworks, codes, and certifications) that formalize activities within the construction domain, distinguishing between systems that formalize management practices vs those that formalize construction practices, and between those that formalize sustainable development practices from those that formalize other domains.

Much of the construction industry is striving to become more sustainable and is spending considerable management and administrative effort to achieve this through standards and certification processes. However, corresponding to the above gap, the industry understanding of how to achieve broad sustainability, the effectiveness of certification as a mechanism, and companies' management practices remain under-developed and disconnected.

Consequently, the overall objective of this research is to propose a solution that formalizes sustainable development management practices into a body of knowledge framework: an SDMBOK.

1.7. Layers of Sustainable Development Management

This study makes contributions at two distinct management layers: *Sustainability Organizational Practices (SOP)* and *Sustainability Management Processes (SMP)*.

The SOP are the processes that the organization uses to identify its sustainability goals, the human resources to execute the sustainability tasks, and the methodologies to identify and incorporate sustainability values and policies into the organization's operations. It focuses on the corporate organizational structure divided into four areas: *Corporate Sustainability Strategy*, *Corporate Sustainability Objectives*, *Corporate Sustainability Structure*, and *Corporate Sustainability Policies and Procedures*. Table 1.1. demonstrates examples for each of the three pillars of sustainability for the SOP level. The numerical values in this example are hypothetical and are used to illustrate the application of the SDMBOK framework proposed in this research at the strategic level - SOP.

The SMP are the processes that the organization uses to implement its sustainability strategy, identifying the tasks and the methodology to implement, manage, control, and report the sustainability activities of the organization, based on the *Corporate Sustainability Tasks*. It focuses on the management processes divided into three areas: *Sustainability Operations Management*, *Sustainability Indicators and Assessment Management*, and *Sustainability Reporting Management*.

Table 1.2 demonstrates examples for each of the three pillars of sustainability for the SMP level. The numerical values in this example are also hypothetical and are used to illustrate the application of the SDMBOK framework proposed in this research at the tactical level - SMP.

The SDMBOK was founded on proven management methods and resulted in a transparent implementation of sustainable development practices.

Table 1.1. Practical examples for each of the three pillars of sustainability for the Sustainability Organizational Practices (SOP) level, contribution of the SDMBOK.

Sustainability Pillar	Corporate Sustainability Strategy	Corporate Sustainability Objectives	Corporate Sustainability Structure	Corporate Sustainability Policies and Procedures
Social	<ul style="list-style-type: none"> To contribute to the SDG #4 (Quality Education): “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (United Nations, n.d.) 	<ul style="list-style-type: none"> To ensure that 100% of the employees at the managerial level and 75% of the employees at the operational level acquire the knowledge and skills needed to promote sustainable development, including, among others, through education and sustainable lifestyles (Target 4.7 of the SDG #4) 	<ul style="list-style-type: none"> To define the department that will manage and implement the goal. The organization decides either having a sustainable development management department or distributing among the departments according to the traditional management model 	<ul style="list-style-type: none"> To train 100% of the employees at the managerial level. Preferable before initiating their activities in the organization (as soon as being hired). To have periodic training and workshops for the employees at the operational level promoting personal sustainable development behaviours, sustainable consumerism (also contributing to SDG #12), and sustainable development behaviour at the workplace environment Use OECD (Organization for Economic Cooperation and Development) as a policy creation standard.
Environmental	<ul style="list-style-type: none"> To contribute to the SDG #12 (Responsible Consumption and Production): “Ensure sustainable consumption and production patterns” (United Nations, n.d.) Zero Waste at the construction site 	<ul style="list-style-type: none"> To sort 100% of the waste on the construction site and either reuse or recycle it (Target 12.4.2 of the SDG #12) 	<ul style="list-style-type: none"> To define the department that will manage and implement the goal. The organization decides either having a sustainable development management department or distributing among the departments according to the traditional management model 	<ul style="list-style-type: none"> To use LEED instructions for waste management on the construction site To have a partnership with recycling organizations to sort and re-utilize the waste

Sustainability Pillar	Corporate Sustainability Strategy	Corporate Sustainability Objectives	Corporate Sustainability Structure	Corporate Sustainability Policies and Procedures
Economic	<ul style="list-style-type: none"> To contribute to the SDG #8 (Decent Work and Economic Growth): “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all” (United Nations, n.d.) 	<ul style="list-style-type: none"> To ensure a fairly proportion of employment by sex (Target 8.3.1 of the SDG#8) 	<ul style="list-style-type: none"> To define the department that will manage and implement the goal. The organization decides either having a sustainable development management department or distributing among the departments according to the traditional management model In this case, most likely at the HR department 	<ul style="list-style-type: none"> To have a clear job description based on the capacity, and guarantee that neither preferences nor judgments are based on the sex To define a fair percentage of employees by sex according to ability to the activity Use OECD (Organization for Economic Cooperation and Development) as a policy creation standard.

Table 1.2. Practical examples for each of the three pillars of sustainability for the Sustainability Management Processes (SMP) level, contribution of the SDMBOK

Sustainability Pillar	Sustainability Operations Management	Sustainability Indicators Management	Sustainability Assessment Management	Sustainability Reporting Management
Social	<ul style="list-style-type: none"> • To elaborate a Workshop Plan for personal sustainable development behaviours; • To develop a Workshop Plan for sustainable consumerism; • To develop a Workshop Plan for sustainable development behaviour at the workplace environment 	<ul style="list-style-type: none"> • % of construction managers and coordinators trained in Sustainable Development Management • % of the employees at the operational level participating in the Sustainable Development Workshops promoted by the organization 	<ul style="list-style-type: none"> • Number of employees/number of attendances; evidence: number of employees and list of presence • Evaluation of the context trained; evidence: score of the applicable exam 	<ul style="list-style-type: none"> • To report the number of employees trained per topic and year and the percentage of the total of employees • To use GRI (Global Reporting Initiative) as a standard for sustainability reporting
Environmental	<ul style="list-style-type: none"> • To elaborate the Waste Management Plan 	<ul style="list-style-type: none"> • % of the construction site waste being sorted • % of the construction site waste being either reused or recycled 	<ul style="list-style-type: none"> • List of construction waste generated and diverted to landfill itemizing the waste, the material stream, waste total amount, and diverted amount per item and total per project. All units of measure must be consistent (LEED) • Evidence of average recycling rates for Commingled waste sorting Facilities (if applicable) (LEED) • Waste per Area for the entire project (LEED) 	<ul style="list-style-type: none"> • To report the list of accumulated waste divided per project/ area/ type • To inform the % of the waste to be reused and the way it was applied • To indicate the % of the waste to be recycled and the way it was applied • To use GRI (Global Reporting Initiative) as a standard for sustainability reporting

Sustainability Pillar	Sustainability Operations Management	Sustainability Indicators Management	Sustainability Assessment Management	Sustainability Reporting Management
Economic	<ul style="list-style-type: none"> • To elaborate a Sustainable Hiring Process Plan; from the job description to the interview to the selection of the candidate • To create a Partnership Plan with Educational Institution to motivate Work Skilled Preparation for Woman 	<ul style="list-style-type: none"> • % per sex in each category in each work category • % of the turnover of woman versus man in each work category • % of woman candidates interviewed and hired from the Educational Institutions partners 	<ul style="list-style-type: none"> • A formal report from HR with the % of the employees per sex per position • An official report from HR with the % of turnover per sex 	<ul style="list-style-type: none"> • To use GRI (Global Reporting Initiative) as a standard for sustainability reporting

1.8. Key Motivation for Research

The construction industry contributes over 40% to the greenhouse gas emissions in Canada and utilizes over 50% of the natural resources, according to the National Research Council (Canadian Construction Innovations, 2016). Furthermore, according to the Conference Board of Canada, the Canadian construction industry has made an enormous contribution to other areas such as employment, representing 7% of the country's total workforce, and the economy, representing 7% of the nation's GDP, as well as having a significant impact on society daily (Canadian Construction Innovations, 2016). Therefore, a desire to understand the SD impact of the construction industry and of how to manage the indicators was the *initial motivation* of this research to help the sector with contributing to SD.

A pilot research project performed in 2017 aimed to assess the sustainability management practices of four construction organizations. The research methodology was an interview with professionals from four construction organizations. The study identified the following observations and hypotheses (Espindola & Froese, 2018):

- *Company A*: The Project Manager had training and acknowledged the values and policies of the organization. The individual Project Manager's sustainable behaviour was noticeable. However, the Project Coordinator, Construction Site Superintendent, and Site Safety Officer were unaware of the sustainability policies and sustainability values of the organization. They mentioned that they would follow the processes that the Project Manager determined they were obligated to observe. The lack of involvement and understanding of SD and sustainable practices were visible. The researcher recognized the importance of having a transparent sustainability organizational structure and promoting the values and goals of the organization to implement sustainable behaviours through its employees at all levels. The SOP is expected to support this.
- *Company B*: The organization had a specific department for controlling the sustainability practices of its projects. The company was structuring its sustainability practices, and does not yet have well-defined values and policies but was following LEED practices. The employees acknowledge the importance of these practices, but they are not aware of the organization values. The lack of sustainability organization values demonstrated, again, the importance of identifying and promoting the sustainability organizational structure to the whole hierarchy levels involved in the project construction management, and, again, the SOP is expected to support this.
- *Company C*: Although the Project Manager did not have any specific training in sustainability or additional certification, such as LEED certification, the professional was involved and desiring to

improve the sustainable processes because the organization continually promotes its values and policies. Even though the professional did not have a sustainability background, sustainability practices were incorporated into his behaviour because the organization's sustainability goals were promoted to the whole hierarchy levels involved in the project construction management. This behaviour demonstrated the impact of promoting the organizational sustainability values to the team at all levels—which is the purpose of the SOP and SMP.

- *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, demonstrating, again, the impact of having and promoting the organizational sustainability values to the team at all levels—which is the purpose of the SOP and SMP.

The pilot project also demonstrated the lack of consistency and a formalized management practices for sustainable development management, motivating the researcher to identify the current gap of a framework for sustainable development management.

The principal motivation of this research is to identify a way to help the construction industry to structure itself and implement sustainability practices in its daily activities to contribute to SD. This motivation comes from the fact that we have abundant information regarding sustainability but also complex management processes, with new types and volumes of management and administrative tasks required to pursue SD. Also, there is a lack of a clear framework in assisting in implementing SD at both the strategic and tactic levels.

This research focuses its study on the literature review and practices well recognized in South and North America. The case studies examined in relation to the second objective are drawn from organizations in Canada and Brazil. Therefore, the research results are expected to be relevant to organizations across the Americas and worldwide to the extent that their practices are similar to American operations.

1.9. Results and Main Audience/End-users

The primary purpose of this research is to assist the construction industry to implement sustainable development management into their strategic and tactical level operations, assisting in translating broad sustainability goals into specific tasks.

The audience that stands to benefit the most from this research includes, but is not limited to:

- Construction managers and project managers;
- Sustainability managers and coordinators;
- Contractors;
- Subcontractors;
- Architects, designers, and engineers;
- CEO—Chief Executive Officers;
- Construction consultants;
- Construction industry trades and professionals – the construction business, in general, increases public goodwill, credibility and positions it for growth.

The 100 SDI introduces a consolidated list of sustainability targets focusing on the building construction industry and their contribution to the UN-SDG. The list can be analyzed and considered by the construction organizations for their strategic planning according to their context and values.

The SDMBOK includes the definitions and tools of each knowledge area of both strategic and tactical management layers. It also introduces templates for assisting organizations to implement the framework at the strategic level. In any organization that is willing to demonstrate a systematic approach and communicate performance, the SDMBOK would be useful. The SDMBOK addresses a more generic management knowledge applying to a broader industry group than construction management as projects, and many organizations share the same characteristics described for construction management.

Table 1-3 demonstrates the specificity of each question addressed by this research.

Table 1.3. Research process map

Part I - What is the scope of SDM?							
Research Process	Research Methodology	Research Objectives	Research Activities				
			Data Collection	Data Analysis	Findings		
Research Methods and Findings	Document Analysis - Systemic Literature Review	a. What indicators can be used to assess the construction industry's impact on Sustainable Development?	Identified the sustainability targets of certifications and standards in some way connected to the United Nations Sustainable Development Goals (UN-SDGs) and their respective indicators and assessment methodology Categorized the targets according to the three pillars of sustainability: environmental, economic and social, and governances	Narrative Research Review/Meta-Analysis: it was investigated and consolidated the results of different examinations. It was considered different standards and certifications addressing somewhat sustainability issues in the construction industry (business and operation perspectives) and the UN-SDGs. The objective was to utilize the combination of several results to introduce a list of sustainability targets addressing the three pillars of sustainability for the building construction industry	The initial list of all the sustainability targets, sorted by the category and subcategory, contained more than 800 sustainability targets. By considering overlapping targets, these were consolidated into a set of 100 sustainability targets called the 100 Sustainable Development Indices (100 SDI)—the first objective of this research		
		b. What is the construction industry's impact on achieving the United Nations Sustainable Development Goals (UN-SDGs)?	Identified how each target of the SDI influenced the UN-SDGs, defining the relationships between them. It was considered several different materials-journal papers, conference papers, technical reports, etc.-to identify the effect of the SDI to the SDGs	Mapping system analysis: it was identified how the SDI impacts on the UN-SDGs mapping the relationship between them. The mapping system used the idea of Causal Loop Diagrams (CLD). Each target was analyzed individually through a literature review to identify how it could positively impact the SDGs.	A set of sustainability targets for the building construction industry with their contribution to the SDGs		
Evaluation and Justification Process - Validation	Method Evaluation Model - MEM	The 100 SDI	Specialist Evaluation				
			Evaluation Source	Actual Efficacy-Performance Analysis	Perceived Efficacy-Perceptions Analysis	Adoption-Intentions Analysis	Practice-Behaviour Analysis
			Systemic Literature Review	Yes	n/a	n/a	n/a
		Summary Specialists Report (93%)	100%	100%	89%	81%	

Part II - 2. How to implement SDM?							
Research Process	Research Methodology	Research Objectives	Research Activities				
			Data Collection	Data Analysis	Findings		
Research Methods and Findings	Document Analysis - Systemic Literature Review	a. How to organize the knowledge base of SDM into a framework?	Conducted a literature review of several management frameworks to identify the types of management activities that should comprise a management framework for Sustainable Development (SD) in construction	Narrative Research Review/Meta-Analysis: it was investigated and consolidated the results of different management knowledge areas organized into two distinct layers. It was considered a business model, sustainability management models and construction management models. The objective was to introduce a taxonomy of Sustainable Development Management (SDM)	The taxonomy of the Sustainable Development Management Body of Knowledge (SDMBoK)		
		b. How to facilitate the construction industry's implementation of the SDGs into their strategic and tactical management?	- Conducted a literature review - Conducted case studies with several construction organizations to identify the current sustainability practices at the strategic level—in this research called Sustainability Organizational Practices (SOP)	Narrative Research Review/Meta-Analysis: It was investigated and consolidated the results of different management knowledge areas organized into two distinct layers. It was considered a business model, sustainability management models and construction management models and case studies for the first layer—SOP. The objective was to validate the proposed SDM framework and elaborate set of templates to assist organizations in implementing the SOP	SDMBoK and Templates for assisting an organization to implement the SOP		
Evaluation and Justification Process - Validation	Method Evaluation Model - MEM	SDMBoK	Specialist Evaluation				
			Evaluation Source	Actual Efficacy-Performance Analysis	Perceived Efficacy-Perceptions Analysis	Adoption-Intentions Analysis	Practice-Behaviour Analysis
			Systemic Literature Review	Yes	n/a	n/a	n/a
		Summary Specialists Report (90%)	96%	92%	95%	75%	

Chapter 2: Research Design and Validation Process

While there is a strong history of quantitative research within engineering, qualitative research has also become an essential tool, with its generation of hypotheses instead of testing methods, explanation instead of measurement, and understanding instead of a generalisable set of findings (Labuschagne, 2003). As a qualitative research approach, this study must meet the challenge of establishing a research process and validation that achieves the objectivity required of any Design Science Research (DSR): validity and reliability, the essential elements to make the results trustworthy (Quintero, 2018).

As utilized by several DSR projects with qualitative data analysis, this research combined methodologies to improve the clarity and objectivity of its results. As identified by Poirier (2015) in his Ph.D. research, research validation is the combination of two associated processes: 1) valid research methods and findings, and 2) evaluation and justification processes that are appropriate for DSR. The former, the valid research methods and findings—data collection and analysis—delivers a valid artifact. The latter, evaluation and justification processes—assessing the usefulness of the artifact—requires method and criteria to evaluate the suitability of the artifact. As Poirier (2015), Quintero (2018), and many others identified, the evaluation process of qualitative research projects, such as this one, focuses on the findings, interpretation, and acceptance of the artifact.

This research aimed to identify significant gaps in the studies of sustainability management in the building construction industry—an understanding of the scope and connection of the building construction activities to the SDGs and a taxonomy of management practices to implement sustainability management at both strategic and tactical level. DSR is identified with finding new answers for known or unknown issues. A solution ought to be generic, i.e., applicable not only to one unique situation but to a group of similar cases. A generic solution for general issues cannot be proven exhaustively. The DSR method suggests testing through the execution of the solution in at least one circumstance and researching whether it solves the intended problem or not. The verification reliability of the solution relies upon the number of executions and the variety of details implemented. In any case, the initial step consistently is to execute and confirm a generic solution in at least one situation. In the literature, this is called a demonstration.

Due to the difficulty in implementing the proposed solutions in a corporate organization—requiring long term embedment in the organization, access to a numerous and confidential strategic documents, and willingness of an organization to share its practices—this research utilized a methodology considering the document analysis method following by the Method Evaluation Model (MEM) for validation. Document

analysis methods have been accepted as viable research methods in numerous research reports and journal articles in the past decade (Bowen, 2009).

Qualitative research is predominantly focused on the properties, the state, and the character of the studied phenomena. It emphasizes procedures and implications that are thoroughly analyzed yet not explicitly quantified in terms quantity, amount, or recurrence. Qualitative methods ordinarily produce an abundance of detailed data about a modest number of individuals and cases. The qualitative data method provides profundity and detail through direct citation and cautious depiction of circumstances, occasions, associations and watched practices. For document-based approaches, the challenge of this method is to present sufficient detail in the reviewed literature regarding the procedure utilized and the outcomes of the document analysis (Bowen, 2009). The following topics present the details of the design process of this research.

2.1. Research Methods and Findings—Document Analysis

The valid research methods and findings step of this research consists of an investigation based on multiple data sources, aiming to consolidate the diverse information in the current literature that partially addresses the issues of sustainability and sustainable development management.

The epistemology of this research, as a qualitative research method, uses a document analysis method. This study attempts to consolidate diverse sources of information existing in the current literature, focusing on the three perspectives of sustainability—environmental, economic and social. The lack of a unifying understanding within the existing literature made it difficult to understand the scope of SD in the construction industry, thereby impacting the implementation of SD into organizations.

Document analysis is a systematic method for reviewing or assessing documents—both printed and electronic material. As other expository and analytical techniques in qualitative research, document analysis necessitates that information be analyzed and interpreted to evoke importance, increase understanding, and create observational information (Bowen, 2009).

Qualitative research methods comprise three types of data collection (Labuschagne, 2003):

- In-depth, open-ended interviews
- Direct perception
- Written documents

The systematic evaluation of documents as a part of a research study takes several forms—minutes of meetings, books and brochures, diaries and journals, maps and charts, program proposals, newspapers, organizational or institutional reports, manuals, etc. The previous studies are a source of data, relying on the description and interpretation of data rather than having the raw data as a primary source of analysis (Bowen, 2009).

Document analysis is regularly utilized in combination with other qualitative research techniques as a method for triangulation—the combination of strategies in the investigation of a similar phenomenon. The research looks for intermingling and confirmation using various information sources and techniques. By analyzing data gathered through multiple methods, the specialist can certify discoveries across informational collections and therefore decrease the effect of potential predispositions that can exist in a unique report (Bowen, 2009).

While document analysis has served generally as a supplement to other research techniques, it has likewise been utilized as an independent strategy. Undoubtedly, some specific types of qualitative research depend entirely on the investigation of documents (Bowen, 2009).

According to Bowen (2009), document analysis had five main specific functions in a research process:

- Offer data on the context of the research, providing background information and historical context. Those data assist the research to identify the historical roots of specific issues and indicate the current conditions under investigation
- Provide an understanding of what to question or what needs to be observed as part of the research. These observations can assist in generating interview questions to be conducted if part of the research process
- Provide supplementary research data. The data can be valuable additions to the knowledge base
- Provide resources for tracking change and development. Comparing various documents, the researcher can identify the necessary adjustments needed to add a knowledge base to the field
- Confirm findings or support evidence from other sources. Identifying convergence of information demonstrates the credibility of the results.

In summary, document analysis as a research methodology can provide background and context, additional information to be observed, supplementary data, tracking changes and developments, and support to other data sources. It is most effective when events cannot be observed or when informants do not share many details (Bowen, 2009).

The current literature review—research, standards, manuals, rating systems—of sustainability and management process, is currently very wealthy. However, as the gap identified by this research, the information is not consolidated and is often disconnected. This research did not intend to present a new solution based on new findings; instead, it proposes a new solution based on the consolidation of the wealthy literature in the field. The objective is to provide an understanding of the scope of sustainable development management in the building construction industry, then assisting in implementing it to the daily activities of the organization.

The document analysis methodology proved to be the most reliable and coherent approach to achieve the objective of this research. The data collected from the analysis of the documents provided the background context for this research, an understanding of what was missing and what needed to be observed, supplementary data for the consolidation of the information, and findings that support evidence from other sources as well as introduce the consolidated view of sustainability for the construction industry.

According to Bowen (2009), like any other research methodology, the document analysis method has advantages and disadvantages. The following list presents the advantages and disadvantages listed by Bowen (2009) , followed in each case with the implications for this research:

- Advantages
 - Efficient method—requires data selection rather than data collection. Therefore, it is less time-consuming and more efficient than other research methods.
 - One gap identified in this research was a consensus of scope and practices in the industry regarding sustainability, as demonstrated earlier in this research in the motivation topic (pilot project) where approaches were identified within organizations according to their particularities and values. So, a collection of practices and definitions in the literature review addressing several perspectives of sustainability and sustainability management seemed to be more reliable.
 - Availability—many documents are in the public domain, exceptionally since the advent of the Internet, and do not need the authors' permission. Therefore, the availability of the document makes document analysis an excellent option for qualitative research.
 - Sustainability, sustainable development, and sustainability management have been addressed richly for the past three decades. However, each document/organization addresses partially or strictly to a specific field. Therefore, the analysis of the documents,

through the systematic literature review, can provide a consolidation of the wealthy available information of sustainability in the construction industry.

- Cost-effectiveness—when the collection of new data is not feasible, the document analysis is less costly. As the preceding documents have already gathered the data, the challenge of the researcher is to evaluate the content and quality of the documents.
 - As mentioned earlier, this research identified a lack of consensus in the industry regarding the scope and implementation of sustainability. Therefore, to use quantitative methodology seemed to be unfeasible. As several organizations have approached some of the sustainability perspectives, they have already identified essential data. Therefore, a qualitative analysis seemed again to be more feasible and reliable.
- Lack of obtrusiveness and reactivity—documents are unaffected by the examination procedure. Therefore, document analysis differs from the concerns related to reflexivity (or its absence) that is concerned by other qualitative research methods. Regarding observation, for example, an occasion may continue differently because it is being observed.
 - Once more, the qualitative methodology—document analysis—seemed to be more reliable, allowing this research not to be influenced by individual values or controversial concepts that sustainability can produce.
- Stability—documents are appropriated for repeated reviews because there is no interference of the observer, becoming then more stable.
 - The systematic literature review of the qualitative research method utilized by this research allowed analyzing several perspectives of sustainability and management process without the interference of individual or personal beliefs and values or specificity of a particular field or organization.
- Exactness—documents analysis provides the inclusion of exact names, references, and details, making the research process advantageous.
 - The several materials analyzed by this research and introduced with their references—technical expertise and addressed sustainability and management process— provide more exactness and assuredness than any other quantitative research methodology.
- Coverage—document analysis covers broad information of the time, events and settings.

- This research considered a large number of materials, covering the diverse aspects of sustainability and sustainability management, consolidating the broad information that the current literature offers.
- Disadvantages
 - Insufficient detail—documents usually do not provide sufficient detail to answer a research question because they are produced for a purpose other than research.
 - As the primary objective of this research, this research considered several documents to consolidate the information the current literature offers. Moreover, it is not intended by this research to introduce the technical approach of sustainability, presenting the findings from a broad perspective but connected in a way that allows the construction industry to understand the concept and implement sustainable development into its reality.
 - Low retrievability—access to documents may be blocked. Therefore, documents cannot be retrievable, or their retrievability can be difficult.
 - Most of the documents utilized by this research were available to the public. Some exception is regarding additional information that could have been considered by this research from the ISO documents and rating systems. However, the data not available did not affect the results of this research. The lack of information from one record doubtlessly was covered by other documents in the consolidation process (meta-analysis).
 - Biased selectivity—the ‘biased selectivity’ can be considered due to an incomplete collection of documents. In an organizational context, the available/selected materials are likely to be aligned with the organization’s principles or may also reflect the emphasis of the particular corporate activity.
 - Due to the several materials about sustainability in the current literature, to select the ones that this research would consider was a challenge. Therefore, this research examined the UN-SDG as a reference to determine the selected documents, for the 100 SDI, and three categories of management perspective—sustainability management, project management, organizational management—for SDMBOK, narrowing the selection of the document and materials. Also, it focused on the building construction industry.

Document analysis involves data collection—skimming (superficial examination) and detailed review—and data analysis—interpretation (Bowen, 2009). The data collection and data analysis of this

research engaged a multi-method approach: systematic literature method and meta-analysis, respectively, as discussed on the following sections.

2.1.1. Data Collection—Systematic Literature

The document analysis principle lies in its role in methodological and information triangulation, the considerable documents in case study research, and its value as an independent technique for specific types of qualitative research. Justifiably, records might be the primary noteworthy information to examine an interpretive paradigm (Bowen, 2009).

The systematic literature method for document analysis was designed to consolidate the sustainability targets for the building construction industry—the 100 SDI—and identify the taxonomy for the framework—SDMBOK.

This research determined not only the availability but also the authenticity and usefulness of each document, taking into consideration the original purpose of each document, the focus of the sustainability perspective or management knowledge area, and the intended audience, focusing on the building construction industry.

The systematic review of the documentation provided background information to understand the economic, social and environmental aspects of the construction industry and sustainable development management body of knowledge.

Chapter 5 - Research Validation presents more details of the documents and data analyzes by this research. The appendices B.14—The 100 SDI and D.2—SDMBOK introduces the whole data and references utilized by this research.

2.1.2. Data Analysis—Meta-Analysis

The progression of scientific knowledge depends on the systematic structure of one investigation on the head of the earlier studies, the aggregation of which takes our comprehension to a higher understanding (Card, 2011).

Although documents can be valuable sources of information, the research process should analyze the materials critically and cautiously. Documents ought not to be treated as fundamentally exact, precise, or complete. The data need to be analyzed and introduced with the meaning and its contribution to the investigated issues (Bowen, 2009). The qualitative analysis needs to assess the documents for

completeness—covering the topic entirely or broadly—or selective—covering only some aspects of the issue (Bowen, 2009).

This research identified the source of information as selective due to the partial coverage by each document of the topic of sustainable development management. Therefore, the meta-analysis allowed this research to assess the completeness of the materials and consolidate the information according to sustainable development—economic, environmental, and social perspectives—and management process in the two layers of management—strategic and tactical.

Meta-analysis considers the analysis of the results from more than one study and does not require access to the raw data, which can be unavailable. It is the analysis of the results from multiple studies, in which individual studies are the unit of analysis (Card, 2011).

Meta-analysis is part of a larger family of literature review with some particularities that differs from other literature reviews regarding the focus and method of synthesis, as illustrated in Figure 2-1 (Card, 2011).

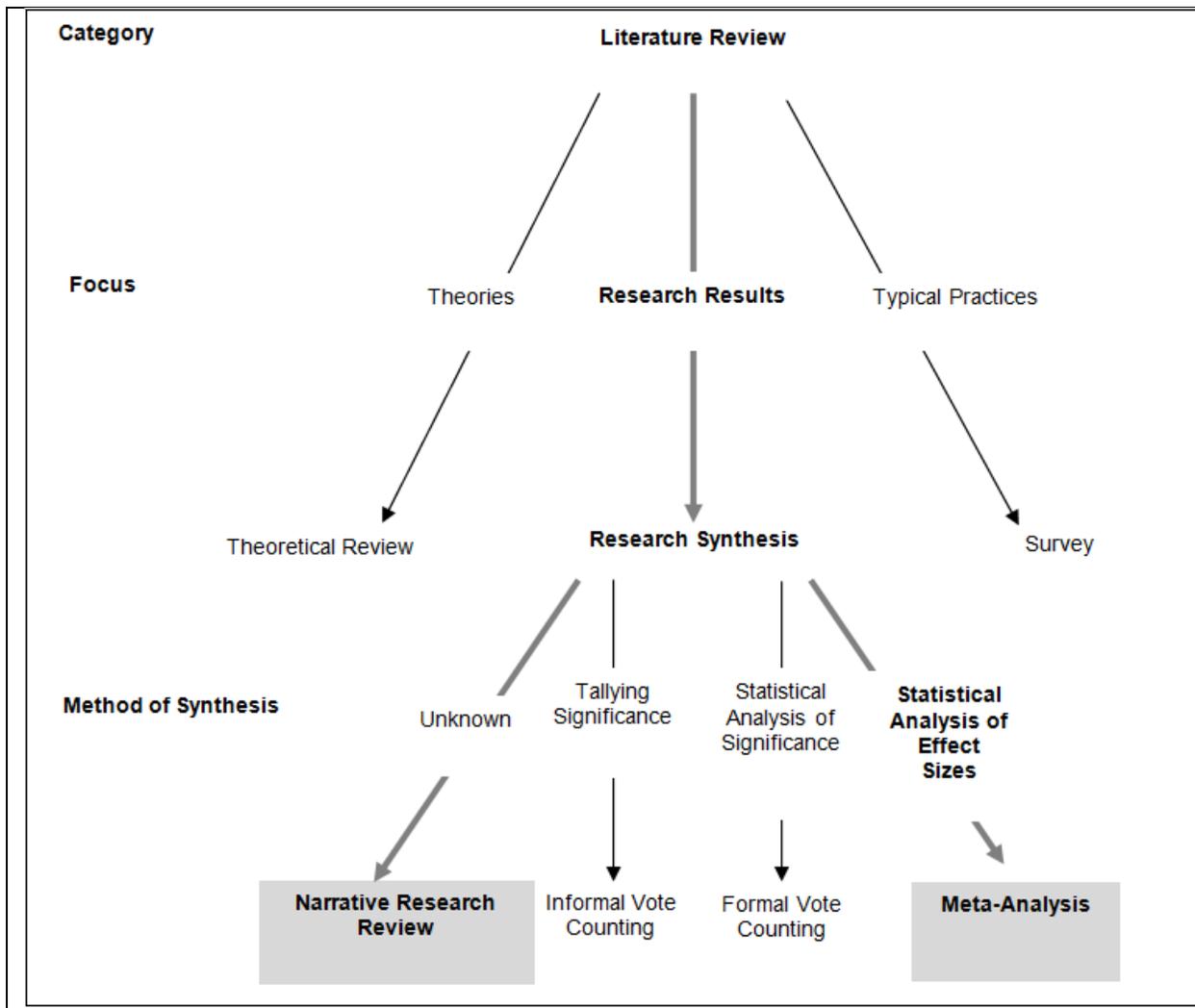


Figure 2-1. Relation representation of meta-analysis and narrative research review as part of a larger family of literature review methods (Adapted from Card, 2011)

Systematic reviews can include meta-analyses and other sources of evidence, as demonstrated in Figure 2-1. The most common definition of meta-analysis methodology is the combined or integrated results of several independent studies considered by the researcher to be combinable using statistical analysis (Matthias & Davey, 1997). However, this terminology, according to Matthias & Davey (1997), is still debated, and terms used simultaneously include “overview,” “pooling,” and “quantitative synthesis.”

As illustrated in Figure 2-1, the meta-analysis moves from qualitative to quantitative synthesis. As a research synthesis method, it focuses on the research outcomes, analyzing and demonstrating the findings of each study and synthesizing findings to elaborate conclusions. It differs from the theoretical reviews, which focus on theoretical analysis, and survey reviews, which focus on typical practices within a field (Card, 2011).

As this research focus is qualitative analysis, it is using the idea of meta-analysis to consolidate the various studies analysed, due to the objective of consolidating information from diverse knowledge areas from diverse literature, however without statistical analysis, bringing the study to a narrative research review.

So, when mentioning meta-analysis, the research practice of this study is considering a research synthesis analysis of combining diverse studies, as a definition of meta-analysis, but without the statistical analysis, which as demonstrate in Figure 2-1 is used for quantitative analysis. The "unknown" method of synthesis demonstrated in Figure 2-1 for the "Narrative Research Review" is being applied by the primary idea of the meta-analysis for this study.

According to Cooper, cited by Card (Card, 2011), there are five stages of research synthesis, including the meta-analysis, that define its process and scientific principles. Below are the five steps and the activities developed for this research in each of the stages.

- Formulate the problem—the primary objectives of this stage are: to formulate the question that the research aims to answer, defining the existing literature that can answer the question; to determine the constructs, making sure that the terms or operationalizations are the same in the literature; and to define which samples will be included in the literature review

The questions are discussed elsewhere in this thesis. As this research utilized a broad literature review of sustainable development, it required interpreting the terms to make sure they are being used for the same context. While defining the problem, it was observed how broad the sustainable development scope and management practices could be. Therefore, the research focused on the building construction industry for the first part of this research and management practices at the strategic level (dealing with the business model) and tactical level (dealing with project management practices).

- Obtain the studies—to obtain the literature relevant for the study. It is essential to consider representative relevant literature and highlight the importance of the literature to the review process. Also, consider the limitation of language and access to studies in different geographic areas

The literature review used by this research was presented elsewhere. Their importance and contribution can also be found in Table 5.1..

- Decide on study inclusion—to evaluate the studies existing in the current literature and to decide which should be considered in the research

As mentioned before, this research focused on the building construction industry and organizations that contribute and consider the SDGs in their studies or process, for identifying the sustainability targets. Also, for management practices, the research considered business models and project management practice to analyze the taxonomy of the framework.

- Analysis and interpretation of the study results—the most time-consuming and challenging stage. This stage involves creating a systematic code study to determine the characteristics and effect sizes, and then, how to analyze the data

The analysis of the data can be found in appendices B.14—the 100 SDI and D.2—SDMBOK. For the 100 SDI, the data were categorized according to four sustainability perspectives (economic, social, environmental, and governance), and the way the targets contribute to the UN-SDGs. The SDMBOK was categorized according to the taxonomy of the framework, divided into two layers (strategic and tactical).

- Present the findings from the research synthesis—this final stage synthesizes the literature, presenting the results of the analysis and providing valuable information from multiple studies. It does not just list the individual reviews, but summarize the study

The results of this research are founded in appendices The 100 SDI and SDMBOK. All the stages were carefully analyzed to execute the activities of this research. According to Card (2011), four general aspects should be considered, to explain the steps of the meta-analysis process: literature search procedures, study inclusion and exclusion criteria, study characteristics and effect sizes, data-analytic strategy. The summary of those steps is presented in the following section.

The findings and validation process of this research are introduced in Chapter 5 - Research Validation.

2.2. Evaluation and Justification Process (Validation Process)—Method Evaluation Model (MEM)

Design Science Research connects the appropriation or utilization of a particular artifact, such as a procedure or a belief, to quantifiable and significant impacts. This way, DSR consistently addresses gaps in theory and supports scientific progression (Baskerville, Marco, & Spagnoletti, 2013).

DSR is part of the Information System (IS) design research and emphasizes the development of new procedures while addressing the evaluation of methods in only a limited form. Therefore, it requires a different approach to validate methodological knowledge (Moody, 2003). Moody (2003) suggests a theoretical model for evaluating IS design methods called the Method Evaluation Model (MEM). MEM is

based on two previously unrelated areas of theory: Methodological Pragmatism from the philosophy of science and the Technology Acceptance Model (TAM) from the IS success literature.

Methods have only pragmatic value without truth value—a method does not describe any external reality, so it cannot be true or false but effective or ineffective. The objective of validation is not necessary to demonstrate that the method is correct but that it is a reasonable practice to adopt the technique based on its pragmatic success, which considers efficiency improvement—by reducing the effort required to complete a task (the inputs)—and effectiveness—improving the quality of the result (the outputs) (Moody, 2003).

Moreover, user acceptance analysis became an essential tool in the IS field because, regardless of the technical benefits of an artifact, if it is not used or is under-utilized, the benefits cannot be realized. So, according to Moody (2003), Technology Acceptance Model (TAM) is the most powerful model for user technology acceptance and has been used as the theoretical basis for many pragmatic studies. The advantage of resource low-cost, IT specificity, strong theoretical foundation and practical support names this model very attractive for the validation process. The TAM evaluates three primary constructs for validation: perceived ease of use, perceived usefulness and intention to use.

Therefore, TAM considers two dependent variables to analyze and validate whether a method accomplishes its purpose or not: actual efficacy—the methodological pragmatism science to determine the efficiency and effectiveness of an artifact—and adoption in practice—the acceptance model to determine whether an artifact is useable in practice, regardless if it improves performance or not (Moody, 2003).

Figure 2-2 is an adaptation of the MEM, illustrating the connection between those two variables and the activities executed by this research.

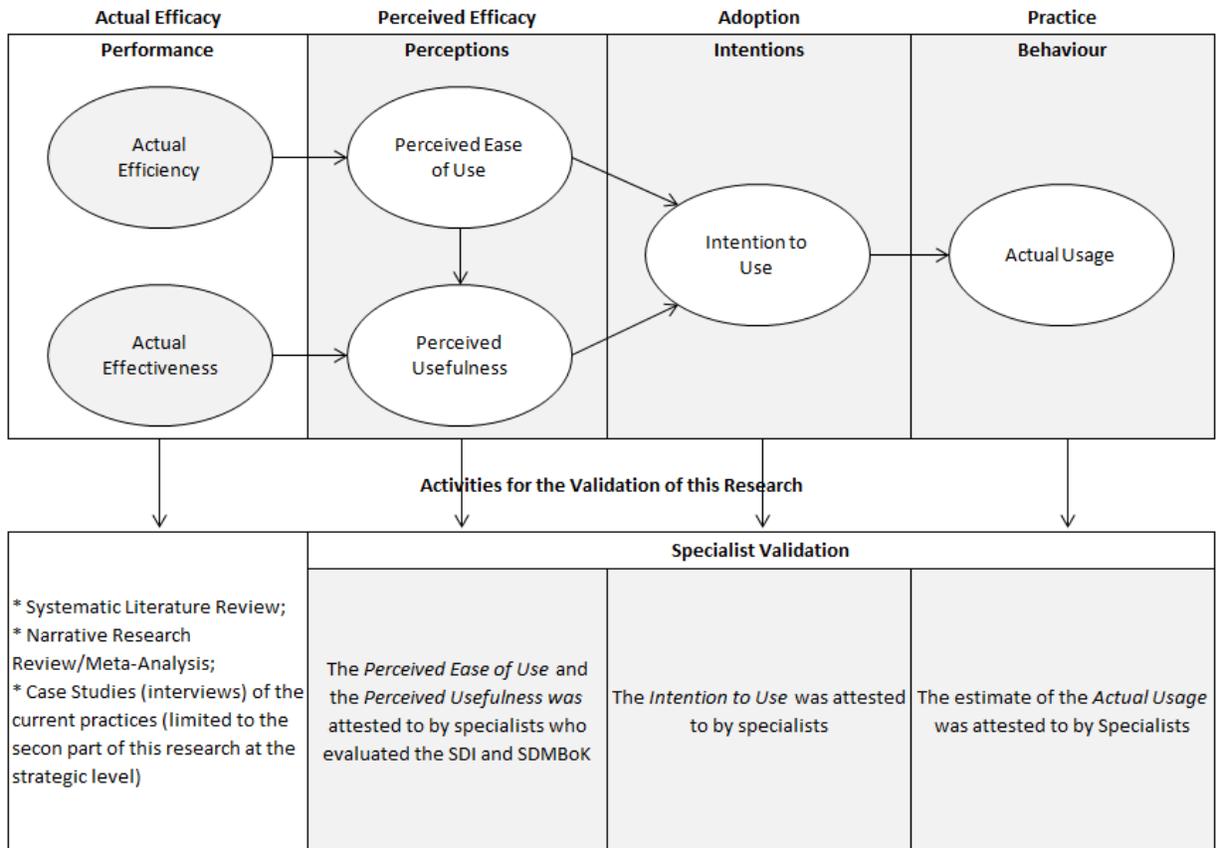


Figure 2-2. An adaptation of the Method Evaluation Model—a method used by this research—representing the two dependent variables to analyze and validate whether a method accomplishes its purpose or not: actual efficacy and adoption in practice. (adapted Moody, 2003)

MEM's constructs, illustrated in Figure 2-2, are as follow:

- Actual Efficiency (Actual efficacy/Performance): determine the required effort to apply a method
- Actual Effectiveness (Actual efficacy/Performance): determine the way a method achieves its objectives
- Perceived Ease of Use (Perceived Efficacy): identify a person's belief that a method would be effortless
- Perceived Usefulness (Perceived Efficacy): identify a person's belief that a method will be useful in achieving its intended objectives
- Intention to Use (Adoption): identify a person's intention in using a method
- Actual Usage (Practice): to determine whether a method is used in practice

This research divided the MEM validation process into two parts: The methodological pragmatism of the findings (Actual efficacy/Performance) and the technology acceptance of the findings (perceived efficacy/adoption/practice). The validation process and the results are presented in Chapter 5 - Research Validation.

Figure 2-3 illustrates the combining research process.

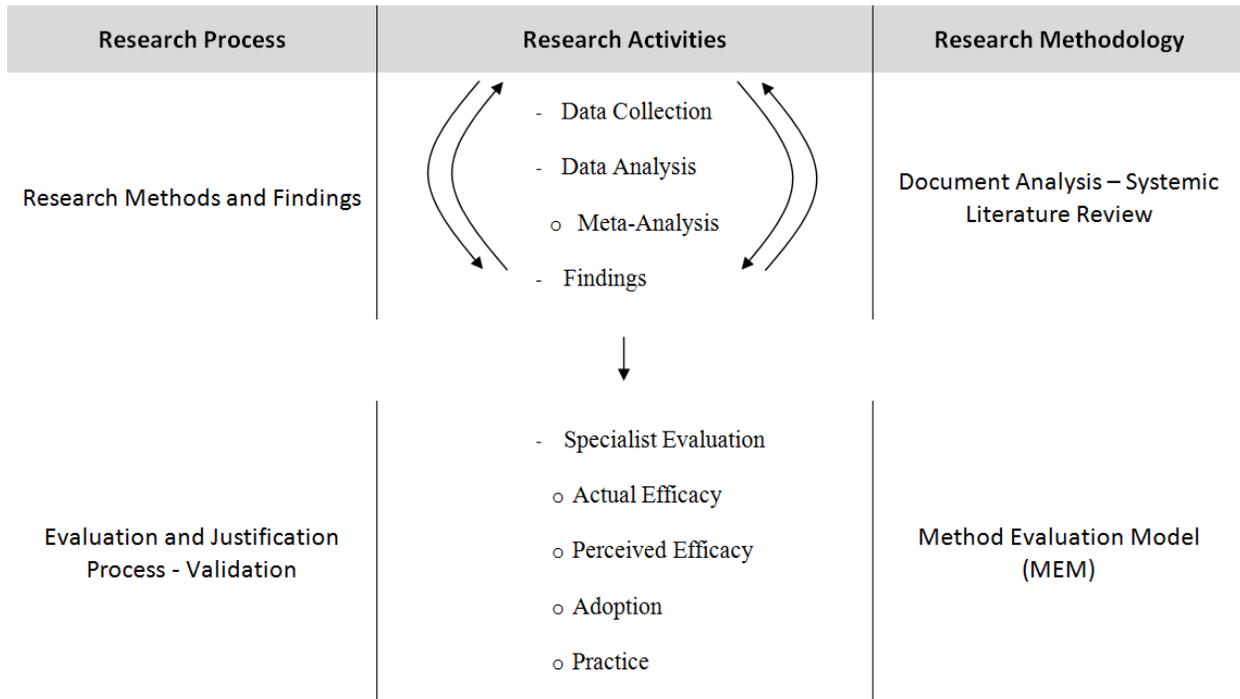


Figure 2-3. An illustration of the specificity of each question addressed by this research—a summary of the research process

Chapter 3: What is the Scope of Sustainable Development Management?

This chapter attempts to identify and formalize the broad scope of sustainable development in construction. The section is divided into the following six parts: Introduction, Points of Departure, Research Activities, Contribution of the 100SDIs, Validation, and Conclusions.

- Introduction—An understanding of how the term evolved gives us a general understanding of sustainable development and of how it can be applied in a specific area—here, the field of building construction.
 - Sustainability definitions and background—According to Fowke and Prasad (1996), there are more than eighty varying definitions of sustainable development. The absence of a comprehensive sustainable development definition has two main outcomes: the significance is unclear, permitting it to be diminished to any groups' interests, suiting to their objectives and plans, and it leads to the idea that sustainable development risks are getting meaningless.
- Points of Departure—this study does not intend to create a new sustainability standard or rating system. Instead, we aimed to use the current literature from the past three decades to identify the sustainable development approaches used in the construction field.
 - Applied sustainability—this study focused on common standards and rating systems used in the construction industry and business focusing on the three pillars of sustainability (social, economic, environment): UN-SDGs, Organization for Economic Co-operation and Development (OECD), International Chamber of Commerce (ICC), World Business Council for Sustainable Development (WBCSD), Global Reporting Initiative (GRI), BREEAM, LEED, Institute for Sustainable Infrastructure - ENVISION, Living Building Challenge (LBC), Sustainable Project Appraisal Routine (SPeAR), Green Globe, ISO, and legislations and policies.
- Research activities—this section presents the research activities developed to capture the current sustainability targets to assess the construction industry's impact on sustainable development, specifically:
 - What indicators can be used to assess the construction industry's impact on Sustainable Development?
 - What is the construction industry's impact on achieving the United Nations Sustainable Development Goals (UN-SDGs)?

- Contribution: the 100 SDI—this section presents the final contribution of the first objective of this study, the 100 Sustainable Development Indices (100 SDI) for the building construction industry, a list of sustainability targets and the impact they have on achieving the SDGs.
- Validation—this section presents the methodology of validation of the first deliverable: the 100 SDI
- Conclusion—This section concludes with a summary of the findings and benefits of the 100 SDI.

3.1. Introduction

There is an increasing number of articles, books, methodologies, and other materials trying to achieve ambitious targets of defining sustainable development; however, what defines a sustainable product or service and how to accomplish sustainable goals? A sustainability approach will diverge according to the diverse interpretations across fields. It depends on the stakeholder’s analysis: environmental specialists, owners, clients, communities, etc. Thus, it is clear that sustainability is not a single, well-defined field of study; it requires a high level of expertise in diverse areas. In the same way, a sustainability approach in the construction industry has several standards, rating systems, and other materials for helping to capture and codify sustainable practices. Each of these materials helps to approach some of the sustainability targets. Therefore, the concept of sustainability depends on the impacts of the sector. Points of Departure

3.1.1. Sustainability Definitions and Background

Definitions

Sustainability has been an increasing focus of discussion since the United Nations Conference on the Human Environment, held in Stockholm, in 1972. The term has become a political and ethical argument for the ecological and social crisis of the world. However, the notion of sustainability appeared for the first time almost three centuries ago, in Germany, as the forestry terminology *nachhaltiger Ertrag*, which means *sustained yield* (Grober, 2007). Sustained yield, according to the Oxford online dictionary (2017), means “a level of exploitation or crop production, which is maintained by restricting the quantity harvested to avoid long-term depletion.”

The idea of preserving the current resources to avoid a collapse in the future was a concern identified many years ago to prevent environmental depletion. Over the years and the constant observation of the ecological and social crisis of the world, the connection between the environment and human beings was becoming more evident. However, the approach of sustainability is still a challenge due to the various

theories of sustainability across the fields. The explanation appears to depend on the strategy and particularity of the field.

Sustainable development became a significant term to describe the balance between the use and preservation of current resources (Grober, 2007), and the relationship between human beings and nature. Currently, sustainability engages more complex issues such as economic development models, the world food supply, poverty reduction, distributive justice, and also nature conservation (maribus gGmbH, 2017).

Some definitions and approaches have been explored over the years.

Table 3.1 demonstrates some of them.

Table 3.1. Sustainability Statements and Awareness - A Timeline with the Evolution of Sustainability Definitions

Year	Author/ Event Statement and Awareness
1713	<i>Hans Carl von Carlowitz, a German silvicultural professional</i> Carlowitz recommended that people should harvest wood as it regrows, without overexploiting the forest, conserving the forest by sowing and planting trees (maribus gGmbH, 2017). At that time, the conservation of nature was the primary economic and environmental issues.
1874	<i>George Perkins Marsh, a US scholar</i> Marsh observed the impacts of industrial growth in Europe and how humans were changing and, to some extent destroying nature. He published his most important work, <i>Man and Nature: the Earth as Modified by Human Action</i> , in 1874. Marsh defended the idea of conserving nature in the long term and using natural resources respectfully. He believed that people have the right to use natural resources, but not to abuse them (maribus gGmbH, 2017).
1972	<i>Club of Rome</i> After the severe scarcity in the mid-20th century, during the two World Wars, the governmental leaders had a big goal to generate prosperity for all and, through constant economic growth, to overcome absolute poverty and alleviate class disparities. This concept of unrestricted economic growth caused immense damage such as poisoned soils and rivers, smog from urban centres and industries, and dead forests from the emission of sulphur dioxide. So, in 1972, the Club of Rome published its study, <i>The Limits to Growth</i> , using the term “sustainable global system” for the first time, and warning against the consequences of overexploitation. The study developed a theory that every phase of strong economic growth would undoubtedly collapse the system, and that the scarcity and environmental pollution would create severe crises in living conditions for people before the year 2100 (maribus gGmbH, 2017).
1972	<i>Report of the United Nations Conference on the Human Environment, held in Stockholm</i> In the same year, the first conference to approach the relationship between economic development and environmental degradation was held. The first two principles of the report from this conference are (United Nations, 1972):

Year	Author/ Event Statement and Awareness
	<p>1) It respects the central right to opportunity, fairness and sufficient states of life, nonetheless, with the duty to secure and improve the earth for people in the present and the future.</p> <p>2) It announces that the natural assets of the planet must be safeguarded to support people in the present and future through cautious planning or management of natural resources.</p>
1983	<p><i>World Commission on Environment and Development (WCED)</i> The Commission agreed that the environment is where we live, and development is what we do to improve the environment, and the two of them are inseparable. It affirmed that the purpose of sustainable development is “to meet the needs of the current generation without compromising the ability of future generations to meet their needs” (United Nations, 1983).</p>
1992	<p><i>United Nations Conference on Environment and Development (UNCED)—Earth Summit, held in Rio de Janeiro (Brazil)</i> The conference reaffirmed the declaration of the Report of the Nations Conference on the Human Environment, held in Stockholm, in 1972. It established the need for a global partnership, once the integral and interdependent nature of the Earth was recognized. The conference recognized the interlinkage of the economic, social and environmental aspects to achieve sustainable development. (United Nations, 1997).</p>
1994	<p><i>John Elkington</i> John Elkington is an author, advisor and serial entrepreneur, and a world authority on corporate responsibility and sustainable development. He has written and is a co-author of more than 19 books. (Wikipedia, n.d.). He published in the Cannibals with Forks—The triple Bottom Line that the future of market success depends on the organization’s ability to satisfy the three-pronged forks of profitability, environmental quality, and social justice (Elkington, 1999).</p>
2001	<p><i>United Nations</i> <i>The concept of Corporate Social Responsibility (CSR) has been gaining attention in the business field for many years. According to the United Nations, CSR goes beyond ensuring day-to-day operations- assuring to follow relevant laws and regulations most efficiently and economically. CSR involves several stakeholders and considers impacts on shareholders, clients, suppliers, creditors and employees, and communities and environment impacted by the organization's activities (United Nations, 2001).</i></p>
2008	<p><i>Organization for Economic Co-operation and Development (OECD)</i> The OECD described sustainable development as an essential introduction to the complex relationships between the economy, society, and the environment. It approaches issues such as climate change, growth in developing countries and corporate social responsibilities (OECD, 2016).</p>
2015	<p><i>United Nations</i> The 2030 Agenda for Sustainable Development was adopted for about 193 nations. It provided the goals for peace and prosperity for people and the planet. They recognized the significance of the worldwide partnership—developed and developing countries - to address the end of poverty and other deprivations. Procedures to improve wellbeing and education, decrease inequality, and spike economy development while handling climate change and attempting to protect our seas and forests need to be aligned with the national strategies. (United Nations, 2015).</p>
2015	<p><i>International Council for Science (ICSU), in partnership with the International Social Science Council (ISSC)</i></p>

Year	Author/ Event Statement and Awareness
	<p>ICSU and ISSC reported an analysis of the SDGs, a review of targets for the Sustainable Development Goals, affirming that from the science perspective, the UN-SDGs does not present an 'end-goal' to provide a big-picture vision for goals. 'A definitive objective' of the SDGs is not clear, nor is how the proposed objectives and targets would add to accomplishing that final objective. According to the authors, the meta-goal could be "a prosperous, high quality of life that is equitably shared and sustained." (International Council for Science (ICSU), International Social Science Council (ISSC), 2015)</p>

Based on this broad historical perspective, this research considers the following sustainability approach as a foundation for sustainability management analysis:

- Sustainability strategy and sustainability process management take into consideration the economic, environmental, social and governance impacts of the organization’s activities for the current and future generations. Sustainability management evaluates the effects of the events from the following perspectives: human rights, resource preservation, environmental protection, economic and social development, ethical decisions, regional particularities, and transparency (reporting).

The construction industry contributes to sustainable development with the ability to positively contribute to the three pillars of sustainability: economic growth, environmental quality, and social justice, as well as ethical policies.

Terms Used for Defining Sustainability Goals

In this research, the following terms are used to define the levels of sustainability goals and related concepts:

- Standards—the standards studied in this research are specific sets of sustainability requirements for projects established by various organizations.
- Certifications—the certifications studied in this research assess and verify the sustainability performance of projects with respect to given standards (Building Research Establishment Ltd, 2018).
- Indices—the term “indices” is used in this research to describe a group of sustainable targets, including their associated indicators.
- Targets—in this research, a target is an issue or topic area that is considered to be important for setting policies or organizational goals. Multiple indicators can be identified to assess each target.

- Indicators—performance indicators are used for evaluating specific goals and objectives (WebFinance Inc., n.d.). This research considers the indicator as a measurable variable used as a representation of an associated target.
- Assessment Methodology—an assessment methodology is a prescriptive technique for assessing or measuring the performance of a project or unit or work, generally with respect to specific indicators.

Figure 3-1 represents the connection among the terminologies.

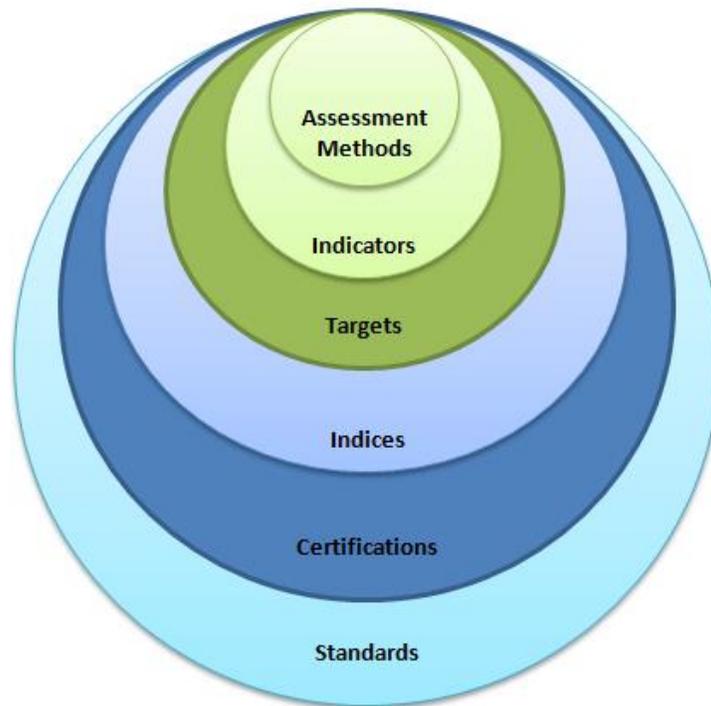


Figure 3-1. Sustainability practices terminologies used by this research demonstrating the delimitation of each term

Background - A Brief History of Sustainability and Sustainable Development

The UN Conference on the Human Environment was held in Stockholm in 1972, placing for the first time the relationship between economic development and environmental degradation (Nations, 1997). The conference acknowledged that the inherent nature of the nation-state system continues to be the most significant obstruction to global action (Taylor, 1994). However, no international commitment to development was made (Nations, 1997).

Still, the UN understood the importance of the subject and, led by Gro Harlem Brundtland of Norway, established the World Commission on Environment and Development (WCED) in 1983. WCED approached the concept of sustainable development and economic growth with the following statement: “meet the needs of the present without compromising the ability of the future generations to meet their own needs” (Nations, 1997).

The urgent call for this general assembly was to formulate a report, known as the 1987 Brundtland Report or Our Common Future, for the following purposes (WCED, 1987):

- To suggest long-term environmental strategies for achieving sustainable development,
- To recommend the co-operation between developing and developed countries to meet general and mutual objectives that take into account the relationship between people, resources, environment, and development
- To consider a practical approach to environmental concerns on the international community
- To assist in defining shared perceptions of long-term environmental issues and suitable efforts to protect the environment.

After considering the 1987 Brundtland report, the UN General Assembly summons the 1992 United Nations Conference on Environment and Development (UNCED)—informally known as the Earth Summit—to understand socio and economic development while preventing the continued deterioration of the environment. The conference was hosted by the Brazilian Government in Rio de Janeiro in June 1992 and had the participation of 172 other Governments, and 2400 representatives of non-governmental organizations (NGOs) discussing environmental and sustainable development (United Nations, 1997). The Earth Summit laid a foundation for a global partnership between the developing and the more industrialized countries. This foundation is based on mutual needs and shared interests, ensuring a healthy future for the planet.

The UN has maintained the objective to help governments to rethink economic development and protect the planet against the pollution and the destruction of irreplaceable natural resources. The subsequent conferences were influenced by the Earth Summit, examining the relationship between human rights, population, social development, women and human settlements, and the need for environmentally sustainable development (Nations, 1997).

The Earth Summit adopted three key agreements intending to change the traditional approach of development, described in

Table 3.2, and two legally binding conventions designed to prevent global climate change and the eradication of the diversity of biological species, described in Table 3.3 (Nations, 1997):

Table 3.2. Earth Summit Agreements

Three Major Agreements		
Title	Topic	Description
Agenda 21	Global action program in areas of sustainable development	Recommendations for actions in social and economic spheres, for example, fighting poverty and conserving and overseeing natural assets such as protecting the atmosphere, seas, and biodiversity.
The Rio Declaration on Environment and Development	Principles defining rights and responsibilities of states	An international declaration that supports the Agenda 21 by establishing rights and responsibilities of states. The statement has the following principles: <ul style="list-style-type: none"> • human beings are the centre of concern for sustainable development; • scientific uncertainty ought not to defer measures to protect the environment; • the states have the right to exploit their resources, but not damage the environment; • eradicating poverty and reducing global economic disparities are essential for sustainable development; • the full participation of women is essential for accomplishing sustainable development; • developed countries acknowledge their responsibility in international sustainable development due to their technologies and financial resources.
The Statement of Forest Principles	Non-legally binding principles defining the sustainable management of forests worldwide	The first global consensus reached on forests. Some of the values are as follows: <ul style="list-style-type: none"> • all countries (chiefly developed countries) should strive to “green the world” through reforestation and forest conservation; • states have the right to utilize forests according to their needs but keep the national sustainable development policies; • encourage specific financial, economic, and social programs.

Table 3.3. Legally Binding at the Convention Designing to Prevent the Global Climate Change

Two Legally Binding Conventions	
Title	Description
The United Nations Framework Convention on Climate Change	Framework for preventing global climate change
The Convention on Biological Diversity	Framework for preventing the eradication of the diversity of biological species

The Earth Summit conference succeeded in its purpose, giving a new perspective of economic progress and beginning a new era in the understanding of sustainable development. The Earth Summit’s success can be measured by the local, national and international implementation of its agreements since the conference.

Since the Earth Summit, the UN continues to play a crucial role in the implementation of Agenda 21. Since then, the UN is reinforcing the integration of sustainable development into all relevant policies and programs (United Nations, 2015). Furthermore, the UN’s position is that international criteria and indicators of sustainable development should be accepted so that the governments can prepare sustainable policies and regulations. The governments would choose the sustainable indicators according to their local conditions, and the commission would enable countries to gather and report data to measure the progress of Agenda 21 (United Nations, 1997). The commission would monitor sectoral issues such as health control, human settlements and forest preservation.

To summarize the historical path, Table 3.4. describes key activities for approaching sustainable development since 1919. Several of these organizations or initiatives are described in greater detail in the subsequent sections.

Table 3.4. General Information of the Historical Path Towards Sustainability (items marked “*” are discussed in more detail in the following sections)

Date	Description Objectives and Outcomes
1919*	<i>International Chamber of Commerce (ICC) was created</i> ICC was created by a group of industrialists, financiers and traders to represent business and fill the gap of no world system of rules to govern trade, investment, finance, and commercial relation after the First World War. It started to issue anti-corruption regulations in 1977, became a signatory of the UN Global Compact in 2003 and has promoted standards of excellence in global professional education since 2015 (International Chamber of Commerce - ICC, 2019).
1961*	<i>Organization for Economic Co-operation and Development (OECD) was created</i> The OECD is an international organization that works on establishing international norms and find evidence-based solutions to social, economic and environmental challenges (OECD, 2011).
1972	<i>United Nations (UN) Conference on the Human Environment was held in Stockholm</i>

Date	Description Objectives and Outcomes
	This conference was the first to approach the relationship between economic development and environmental degradation. After the meeting, the governments created the United Nations Environment Program (UNEP), which continues acting to protect the environment. However, there was no substantial international engagement in this matter after this conference (United Nations, 1997).
1983	<i>World Commission on Environment and Development (WCED) was created</i> Led by Gro Harlem Brundtland of Norway and created by the UN, the WCED understood the importance of the subject and presented a sustainable development concept: to meet the needs of the present without compromising the ability of future generations to meet their needs (United Nations, 1997).
1987	<i>Brundtland report was presented</i> The report requested by the General Assembly of the United Nations proposed, recommended, considered, and helped to establish environmental strategies (United Nations, 1997).
1990*	<i>Building Research Establishment Environmental Assessment Method (BREEAM) was created</i> BREEAM was the world’s first established method of sustainability assessment for buildings. It is a rating system that reflects the performance achieved by a project and its stakeholders measuring according to its standard and benchmarks (Building Research Establishment Ltd, 2018).
1992*	<i>World Business Council for Sustainable Development (WBCSD) was created</i> The WBCSD is a global network that brings best practices to accelerate the implementation of sustainable development into business activities (WBCSD - World Business Council for Sustainable Development, 2019).
1992 (June)	<i>United Nations Conference on Environment and Development (UNCED)—Earth Summit was held in Rio de Janeiro (Brazil)</i> The conference established an international sustainable development agreement as follows (United Nations, 1997): <ul style="list-style-type: none"> • Three international agreements • Two legally binding conventions Consequently, the UN created the following mechanisms: <ul style="list-style-type: none"> • Inter-agency Committee on Sustainable Development • UN Commission on Sustainable Development (UNCSD) • High-level Advisory Board on Sustainable Development
1992	<i>Inter-agency Committee on Sustainable Development was created</i> The UN created this committee to ensure an adequate system: extensive cooperation and coordination of the Agenda 21 implementation (United Nations, 1997).
1993 (June)	<i>UN Commission on Sustainable Development (UNCSD) was created</i> The UN created this committee to support the Agenda 21 implementation (United Nations, 1997).
1993	<i>High-level Advisory Board on Sustainable Development was created</i> The UN formed this committee to advise the Secretary-General and the Commission on issues relating to the Agenda 21 implementation (United Nations, 1997).
1993	<i>The U.S. Green Building Council (USGBC) was created</i>

Date	Description Objectives and Outcomes
	Approximately 60 firms and several non-profit organizations formed the USGBC. The goal was to change how structures are planned, built and operated, and to advance sustainable practices in the building and construction industry. They later created the Leadership in Energy and Environmental Design (LEED) in 2000 (U.S. Green Building Council, 2017).
1994 (May)	<i>Global Conference on the Sustainable Development of Small Island Developing States was held in Barbados</i> The Earth Summit requested that the UN produce an action program to assist the environmental issues, economic issues, and well-being of people living in island countries (United Nations, 1997).
1994 (October)	<i>International Convention for Combating Desertification and Drought happened</i> At the Earth Summit, governments requested an international legal agreement to prevent the degradation of drylands. The formal agreement was presented for signing in 1994 but only enacted in December 1996 (United Nations, 1997).
1995	<i>Intergovernmental Panel on Forests was created</i> The UNCSO created a broad mandate that covered the forest issues, conservation, sustainable development, and management of all types of forests (United Nations, 1997).
1995	<i>A work program for transferring environmental technology, cooperation, and capacity-building was created</i> The UNCSO created the program to emphasize three interrelated priority areas: access to and dissemination of information, capacity building for managing technological change, and partnership arrangements (United Nations, 1997).
1995 (April)	<i>The first Conference of the Parties (COP1) to the UN Framework Convention on Climate Change (UNFCCC) was held in Berlin</i> The developed countries committed to reducing their greenhouse gas (GHG) emissions: to reinforce the commitment of these countries without introducing any new promises for the developing ones (Brandon & Lombardi, Evaluating Sustainable Development in the Built Environment , 2011).
1996	<i>Sustainable Development Reports submission</i> By mid-1996, around 100 governments had set up broadly sustainable development committees or other planning bodies. More than 2,000 municipal and town governments had defined their Agenda 21 objectives. Several nations looked for authoritative endorsement for sustainable development plans, and the degree of NGO association stayed high. (United Nations, 1997).
1996 (June)	<i>United Nation International Conference on Human Settlements—Habitat II was held in Istanbul</i> The conference discussed the habitation issues of current built environmental problems related to significant global changes: population growth, migration towards urban areas, tourism, urban generation. Vancouver held the first conference on this matter in 1976 (Brandon & Lombardi, Evaluating Sustainable Development in the Built Environment , 2011).
1997*	<i>Global Reporting Initiative (GRI) was created</i> The GRI is an independent international organization that assists businesses, governments, and other organizations to identify and report their impacts on issues such as climate change, human rights and corruption (GRI - Global Reporting Initiative, 2015).
1997 (June)	<i>UN General Assembly’s special session was held in New York</i>

Date	Description Objectives and Outcomes
	The General Assembly was the first international meeting to review the progress since the Earth Summit (United Nations, 1997).
1997 (July)	<i>Conference of the Parties 2 (COP2) to the UNFCCC was held in Geneva</i> This conference provided a political impetus to the Berlin Mandate process at COP1 (Brandon & Lombardi, Evaluating Sustainable Development in the Built Environment , 2011).
Annual meeting	<i>COPs to the UNFCCC</i> After the signing of the UNFCCC’s legally binding conventions at the Summit Earth, UNFCCC has been meeting (most often annually) to discuss how to achieve the objective of greenhouse gas emissions reduction and to assess progress in dealing with climate change. The COP is the highest body for decision-making of the Convention. All parties to the Convention are represented at the COP, auditing the usage of the Convention and whatever other lawful instruments that the COP adopts to advance the compelling execution of the Convention, including institutional and administrative action. (UNFCCC, 2017). By the year 2019, they are in session 25—COP 25 UN Climate Change Conference.
2000 (September) *	<i>The Millennium Development Goals (MDG) was set</i> The most noteworthy get-together of world leaders adhered to the UN Millennium Declaration, committing their countries to a new worldwide partnership to decrease extreme poverty and setting out a progression of time-bound targets: the Millennium Development Goals by 2015 (MDG - Millenium Project, 2006).
2000*	<i>USGBC created a green building rating system called LEED—Leadership in Energy and Environmental Design</i> The representatives of the USGBC shared the idea of an open and balanced alliance across the building industry field and a green building rating system called LEED, becoming an international standard for environmentally sound buildings (U.S. Green Building Council, 2017).
2000*	<i>Green Globe was created</i> Green Globes assists the organization with a self-assessment questionnaire at the pre-design level, concept design, construction documents—leading to design certification, and post-construction—and the final certification. (Green Building Initiative - GBI, 2019).
2000*	<i>Sustainable Project Appraisal Routine (SpearArup) was created</i> SPeAR is a sustainability appraisal tool developed to monitor and evaluate project performance and informed decision making throughout the project life cycle (Arup Group Ltd., 2017).
2002	<i>UN World Summit on Sustainable Development - The Johannesburg Declaration on Sustainable Development and the Plan of Implementation was developed</i> UN, governments and major groups committed to revitalize and integrate sustainable development such as: <ul style="list-style-type: none"> • Governments should move forward nationally in implementing Agenda 21 • Governments should organize new regional or even global conventions • Governments should elaborate policy recommendations for global environmental security issues (Brandon & Lombardi, Evaluating Sustainable Development in the Built Environment , 2011).

Date	Description Objectives and Outcomes
	It likewise reaffirmed the worldwide network's responsibilities to poverty eradication, environment protection and focused on Agenda 21 and the Millennium Declaration, adding more emphasis on multilateral partnerships. (United Nations, 2015).
2005	<i>The EU Ministers on "Creating Sustainable Communities in Europe," Bristol Accord (UK) reaffirmed the importance of sustainable development</i> The 2005 Bristol Accord acknowledged that, for a more prominent Europe, sustainable communities are a significant initiative (Brandon & Lombardi, 2011).
2006*	<i>Living Building Challenge (LBC) was created</i> LBC is a philosophy, certification, and advocacy tool for projects to be not only less harmful but truly regenerative, coming from negative environmental impacts to positive environmental impacts. The standard is not a checklist of best practices but a performance-based evaluation and positions the ideal outcome as an indicator of success (International Living Future Institute, 2019).
2007	<i>Informal Ministerial meeting on urban development and territorial cohesion was held in Leipzig (Germany)</i> The meeting acknowledged that for sustainable development and stable European cities, competitiveness and social and national cohesion are critical. (Brandon & Lombardi, 2011).
2012 (June)	<i>United Nations Conference on Sustainable Development (Rio+20) was held in Rio Janeiro</i> Member States adhere to the result report "The Future We Want," in which they decided, in addition to other things, to launch a procedure to build up the Sustainable Development Goals to expand the MDGs and to set up the UN High-level Political Forum on Sustainable Development. The Rio +20 results additionally contained measures for implementing sustainable development, including mandates for future projects of work for advancement financing, small island developing states and more. (United Nations, 2015).
2013	<i>General Assembly - Open Work Group was assembled</i> The General Assembly set up a 30-part Open Working Group to build up a proposition on the Sustainable Development Goals (SDGs) (United Nations, 2015).
2013 (annual meeting)	<i>The first meeting of the High-Level Political Forum (HLPF) was held</i> The foundation of the United Nations HLPF on Sustainable Development was ordered in 2012 by the result of the United Nations Conference on Sustainable Development report (Rio+20), "The Future We Want." The Forum meets yearly under the sponsorship of the Economic and Social Council for eight days, including a three-day ministerial segment and every four years at the degree of Heads of State and Government under the support of the General Assembly for two days. The HLPF became the central United Nations platform on sustainable development, and it has a central role in the follow-up and reviews of the 2030 Agenda for Sustainable Development the Sustainable Development Goals (SDGs) at the global level (United Nations, 2015).
2013*	<i>Envision Rating System for Sustainable Infrastructure (ENVISION) was created</i>

Date	Description Objectives and Outcomes
	ENVISION is a framework that provides a consistent, consensus-based assessment of sustainability and resilience in infrastructure, evaluating and rating the community, environment, and economic benefits of all types and sizes of infrastructure projects (Institute for Sustainable Infrastructure, 2019) (Institute for Sustainable Infrastructure, 2019) (Institute for Sustainable Infrastructure, 2019).
2015 (March)	<p><i>Sendai Framework for Disaster Risk Reduction 2015–2030 agreement was created in the conference in Japan</i></p> <p>The Heads of State and Government, ministers and delegates taking an interest in the Third United Nations World Conference on Disaster Risk Reduction, perceived the expanding effect of disasters and their unpredictability in several parts of the world. They proclaimed their assurance to upgrade the endeavours to reinforce disaster risk reduction to diminish losses of lives and resources from calamities around the world. (United Nations, 2015).</p>
2015 (July)	<p><i>Addis Ababa Action Agenda on Financing for Development</i></p> <p>Addis Ababa Action Agenda is a worldwide system for financing development. The Head of States and Governments and High Representatives affirmed the substantial political commitment to address the issues of financing and making an empowering domain at all levels for sustainable development in the worldwide partnership and solidarity. (United Nations, 2015).</p>
2015 (September) *	<p><i>The Official Agenda for Sustainable Development Goals (SDGs) for 2030 was launched</i></p> <p>The United Nations Development Programme (UNDP) revised the MDGs for 2030, now named SDGs. It includes 17 goals (UNDP, 2017).</p>
2015 (December)	<p><i>Paris Agreement at the 21st COP (Conference of the Parties)</i></p> <p>The 21st COP invited the appropriation of United Nations General Assembly, "Transforming our world: the 2030 Agenda for Sustainable Development", the SDGs, specifically the objective 13 (climate change), and the adoption of the Addis Ababa Action Agenda of the Third International Conference on Financing for Development, and the endorsement of the Sendai Framework for Disaster Risk Reduction. The 21st COP additionally perceived climate change as an urgent and conceivably irreversible danger to human societies and the planet and, in this manner, requires the most conceivable collaboration by all nations and their participation in a powerful and appropriate international reaction to quicken the decrease of worldwide greenhouse gas emissions. Additionally, the 21st COP likewise perceived that profound reductions in global emissions would be required to accomplish the target of the Convention and underlined the requirement for urgency in addressing climate change (United Nations, 2015).</p>
2016	<p><i>Voluntary National Reviews Database</i></p> <p>The 2030 Agenda for Sustainable Development encourages member states to "conduct regular and inclusive reviews of progress at the national and sub-national levels, which are country-led and country-driven" (United Nations, n.d.). (These national reviews are relied upon to fill in as a foundation for the regular reviews by the High-Level Political Forum (HLPF), meeting under the protection of the Economic and Social Council (ECOSOC). Periodic reports by the HLPF are to be voluntary, as specified in at the 2030 Agenda, state-driven, attempted by both developed and developing nations and include several stakeholders.</p>

Date	Description Objectives and Outcomes
	The Voluntary National Reviews (VNRs) intend to encourage the sharing of encounters, including successes, difficulties and lessons learned, and to quicken the implementation of the 2030 Agenda. The VNRs additionally try to fortify policies and institutions of governments and to assemble multi-stakeholder for the implementation of the Sustainable Development Goals. Every nation partaking in the VNR is expected to aggregate data in the VNRs of the HLPF on Sustainable Development every year. (United Nations, 2019).
2017 (June)	<i>Our Ocean, Our Future: Call for Action</i> The Heads of State and Government and high-level representatives met in New York for the United Nations Conference to reinforce the implementation of Sustainable Development Goal Number 14 (SDG #14) of the 2030 Agenda, with the full interest of civil society and other pertinent stakeholders. It insisted on the strong commitment to rationally and sustainably use the seas, oceans and marine assets for sustainable development. (United Nations, 2019).

Therefore, critical international conferences have emphasized the importance of sustainable development. Besides, these international conferences have four principles in common for sustainable development as follows (Brandon & Lombardi, 2011):

- Equity (today’s concern)
- Futurity (concern for future generations)
- Environment (the integrity of ecosystems)
- Public Participation (public involvement in sustainable development concerns)

3.1.2. Applying Sustainability

The previous section introduced sustainability’s ongoing development—its definition and related political and nongovernmental activities. This section discusses the application and practicability of sustainability, particularly within the construction industry. The section explores the certifications and standards studied by this research. It presents a brief introduction, the way the accreditation evaluates the sustainable performance and the corresponding sustainability criteria. It also introduces a list of sustainability indicators in the appendices—see reference of the appendix in each section—, categorized according to the sustainability triple bottom line. Appendix B.14 presents the detailed description of each indicator and assessment methodology. Appendix A: presents the results of the meta-analysis in the form of the 100 SDI.

Sustainable Development Goals (SDG)

The Sustainable Development Goals (SDGs) are the continuation of the UN Millennium Development Goals (MDGs), an ambitious global plan with eight goals (listed below) and a deadline of 2015 (MDG - Millennium Project, 2006). International leaders came together at the UN Headquarters in New York in September 2000 to adopt the MDGs and to commit to a new global partnership to reduce extreme poverty and to set out a series of targets, the MDGs. (MDG - Millennium Project, 2006).

In 2002, the UN Secretary-General was commissioned and developed an action plan to achieve the Millennium Development Goals. In 2005, the independent advisory body headed by Professor Jeffrey Sachs presented its final recommendations to the Secretary-General in a synthesis volume called “Investing in Development: A Practical Plan to Achieve the Millennium Development Goals.” The eight MDG goals are as follows: (MDG - Millennium Project, 2006).

Goal 1—Eradicate Extreme Poverty and Hunger

Goal 2—Achieve Universal Primary Education

Goal 3—Promote Gender Equality and Empower Women

Goal 4—Reduce Child Mortality

Goal 5—Improve Maternal Health

Goal 6—Combat HIV/AIDS, Malaria, and Other Diseases

Goal 7—Ensure Environmental Sustainability

Goal 8—Develop a Global Partnership for Development

On September 25th, 2013, the President of the UN General Assembly hosted an event where the UN Secretary-General Ban Ki-moon presented to the Member States his report entitled “A Life of Dignity for All.” The world leaders renewed their commitment to meet the MDGs and scheduled a high-level Summit in September 2015 to adopt a new set of goals for the next 15 years. (MDG - Millennium Project, 2006).

The process of developing the new set of goals commenced at the United Nations Conference on Sustainable Development, Rio +20 Conference, in Brazil in 2012 (Sustainable Development Goals Fund, n/a). The UN conducted an intensive public consultation with civil society organizations, citizens, scientists, academics, and the private sector from around the world. The queries resulted in the 2030 Agenda for Sustainable Development, along with a set of 17 Sustainable Development Goals, called SDGs, and 169 associated targets, formally adopted on September 25th of 2015 (United Nations, 2015).

The SDGs are based on, and go beyond, the eight Millennium Development Goals (United Nations, 2015). The SDGs address the three dimensions of sustainable development—social, economic and environmental—as well as institutional/governance aspects from the International Council for Science (ICSU) (2015).

The SDGs focus on five main critical areas for humanity and the planet, as follows (United Nations, 2015):

- People—to ensure dignity, equality, and a healthy environment to all human beings, as well as to end poverty and hunger.
- Planet—to protect the world from being degraded, which includes sustainable consumption and production, sustainably managing the natural assets and taking urgent action on climate change.
- Prosperity—to guarantee economic, social and innovative advancement in agreement with nature, ensuring prosperous lives to all
- Peace—to provide an inclusive society that is liberated from dread and violence.
- Partnership—to implement an international association for Sustainable Development, focusing on strong global partnerships concentrating specifically on the necessities of the least fortunate and most vulnerable individuals/nation.

Appendix B.1 introduces the list of the SDGs with its 17 goals and the 169 associate targets, and the certifications and standards that address each of those goals.

This study focuses on the SDGs for guiding the sustainable development definition. The 2030 Agenda for Sustainable Development has the following advantages and disadvantages:

1. Advantages

- a. The SDGs cover considerable foundational obstructions to sustainable development and the balance between the three perspectives of sustainability—social, economic and environmental. (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).
- b. The SDGs are agreed internationally and used by governments for their national strategies until 2030, which affects policies and the way the organizations work.
- c. The SDGs have the international acknowledgment of the essential subjects that make sustainable development management possible.

- d. The SDGs are based on a global consultation of stakeholders and have a scientific basis for its formation.
2. Disadvantages
- a. According to International Science Council (ISC), although the SDGs, with their 17 goals and 169 targets, are an improvement from the Millennium Development Goals (MDGs), only 29% (49 targets) are well defined. In contrast, 54% (91 targets) should be more specific, and 17% (29 targets) require significant work (International Council for Science, 2015).
 - b. According to ISCU, the goals experience an absence of consolidation, some redundancy and contain ambiguous and subjective language instead of objective, quantifiable, time-bound, quantitative targets (International Council for Science, 2015).
 - c. According to the International Science Council (2015), the SDGs are lacking a main general objective, a definitive meta-objective for assisting with gathering the 17 Sustainable Development Goals. The International Council for Science suggested the following main goal: “a prosperous, high quality of life that is equitably shared and sustained.”
 - d. The SDGs address the Sustainable Development at the governmental level, lacking direction to specific fields. This research aims to address this gap.

Although the SDGs address the targets at the governmental level, the goals are the guidelines for creating the individual targets for the social, economic and environmental aspects of any production process or services within society. This study will focus on the building construction industry and, through the current standards and certifications, will identify the way the building construction industry can effectively contribute to sustainable development and the SDGs.

Organization for Economic Co-operation and Development (OECD)

The Organization for Economic Co-Operation and Development (OECD) is a global association with almost 60 years of experience in building international standards and exploring solutions for social, financial and environmental issues based on scientific evidence and network experiences. Governments, parliaments, policymakers, businesses and citizens contribute to elaborating policies focusing on well-being, equality, opportunity and prosperity for all (OECD, 2019).

The OECD was formally established in 1961 to encourage economic advancement and world exchange focusing on the local activities at the governmental level that promote strategy benchmarking and the trading of good practices between nations in a particular geographical zone. It currently has approximately 450 international standards, with 36 democratic governments as member countries (OECD, 2019).

Sustainability Impact Assessment (SIA) is the OECD's sustainability assessment methodology that analyzes the combined economic, environmental and social impacts of proposed sustainable policies and procedures.

The SIA has two main functions and considers the aforementioned three pillars of sustainability—social, economic, and environmental: (i) it is a methodological policy instrument for developing integrated policies; and (ii) it is a process for assessing the possible effects of the policies (OECD, 2010).

Hence, the general purpose of an SIA is to create an integrated policy that considers the three pillars of sustainability and both short and long-term effects. It also examines the possible conflict between global, regional and local objectives in the policymaking process (OECD, 2010), providing good governance, policy integration, transparency, participation, and efficiency (Berger, 2008).

The SIA follows eight steps for defining and elaborating on a new policy, as explained below (OECD, 2010):

1. Screen the proposal

This step identify whether an SIA is needed. According to the OECD (2010), not all the policies require a sustainability impact assessment. To analyze if the SIA is necessary will depend on the type of initiative, its content, and what are the possible impacts and consequences of implementing the policy. The criteria to decide if the policy proposal has characteristics or foreseeable effects sufficient to require an implementation of the SIA can differ from one organization to another.

For screening proposals, checklists or impacts matrices are the most common methods used. The OECD (2010) suggests to break down the policy proposal into the main components to assess economic, environmental and social criteria.

2. Scope the assessment

The next step is to identify the extent and depth of the assessment to be conducted, analyzing the significance of and resources used by the policy. The scoping will also determine the most critical issues for the assessment and the best ways to address the issues (OECD, 2010).

The OECD (2010) also suggests six questions to summarise the relevant criteria that should be considered in this step. Those questions are part of a simple process improvement tool known as 5W2H analysis, which analyzes questions whose answers are considered essential in information gathering: what?; who?; why?; when?; where?; how?; and how much (what the resources needed)?

3. Select tools or methodologies to match the scoping

This step will select the tools or methodologies to assess the policy. The SIA can use several methods or tools—depending upon the desired depth of examination and the specific impacts to be examined—balancing qualitative and quantitative information for achieving reliable assessment. The chosen tool should address issues such as cost-benefits, short and long-term effects, global competitiveness and many other aspects of sustainable development (OECD, 2010).

4. Ensure stakeholders engagement

This step will identify the role of stakeholders. Transparency and the participation of all stakeholders are essential for implementing sustainable development processes (OECD, 2010).

According to the OECD (2010), studies of the political economy of reform suggest that a transparent decision-making process is more effective and efficient in achieving the policy results. The composition and representation of stakeholder groups should be defined in advance as well as their environmental, economic and social minimum requirements.

5. Analyze the economic, environmental and social impacts

This step has a more technical perspective, analyzing the short and long-term, economic, environmental and social effects of the proposed policy and the impacts of its implementation (OECD, 2010).

6. Identify synergies, conflicts, and trade-offs across the identified impacts

This step will analyze the significant interaction, conflicts or trade-offs across the economic, environmental and social domains of the proposed policy. The objective is to compare the positive and negative impacts and to evaluate potential conflicts if implementing the policy (OECD, 2010).

7. Propose mitigation measures to optimize positive outcomes

After identifying the possible conflicts, the next step is to identify the possible alternatives and solutions for them, developing measures or frameworks for minimizing the potential adverse effects and strengthening the sustainable aspects of the proposed policy (OECD, 2010).

8. Present the results and options to policymakers

The final step is to present the results of the SIAs and alternative policy options in a transparent way, including appropriate qualitative information. Therefore, the decision-makers can analyze the impacts and possibilities before deciding to implement the policy (OECD, 2010).

Based on shared experiences and benchmarking from countries members of the organization, the OECD suggests the use of a traffic light presentation to introduce the sustainability impact assessment in an overall score from the environmental, economic and social evaluation. Figure 3-2 illustrates an example of a traffic light analysis used by the OECD called the Sustainability Compass Guide (OECD, 2016).

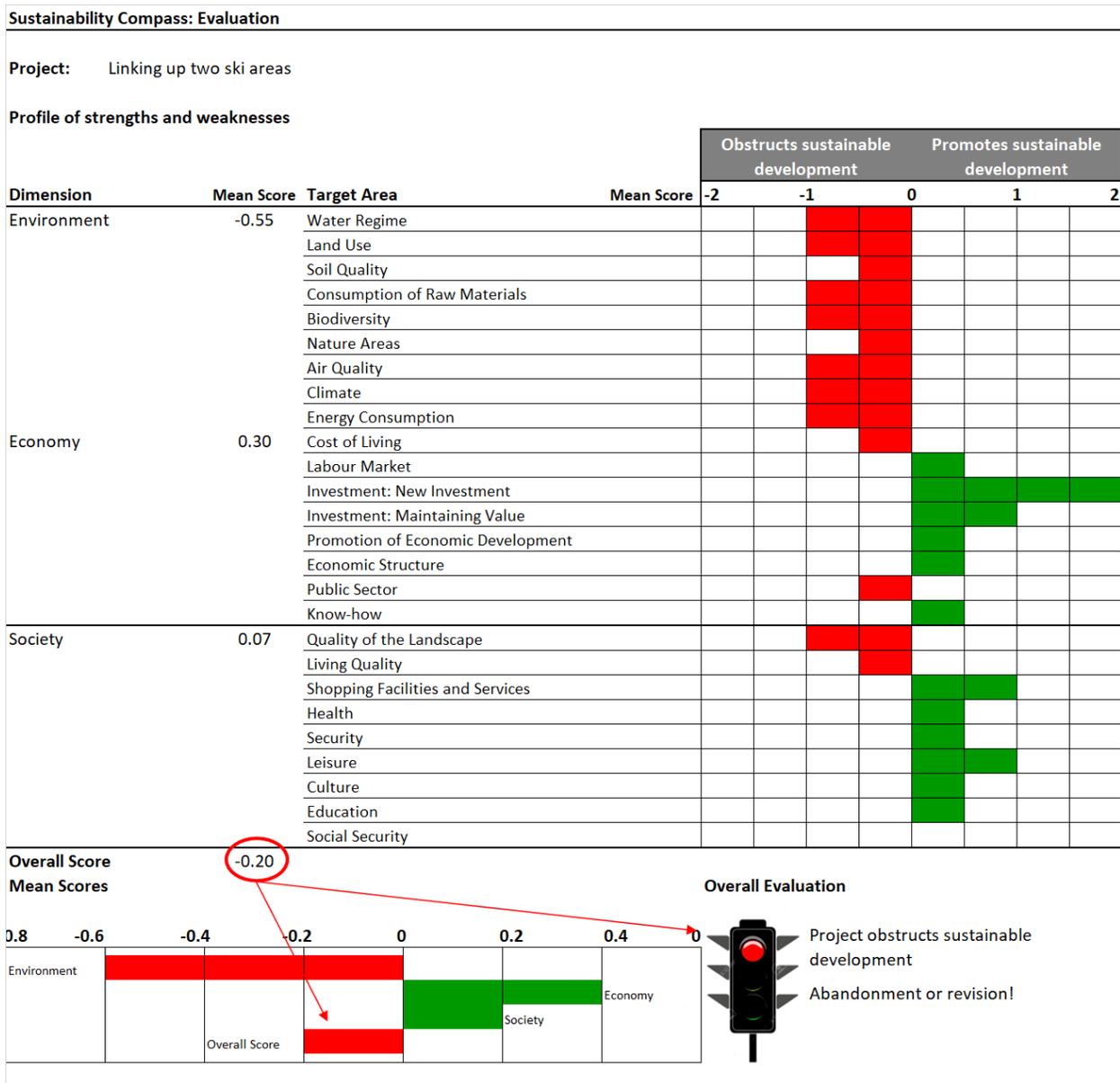


Figure 3-2. Traffic Light presentation of the SIA that introduces the sustainability impact assessment in an overall score from the environmental, economic and social perspectives (OECD, 2016)

The extent of an SIA is related to the cruciality, political and legitimate nature, and sectoral context of the proposed policy. The technique follows the sustainability measures considered by the OECD, as described below (OECD, 2011):

- Social
 - To promote human health and security
 - To guarantee education, personal development, and individual identity

- To improve culture, social, heritage, and resources safety
- To ensure equality rights
- To promote solidarity within and between generations
- Environmental
 - To maintain natural habitats and biodiversity
 - To control the use of renewable resources
 - To limit the use of non-renewable resources
 - To avoid or mitigate pollution
 - To reduce ecological disaster
- Economic
 - To increase incomes and employment
 - To maintain productive capital
 - To improve competitiveness and innovative capacity
 - To pursue market principles
 - To prevent public debt at the expense of future generation

Effectively implemented public policies are crucial for the achievement of the 2030 Agenda for Sustainable Development, and the OECD works in several of the areas covered by the SDGs with member and partner countries to generate evidence, identify good practices, develop standards, and help design and implement policies (OECD, 2016). Appendix B.2 demonstrates the complete list of the 64 sustainability targets of the OECD, categorized according to the sustainability pillars used by this research.

This research identified the following advantages and disadvantages of the OECD:

1. Advantages

- a. The OECD takes into consideration the triple bottom line of sustainability (economic, environmental, and social), not only one of them, while many other types of impact assessment methodology, such as LEED, focus on one specific perspective.

- b. The OECD does not consider just quantitative analysis, such as cost-benefit. It also considers a qualitative and a participatory analysis (related to environmental, social and other non-market considerations).
- c. The OECD allows transparency in the policy process, considering the stakeholders' examination, by analyzing their inputs and possible impacts (direct or indirect).
- d. The OECD acquires exchange knowledge and experience through data sharing across countries, experts, peer review mechanisms, and open data platforms, making the process more reliable (OECD, 2016).

2. Disadvantages

- a. The OECD focuses on governance and strategic perspectives only. Although the OECD analyzes the best “technical” assessment method, it can be very subjective, requiring an extension for specific fields. OECD concentrates on public policy (OECD, 2016)
- b. Because the OECD focuses on strategic and governmental levels, it does not specify the approach or contribution of a particular field, such as the construction industry.

The OECD provides a general outline to implement and adapt a sustainability impact assessment according to the government authorities at different levels, not a technical sustainability guide for the users. As this study intends to create a framework for sustainability management, addressing both organizational and processes management aspects, the OECD policy-making process has an essential role in this study.

International Chamber of Commerce (ICC)

The International Chamber of Commerce (ICC) was created in 1919 by a group of industrialists, financiers and traders to fill the gap of the lack of a world system of rules to govern trade, investment, finance, and commercial relation after the First World War. It is currently a global network of more than 100 countries, representing more than 45 million companies. Its primary objective is to assist businesses of all sizes to operate both internationally and responsibly. The ICC also represents business interests at the highest levels of intergovernmental decision-making, such as the World Trade Organization and the United Nations (International Chamber of Commerce, 2017).

The ICC centers around systems for the business networks and supports the responsibility of organizations to practice green economy. It perceives that sustainable economic growth provides the establishment of the development and prosperity of societies. It additionally recognizes that innovative and responsible business operations are the core of the economic growth and contribute to dealing with the

global difficulties featured by the Sustainable Development Goals (SDG) (International Chamber of Commerce, 2015).

The ICC actively participates in the global effort for climate actions, and it is recognized as an essential role in mobilizing business positions on environmental and energy issues. It acts as the business and industry heart to the UN Framework Convention on Climate Change as well as promotes the business implementation of the Guidance Principles on Business and Human Rights of the SDGs (International Chamber of Commerce - ICC, 2019).

The ICC created the Green Economy Roadmap to develop a global business policy addressing sustainable development and poverty eradication approached by the SDGs. It also assists businesses in the development and implementation of sustainable policies and actions, taking into consideration global policy developments on green growth assessed by the OECD (International Chamber of Commerce, 2017).

The ICC believes that the term “green economy” is embedded in the broader sustainable development concept and defines the expression as: *“an economy in which economic growth and environmental responsibility work together in a mutually reinforcing fashion while supporting progress on social development. Business and industry have a crucial role in delivering the economically viable products, processes, services, and solutions required for the transition to a green economy.”* (International Chamber of Commerce, 2012).

The Green Economy Roadmap reinforces the importance of innovation, collaboration, and governance on sustainability, which have to work simultaneously, both bottom-up (from operational to strategic level) and top-down (from the strategic to operational level), and in the short and long term.

The Green Economy Roadmap framework follows three main phases, as demonstrated in Figure 3-3.

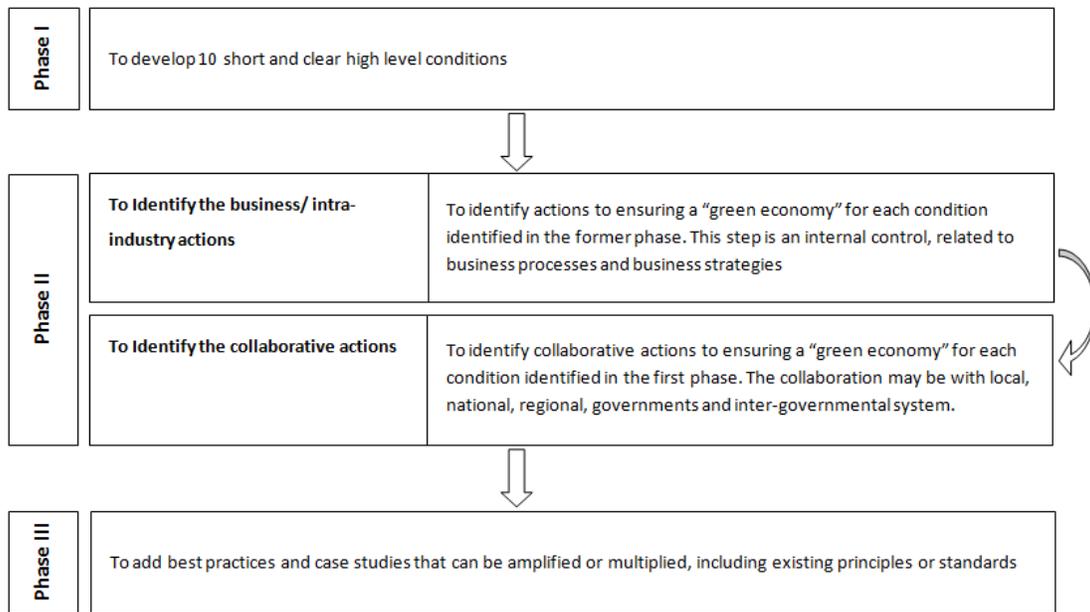


Figure 3-3. The Green Economy Roadmap steps illustrating the three main phases for implementing the green economy methodology introduced by the ICC

The ICC designed the Business Charter for Sustainable Development containing eight strategies to contribute to sustainable development, as follows (International Chamber of Commerce, 2015):

- Information clarity
- Reduction of risks and liabilities
- Enhancement of efficiency and effectiveness of existing products and process
- Generation of new business opportunities
- Longer-term cost reductions
- Improvement of awareness, knowledge, and education
- Increased employee loyalty
- Higher standing in society and better reputational value development

The ICC also recognizes that corporate sustainability reporting is essential for building trust and engaging with the public. Therefore, the ICC proposed eight approaches that businesses should reflect in their corporate sustainability reporting (International Chamber of Commerce, 2015):

- Corporate Sustainability Strategy—to communicate the business activities information that is relevant to sustainable development. The ICC believes that sustainability reporting can inspire

improved actions by companies while improving the value of the company. Consequently, it is not just a desirable interest but also a strategic interest to promote sustainability reporting.

- Scope and Materiality—to identify and report material issues that consider the sustainable impacts of the business value chain, not only its operations but also its supply chain.
- Harmonization—to harmonize and align with one or two global reporting standards, such as the Global Reporting Initiative (GRI) and the International Integrated Reporting Council (IIRC), reducing inefficiencies. The ICC recognizes that the current proliferation of standards, framework, and guidelines is increasingly burdensome for companies to manage, and it suggests a harmony of communication.
- Verification—to utilize a third-party audit for harmonizing and professionalizing the quality of the reporting, if not cost-prohibitive or impractical.
- Local and Global relevance—to consider not only legal requirements but also relevant emerging trends, standards, and best practices to the local and global standards and norms.
- Internal and External Consultation—to adopt an inclusive internal and external approach engaging stakeholder groups who are most impacted by the company's operation.
- Continuous improvement—to seek to enhance and extend the reporting to support the sustainability strategies and performance, once the field of sustainability reporting is still evolving.
- Integrated Reporting—to integrate non-financial aspects of corporate reporting into business strategy and financial reporting.

Table 3.5. demonstrates the ICC Guiding Principles for Sustainable Development and how these principles can contribute to the SDGs (International Chamber of Commerce, 2015).

Table 3.5. ICC Guiding Principles for Sustainable Development and the Relationship with the SDGs

Principle	Objective	Contributed SDGs
Sustainable Development as a Business Priority	<ul style="list-style-type: none"> • To recognize the importance of the business’ contribution to sustainable development • To multiply amongst the employees, shareholders, customers, and other stakeholders the awareness and understanding of sustainable development • To incorporate sustainable values into the organization’s strategies, leadership principles, operations, activities, and investments • To manage the organization with integrity, develop best practices and promote ethical conduct, including fighting corruption 	<ul style="list-style-type: none"> • SDG 5 • SDG 8 • SDG 12 • SDG 16
Inclusive Economic Growth and Development	<ul style="list-style-type: none"> • To support business practices to contribute to economic growth— sustainable development • To promote efficient and cost-effective policies and approaches that encourage entrepreneurship and allow the establishment of business • To avoid economic activity with adverse environmental impacts, including new methods to incorporate externalities in economic terms 	<ul style="list-style-type: none"> • SDG 1 • SDG 2 • SDG 3 • SDG 4 • SDG 5 • SDG 8 • SDG 11 • SDG 12
Environmental Responsibility and Management	<ul style="list-style-type: none"> • To recognize and assess environmental impacts related to the business activities and process • To implement a successful environmental management system to reduce adverse environmental effects • To improve natural resources efficiency, chiefly water, energy, and soil 	<ul style="list-style-type: none"> • SDG 6 • SDG 7 • SDG 8 • SDG 9 • SDG 12 • SDG 13 • SDG 14 • Goal 15
Responsibility toward People and Societies	<ul style="list-style-type: none"> • To recognize the value of employees and external stakeholders for the success of any business • To promote skill development for the workforce • To ensure human rights • To identify the social impact of the business practices and to determine priorities according to its specific circumstances 	<ul style="list-style-type: none"> • SDG 1 • SDG 2 • SDG 3 • SDG 4 • SDG 5 • SDG 8 • SDG 9
Responsible Products and Services	<ul style="list-style-type: none"> • To develop valuable and safety product and process that follows laws and regulations, and minimize adverse environmental and social impacts • To consider the whole product life-cycle to maximizing the economic, social and ecological benefits • To invest in innovation through research and development of sustainable product and process 	<ul style="list-style-type: none"> • SDG 3 • SDG 6 • SDG 8 • SDG 11 • SDG 12 • SDG 13

Principle	Objective	Contributed SDGs
Sustainable Value Chain Approach	<ul style="list-style-type: none"> • To multiply the sustainable development principles across the value chain such as suppliers, customers, distributors, service providers and other relevant partners. • To work in partnership with the whole product or service life-cycle performers for a responsible behaviour • To promote corporate responsibility and supplier policy 	<ul style="list-style-type: none"> • SDG 8
Collaboration and Partnerships for Continuous Improvement	<ul style="list-style-type: none"> • To promote cooperation with other businesses, academia, governments, or consumers to generate jobs, innovative business models, and solutions • To increase trust between the company and its stakeholders through regular dialogue and communication. 	<ul style="list-style-type: none"> • SDG 10 • SDG 17
Transparency, Communications, and Reporting	<ul style="list-style-type: none"> • To identify goals and assessment methodology. To identify also business risks and opportunities • To report and divulge progress through efficient dissemination communication tool. 	<ul style="list-style-type: none"> • SDG 5 • SDG 12 • SDG 16

The ICC (2012) acknowledges that the world is confronting a significant challenge: to create economic opportunities while working together with environmental and social responsibilities. Also, business has an essential role in bringing solutions to sustainability challenges.

Appendix B.3 introduces the complete list with the ten sustainability targets listed and categorized accordingly to this research.

The ICC, for this research, has the following advantages and disadvantages:

1. Advantages

- a. The Green Economy Roadmap takes into consideration the policies and strategies aspects, and the way business can contribute to the sustainable development of the society and the global sustainable development
- b. The Green Economy Roadmap considers the innovation, collaboration, and governance to integrate sustainable development
- c. The Green Economy Roadmap considers internal actions (processes and business strategies), and external efforts (external collaboration), contributing to a decision-making process. It also suggests some procedures that contribute to the globally sustainable goals
- d. The Green Economy Roadmap recognizes the importance of sustainable reporting for growing the sustainable development process.

2. Disadvantages

- a. The Green Economy Roadmap framework addresses the broad actions, requiring a process for a detailed implementation
- b. The Green Economy Roadmap does not have an assessment methodology for each step
- c. The Green Economy Roadmap is a framework for business strategy, not for a procedural implementation

Thus, the ICC Green Economy Roadmap is a general framework to assist in elaborating strategic business plans, approaching the organizational level of the company. Although it does not have a procedural or assessment framework, it supports this study at the corporate structure level, such as sustainable targets, policy strategy standardization, and at the processes management level such as reporting.

World Business Council for Sustainable Development (WBCSD)

The World Business Council for Sustainable Development (WBCSD) is an international network with more than 200 leading businesses and almost 70 national business councils. The organization works to bring best practices to accelerate the implementation of sustainable development into business activities (WBCSD - World Business Council for Sustainable Development, 2019).

The WBCSD was initiated based on the need of the business voice in the global conversation at the upcoming Rio Earth Summit in 1992. The current UN Secretary-General on Environmental and Development (UNCED) at that time invited a successful businessman to spread the concept of sustainable development among the world's business leaders. The CEO accepted the challenge and understood that the chance for a successful implementation of the sustainable development concept into the business world was to ensure that global business leaders become advocates of the idea rather than become aware of it. Therefore, in 1991, it recruited 48 CEOs from around the world, founding the Business Council for Sustainable Development (BCSD). The WBCSD was created in 1995 when the BCSD merged with the World Industry Council for the Environment (WICE), created by the International Chamber of Commerce (ICC) after the Rio Summit (WBCSD - World Business Council for Sustainable Development, 2019).

To minimize the negative impact of business on sustainable development, the WBCSD considers science-based approaches and business solutions through innovation, sustainable business solutions, collaboration, and increased economic value (WBCSD - World Business Council for Sustainable Development, 2019).

In 2010, the WBCSD released its "Vision 2050" to determine the role of businesses and the actions and solutions related to sustainable development issues (WBCSD - World Business Council for Sustainable

Development). The Vision 2050 is science-based and has the societal “must-haves” to develop solutions that are impactful, measurable, replicable, and beyond the traditional business (WBCSD - World Business Council for Sustainable Development, 2010). The vision determines six priority areas for achieving Sustainable Development Goals (SDGs), as listed below: (WBCSD - World Business Council for Sustainable Development, 2019):

- **Circular Economy**—9% of the business is circular. The WBCSD suggests urgent change from the current “take-make-waste” economic model to a circular economy (WBCSD - World Business Council for Sustainable Development, 2019). The circular economy is based on an emerging economic model that covers both techniques and business models to keep materials and resources in use as long as possible in a closed cycle of extended use, reuse and recycling (WBCSD - World Business Council for Sustainable Development, 2018).
- **Cities and Mobility**—City mobility systems are at their limits. Transport contributes to 23% of global GHG emissions. There are 1.25 million annual road traffic accident deaths, while road congestion is eroding countries’ GDP by 1% to 3%. WBCSD highlights how to: manage mobility more sustainably, integrate initiatives for urban mobility systems, and make them safer, cleaner, and more accessible (WBCSD - World Business Council for Sustainable Development, 2019).
- **Climate and Energy**—the WBCSD suggests that combating climate change and transforming the energy system are core challenges to a sustainable future for business, society and the environment (WBCSD - World Business Council for Sustainable Development, 2019)
- **Food, Land and Water**—the WBCSD focuses on addressing critical challenges of food & land-use systems—food and nutrition security, smallholder livelihoods, natural resource efficiency, including water management, climate change impact and adaptation—using comprehensive approaches and new technologies (WBCSD - World Business Council for Sustainable Development, 2019).
- **People**—the WBCSD advocates that the populations have access to their needs, rights, goals and aspirations (WBCSD - World Business Council for Sustainable Development, 2019).
- **Redefining Value**—the WBCSD aims to help companies measure and manage risk, gain competitive advantage and seize new opportunities by understanding environmental, social and governance information. (WBCSD - World Business Council for Sustainable Development, 2019)

The WBCSD currently has 34 projects addressing these six priority areas to assist the industry from different fields to approach sustainable development. The projects are listed below (WBCSD - World Business Council for Sustainable Development, 2019):

- **Aligning Retirement Assets: Responsible Retirement Plan Investments.** WBCSD believes that considering environment, social and governance factors in investment processes can result in improved risk-adjusted returns for participants and beneficiaries over the longer term.
- **Assurance and International Controls:** Assurance and international controls enhance credibility and trust in sustainability reporting. The project addresses three areas: assurance challenges for companies, understanding the sustainability assurance information that investors need, and guiding assurance providers.
- **Circular Water Management:** Guidance to implement circular water management. The project presents success factors, solutions and tools for implementation.
- **Climate Action and Policy:** Climate Policy activities that are consistent with action on climate change and enable the business to work with solutions to scale and speed implementation of the Paris Agreement.
- **Climate-Smart Agriculture:** this project works together with companies from the food and agriculture sector to address both climate change challenges and the need to satisfy the nutritional requirements of a growing global population.
- **Enterprise Risk Management:** An Enterprise Risk Management (ERM) framework including social and environmental aspects and helping to connect risk, strategy and decision-making while enhancing corporate performance.
- **Factor 10: A Circular Economy Project** that helps businesses to analyze the way they find, use and dispose of the materials.
- **Finance for Social Impact:** Analyse the capital available for business initiatives that generate both business value and social impact.
- **FReSH: Food Reform for Sustainability and Health** is an initiative of business solutions to drive the transformation of the food system.
- **Future of Work:** a project that aims to provide an understanding and inspiring vision of how the business can shape the future of work and identify innovative solutions that enable the company to contribute to a future that works for all.

- Governance and Internal Oversight: Decision-making process improvement integrating sustainability considerations into the corporate governance strategies.
- Human Rights: Guiding Principles on Business and Human Rights (UNGPs), endorsed by United Nations Human Rights, and increasing the number of companies that respect human rights.
- Integrated Performance Management: In collaboration with the Association of International Certified Professional Accounts, this project explores performance management practices that drive long-term business success.
- Low Emissions Economy Partnership (LEEP): The project is an initiative to bring together a cross-sectoral group of companies to drive GHG emissions reduction through a new type of public-private partnership. LEEP offers discussions between cities, businesses and other local stakeholders to remove barriers to commercialization and accelerate investment and emissions reduction.
- Low-Carbon Freight: the WBCSD has a research initiative called Freight Share Lab (FSL) that aims to demonstrate the connection of sharing strategic data between road/rail carriers and shippers with reducing empty running and under-utilization of freight vehicles looking to validate the Road Freight Lab's findings.
- Measurement and Valuation: the WBCSD developed two protocols—Natural Capital Protocol and Social and Human Capital Protocol—for businesses to measure and value their non-financial impacts and dependencies to help manage risks and leverages opportunities.
- Natural Climate Solutions (NCS): according to the WBCSD, new research shows that these solutions could contribute to 37% of the emissions reductions to limit global warming to 2°C. The WBCSD is working to bring awareness across the business community about these solutions.
- New Energy Solution: reduce CO₂ emissions in the short-term through the use of low-carbon energy sources available from the way we heat and light buildings to the way we transport goods, people and services.
- Purpose-Driven Disclosure (PDD): this project seeks to understand how environmental, social and governance information influences management decisions and actions in business. It will support the development and promote a shared understanding of materiality processes in environmental, social and governance decision-making and reporting.
- REscale: this project aims to accelerate the transition to a low-carbon electricity system.

- Reporting Matter: a global resource for corporate sustainability reporting developed by the WBCSD in collaboration with the Climate Disclosure Standards Board (CDSB) (WBCSD - World Business Council for Sustainable Development, 2019) and Ecodesk, bringing environmental, social and governance information to the attention of investors audiences and driving the integration of sustainability within the company's strategy, management, risk and internal control processes.
- Science-Based Targets for buildings and construction sector (SBT4Buildings): the project provides solutions to companies in the building and construction industry for reducing carbon emissions, enabling companies to work with partners in the value chain and developing the tools that can help to find the best combination of measures.
- SDG Action & Policy: to support the members to follow and successfully internalize the SDG agenda.
- SDG Sector Roadmaps: road-mapping initiatives among the sectors and outlining best practices.
- Soft Commodities Forum (SCF): this project is a global platform for leading soft commodities companies to advance collective action around common sustainability challenges.
- Sustainable Lifestyles: this program intends to understand the current technical, practical and emotional needs to enable and inspire a more sustainable lifestyle, exploring solutions at a systemic level, considering products, infrastructure, technology, business model, behaviours and aspirations.
- Sustainable Urban Mobility (SIMPLify): this program is a global city-business collaboration to foster innovation for easy, safe and clean urban mobility systems for all.
- Task Force on Climate-related Financial Disclosure (TCFD): the program aims to improve the information about climate change through recommendations, helping companies to disclose climate-related financial risks and opportunities.
- The Reporting Exchange: A comprehensive source of information on sustainability reporting requirements. Its platform includes information on environmental, social and governances from 70 countries.
- Transforming Heavy Transport: the project aims to reduce emissions from freight and logistics operations, including air, sea, land, and transshipping centers.
- Transforming Urban Mobility (TuM): this project brings businesses and cities together to implement system-level and integrated initiatives to make urban mobility safer, cleaner, and more accessible.

- Access to water, sanitation, and hygiene (WASH): by signing the WASH Pledge, companies commit to implementing access to safe water, sanitation and health at the workplace.
- Water Stewardship: this project assists organizations with moving from water risk assessment only to the usage of a collaborative response strategy of water management.
- Water-Smart Agriculture: the project supports business to find smart solutions that can be co-optimized to improve yields and meet growing food production demands while delivering energy and water efficiency

Appendix B.4 is a complete list of the WBCSD's 17 sustainability targets categorized according to this research.

For this study, the WBCSD has the following advantages and disadvantages

1. Advantages

- a. The WBCSD focuses on the business level, helping to deliver sustainable business solutions through innovation, collaboration and valuation (WBCSD - World Business Council for Sustainable Development, 2019).
- b. It shares best practices from different fields and industry.
- c. It helps to capture and quantify environmental, social and governance into the company's strategies.
- d. It provides business leadership for sustainable development.
- e. It has several projects to address six priority areas for sustainable development that the organization aims to approach.
- f. It advocates the implementation of the SDGs into the organization's strategies.

2. Disadvantages

- a. The WBCSD provides limited contribution to the construction field, although it approaches general business perspective

The WBCSD is a Global Network that shares information and best practices at the organizational level that will help this research to build up the proposed framework.

Global Reporting Initiative (GRI)

The Global Reporting Initiative (GRI) is a worldwide organization that assists businesses, governments, and other organizations to identify and report their impacts on issues such as climate change, human rights and corruption. The GRI was founded in the USA in 1997 and had the involvement of the Coalition for Environmentally Responsible Economies (CERES), the Tellus Institute and the United Nations Environment Programme (UNEP), US non-profit organizations, in its establishment (GRI 2017).

The GRI's fundamental mandate was to “do more than the environment,” and its framework's scope was broadened to include social, economic, and governance issues (GRI 2017).

In 2016, the GRI launched the first global standards for sustainability reporting developed by the Global Sustainability Standards Board (GSSB). The standards assist all organizations in reporting publicly on their economic, environmental and social impacts and demonstrate how the organizations contribute to SD (GRI 2017).

Organizations from all types and sizes around the world are using sustainability reports of the GRI Standards. The GRI Sustainability Disclosure Database is an extensive repository of sustainability reports, with more than 33,286 GRI reports since 1999. The organizations can register their sustainability report, free of charge, contributing to a large pool of data used by a variety of stakeholders. The GRI supports organizations to report their environmental, social and governance performance through four facilities as follow (Global Reporting Initiative (GRI) 2019):

- GRI community—through transparency as a member of the community,
- Report Services—through the GRI's reviewing services,
- Training—through the know-how from the sustainability reporting specialists,
- Reporting Tools—through creating superior reports that make companies' sustainability efforts noticeable.

Moreover, 443 construction organizations were found in the database with more than 1,712 reports (Global Reporting Initiative (GRI) 2019). Sustainability reporting is now becoming more accepted, and the value of sharing sustainability information is becoming more significant. According to the GRI (2017), an active sustainability reporting cycle with a regular program of data collection, communication, and responses benefits the organizations, not only internally but also externally.

Sustainability reporting assists organizations to analyze and manage risks and enables organizations to seize opportunities. Reporting sustainability performances also promotes an organization's values and

contributions. Additionally, it benefits the organizations to acquire external contributions for helping the organizations to achieve the SDGs.

The GRI, the OECD, ISO 26000 and the UN Global Compact are some of the significant providers of sustainability reporting guidance (GRI 2017). The UN Global Compact raised U\$\$ 1.5 billion in September of 2019 for a new innovative financial instrument to advance the SDGs and help private organizations with achieving sustainable goals. The focus of the financial support is on the SDGs 7, 9, 11 and 13 (focus on energy improvement) (The UN Global Compact 2019).

The GRI, through the Sustainability Reporting Standards and the wealth of data, helps to achieve the SDGs following four key objectives as follows (GRI 2017):

- Sustainable development policy—enable and support local and international policy for sustainable development and sustainability reporting,
- Increasing and improving reporting in development countries—making reporting relevant for all stakeholders,
- Transformative capacity building—build the capacity of institutions, businesses, governments and communities to be more aware of corporate responsibility,
- Innovation in emerging issues—provide clarity and guidance to policymakers and corporations.

The GRI focuses on areas such as human rights, climate change, good governance and anti-corruption, SMEs, trade facilitation and sustainability, capital markets, and gender equality influencing corporate practices and public policy (GRI 2017).

Appendix B.5 demonstrates the complete list with the 93 sustainability targets of the organization.

For this study, the GRI has the following advantages and disadvantages:

1. Advantages (GRI, 2017):

- a. The GRI assists organizations to determine their sustainability reporting, increasing the understanding of risks and opportunities of the organizations' activities and emphasizing the link between financial and non-financial performance
- b. The GRI supports long term management strategy and policy, as well as, benchmark sustainability performance concerning laws, norms, codes, performance standards, and voluntary initiatives

- c. The GRI assists organizations to analyze internal performance and performances between organizations and sectors.
2. Disadvantages
- a. As other codes and standards, the GRI does not have a systematic framework to implement sustainable development into the organizations' daily activities.

The Sustainable Development Goals (SDGs) call all businesses to accept and understand that governments are no longer the only responsible agent in building sustainable societies. The corporate actors and the private sector are crucial in achieving sustainable development (GRI, 2017). The GRI assists organizations with standards to report and provide information and policies for decision-makers to build more responsible and sustainable decisions.

Building Research Establishment Environmental Assessment Method (BREEAM)

The Building Research Establishment's Environmental Assessment Method (BREEAM) was the first established method of sustainability assessment for buildings. It is a rating system that reflects the performance achieved by a project and its stakeholders, measured according to its standard and benchmarks (Building Research Establishment Ltd, 2018).

BREEAM is a third-party certification for evaluation of environmental, social and economic sustainability performance for individual buildings, communities, and infrastructure projects. It was created in 1990 by BRE, Building Research Establishment, and has more than 550,000 certified buildings in more than 83 countries (Building Research Establishment Ltd, 2018). The certification is most widely accepted and implemented in the UK and offers practices in environmental design and management (Gu, Wennersten, & Assefa, 2006).

Moreover, BREEAM benchmarks sustainable performance at both individual building and portfolio level through the International Sustainability Alliance (ISA) that sets key performance indicators (KPI) of sustainability goals (Building Research Establishment Ltd, 2018). The increasing legislative and economic demands to address the sustainability of buildings motivated the creation of the BRE International Sustainability Alliance. The ISA's objective is to share the best practices in the sustainable management of its membership and develop a shared understanding of their buildings' performance, including energy, CO₂, waste and water at the site, construction and asset level organized by country and sector (International Sustainability Alliance, 2018).

Building Research Establishment Ltd acknowledges that the construction industry has an essential role in delivering the SDGs and their associated targets and significant economic, environmental and social impacts associated with construction products, buildings and infrastructure throughout their lifecycles (Building Research Establishment Ltd, 2018).

BREEAM has four standards: building standards, communities’ standards, infrastructure standards, and shelter and settlement standards tools. The BREEAM rating system ranges from acceptable to pass, good, very good, excellent and outstanding. The score is calculated based on the credits earned for each section and the weighting they represent for the total. The percentage acquired will determine the BREEAM rating. Generally, the final credit method is expressed in the following equation (Gu, Wennersten, & Assefa, 2006):

$$\sum_{i=1}^n fiCi$$

Element *C* is the final credit, *C_i* is the credit of single indicator, *f_i* is the weighting factor (between 0 and 1) of the indicator, and *n* is the number of indicators. It is a standard equation for most of the building environment assessment methods.

To calculate the weighting of each category, the BREEAM’s assessor will rate the seriousness, relevance and potential of addressing the category aim. Figure 3-4 demonstrates the calculation for weighting each category (BRE Global Ltd, 2016).

	Category 'Z'					
	Seriousness		Relevance		Potential	
Social	A	x	D	x	G	
						+
Environmental	B	x	E	x	G	
						+
Economic	C	x	F	x	G	
Category 'Z' Score = (A x D x G) + (B x E x G) + (C x F x G)						

Figure 3-4. Category Scoring Methodology used by BREEM assessor to calculate the weighting of each category and rate the seriousness, relevance and potential of addressing the category aim. The methodology will assist to determine the possible credit to be earned by the certification process when reviewed.

BREEAM focuses on balancing many and conflicted sustainability performances with long-term benefits during planning, design, construction, operation or refurbishment according to the three bottom lines of sustainability.

BREEAM is now part of a code, known as The Code, for a sustainable built environment—a strategic international framework for sustainability assessment of the built environment (Building Research

Establishment Ltd, 2018). The strategic principles of The Code are the integrated approach of the design and construction phases, management practices, evaluation and certification of the environmental, social and economic impacts of the built environment, interpreted through a Core Technical Standard and a Core Process Standard. Figure 3-5 represents The Code for Sustainable Built Environment by BREEAM (Building Research Establishment Ltd, 2018).

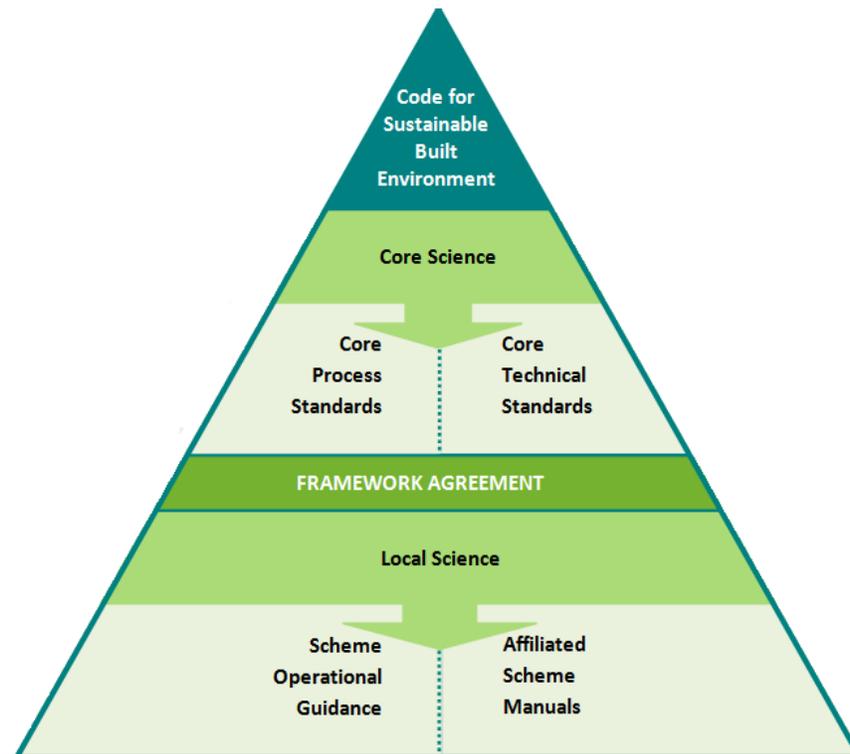


Figure 3-5. The Code for sustainable built environment approach illustrating the strategic principles that integrate design and construction phases, management practices, evaluation and certification of the environmental, social and economic impacts of the built environment (Building Research Establishment Ltd, 2018)

The Code addresses the global and local environment, minimizing impacts and maximizing resources efficiency, health, well-being, comfort, safety and security of users, social and cultural value, opportunities for effective and efficient use of facilities, and direct and indirect economic benefits.

The Code's framework, illustrated in Figure 3-5, enables BREEAM to determine standards, benchmarks, methodologies, and guidance, which maximize BREEAM's relevance and acceptability, based on:

- reviewed science;
- balanced consideration of the benefits and burdens to stakeholders;

- external performance audited: documentation including technical requirements and operational principles; and
- established regulatory, construction and management practices.

Table 3.6. illustrates where BREEAM contributes to meeting the SDGs, considering its Building Standards (Building Research Establishment Ltd, 2018).

Table 3.6. BREEAM contributions towards meeting the SDGs (Building Research Establishment Ltd, 2018)

Sustainable Development Goals - SDG	BREEAM's Contribution	BREEAM Building Standards Contribution
SDG 1 - End poverty	BREEAM encourages the delivery of resilient assets and that use resources efficiently to reduce operational costs connected to the built environment	Some contribution to meeting the SDG
SDG 2 - End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	BREEAM supports the conveyance of benefits that utilization land and resources efficiently, in this way, expanding opportunities for self-improvement and diminishing pressure on rural land and assets.	Limited or indirect contribution to meeting the SDG
SDG 3 - Ensure healthy lives and promote well-being for all at all ages	BREEAM encourages the provision of comfortable, healthy and safe internal and external environments for asset users and others within the vicinity	A significant contribution to meeting the SDG
SDG 4 - Ensure inclusive and quality education for all and promote lifelong learning	BREEAM encourages the arrangement of instruction and preparing chances to neighbourhood networks, in addition to bolsters continuous learning through training and development courses	Some contribution to meeting the SDG
SDG 5 - Achieve gender equality and empower all women and girls	BREEAM encourages responsible sourcing and procurement principles in construction material supply chains	Limited or indirect contribution to meeting the SDG
SDG 6 - Access to water and sanitation	BREEAM encourages the provision of water-efficient solutions, systems and equipment that minimize water consumption while maintaining a clean and reliable supply	A significant contribution to meeting the SDG
SDG 7 - Ensure access to affordable, reliable, sustainable, and modern energy for all	BREEAM encourages the provision of energy-efficient solutions, systems and equipment that minimize energy consumption and carbon dioxide emissions while maintaining a reliable supply	A significant contribution to meeting the SDG
SDG 8 - Promote inclusive and sustainable economic growth, employment, and decent work for all	BREEAM encourages measures that result in a positive economic impact and provision of training and skills to the local community	Limited or indirect contribution to meeting the SDG
SDG 9 - Build resilient infrastructure, promote sustainable industrialization, and foster innovation	BREEAM encourages the delivery of sustainable and resilient buildings and infrastructure and supports and acknowledges innovation that improves the	A significant contribution to meeting the SDG

Sustainable Development Goals - SDG	BREEAM's Contribution	BREEAM Building Standards Contribution
	sustainability performance of assets and gives learning chances to more extensive dissemination.	
SDG 10 - Reduce inequality	BREEAM encourages measures that result in a positive social impact and inclusivity, as well as promoting responsible sourcing in construction material supply chains	Limited or indirect contribution to meeting the SDG
SDG 11 - Make cities inclusive, safe, resilient and sustainable	BREEAM promotes the improvement of sustainable communities and urges access to a sustainable vehicle, conveyance of reasonably priced and secure homes, usage of flood resilience measures, minimization of air contamination, and access to open and green space	A significant contribution to meeting the SDG
SDG 12 - Sustainable consumption and production patterns	BREEAM encourages the sustainable procurement and use of construction materials by recognizing materials that are reused or recycled, have a low environmental impact, are sourced responsibly, and are durable and resilient	A significant contribution to meeting the SDG
SDG 13 - Action to combat climate change and its impacts	BREEAM promotes the sustainable utilization of energy, minimization of greenhouse gas emissions, and execution of climate change adjustment and flood resilience measures in one of the most significant contributing sectors	A substantial contribution to meeting the SDG
SDG 14 - Conserve and sustainably use the oceans, seas, and marine resources	BREEAM encourages the prevention and control of pollution and surface water runoff associated with the location and use of assets	Limited or indirect contribution to meeting the SDG
SDG 15 - Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss	BREEAM encourages sustainable land use, protection and creation of ecological features, and improvement of long-term biodiversity for asset sites and surrounding land	A significant contribution to meeting the SDG
SDG 16 - Promote justice, peaceful, and inclusive societies	BREEAM encourages responsible sourcing and procurement principles in construction material supply chains	Limited or indirect contribution to meeting the SDG
SDG 17 - Revitalise the global partnership for sustainable development	BREEAM promotes the formation of robust global associations and connections across strategy, property, infrastructure and the supply chain to convey and manage sustainable resources and communities	Some contribution to meeting the SDG

This research analyzed the BREEAM's *International New Construction 2016* Technical Manual that consists of 54 individual assessment issues divided into nine environmental categories, plus the tenth category called innovation (BRE Global Ltd., 2017). Appendix B.6 presents the complete list of the sustainability targets analyzed by this study.

Therefore, for this study, BREEAM has the following advantages and disadvantages:

1. Advantages

- a. As a building environmental assessment, BREEAM has been expanding from an ecological, indicator-based scientific system to a more integrated system covering the three pillars of sustainability: environmental, social and economic categories. (Gu, Wennersten, & Assefa, 2006). It also considers the innovation, collaboration, and governance to integrate sustainable development.
- b. BREEAM encourages internal actions (processes management), and external efforts (external collaboration), contributing to a decision-making process. It also suggests some procedures that contribute to the globally sustainable goals.
- c. BREEAM focuses on processes management of sustainable indicators, and its standards have a methodology to calculate an evidence requirement for most of the indicators.

2. Disadvantages

- a. The BREEAM framework addresses technical actions, lacking a strategy plan.
- b. BREEAM does not have an assessment methodology for all the indicators.
- c. BREEAM does not consider the organizational structure, guiding the organization the way to manage their structure.

Thus, BREEAM is a third-party certification to assist the organization in achieving sustainability indicators from a technical perspective. Although it does not help with managing the organizational structure, it supports this study at the tactical level (procedure management).

Leadership in Energy and Environmental Design (LEED)

Leadership in Energy and Environmental Design (LEED)—created by a non-profit association, the U.S. Green Building Council—is an international third-party certification program, a green building rating system, more commonly utilized in North America (USGBC, 2016).

The USGBC was formed in 1993, and its members include building owners and users, real estate developers, facility managers, architects, designers, engineers, general contractors, subcontractors, product and building system manufacturers, government agencies and nonprofits. The non-profit organization launched the first LEED pilot program, LEED Version 1.0, in 1998, and the certification program has been evolving since then. It is currently in its Version 4, introduced in 2013 (U.S. Green Building Council (USGBC), 2019).

More than 165 countries and territories have LEED projects, with more than 94,000 projects. The certification program is based on the number of points (LEED Credits) achieved by the project and has four rating levels: certified (40-49 points earned), silver (50-59 points earned), gold (60-79 points earned), and Platinum (80+ points earned) (U.S. Green Building Council (USGBC), 2019).

The certification program has a rating system, which were introduced over time, according to the type of the project:

- LEED for New Construction—addresses design and construction activities for new buildings and major renovations of existing buildings;
- LEED for Core & Shell—used when a project owner or developer only controls the design and construction of the building’s core and shell;
- LEED for Commercial Interiors—addresses only the interior design and tenant fit-outs.
- LEED for Existing Buildings: Operations & Maintenance—focuses on operation and maintenance activities including limited construction activities;
- LEED for Homes—used for low-rise (one-three stories) residential buildings;
- LEED for Neighborhood Development—addresses the land use planning of a neighbourhood through addressing its components such as building design, infrastructure, street design, and open spaces;
- LEED Campus—used for multiple building on a site under the control of a single entity;
- LEED Volume—used for 25 or more identical projects under BD+C (Building Design + Construction) or O+M (Operation and Maintenance) (e.g., Walmart)

The LEED for New Construction and Commercial Interiors rating systems have six derivatives rating systems to address unique features of building types: LEED for Schools; LEED for Healthcare; LEED for Retail; LEED for Data Centers; LEED for Warehouses and Distribution Centers; and LEED for Hospitality. For this research, the reference documents and information used are related to LEED v4 for Building Design and Construction—LEED BD+C: New Construction, the updated to reflect the July 2, 2018 LEED v4 Building Design and Construction Addenda (USGBC - United State Green Building Council, 2019) only.

A project can earn a total of 110 points distributed in nine categories, as follow (U.S. Green Building Council (USGBC), 2019):

- Integrative Process (IP) ¹—supports and rewards connections between building systems and processes: up to one point;
- Location and Transportation (LT)—addresses and rewards thoughtful decisions about building location, with credits that encourage compact development, alternative transportation and connection with amenities such as restaurants and parks: up to 16 points;
- Sustainable Sites (SS)—addresses impact by rewarding decisions about the environment surrounding the building and emphasizing the vital relationships among structures, ecosystems and ecosystem services: up to 10 points;
- Water Efficiency (WE)—addresses water holistically, taking into account indoor use, outdoor use, specialized uses and metering: up to 11 points;
- Energy and Atmosphere (EA)—focuses on reducing energy and rewards renewable initiatives. The emphasis is on energy and associated impacts, on enhanced building commissioning for higher energy and operational performance: up to 33 points;
- Materials and Resources (MR)—addresses solid waste management and decision-making processes on materials considering the usage, life-cycle assessment, environmental product declarations and material ingredient: up to 13 points;
- Indoor Environmental Quality (IQ)—addresses the indoor environmental quality and it is related to the occupant comfort and health such as thermal comfort, interior light (lighting control and lighting quality), quality views and acoustical performance: up to 16 points;
- Innovation in Design (ID)—deals with innovation features not covered in the other categories. This category is for extra points, and the requirements are innovative building features and sustainable practices: up to six points;
- Regional Priority (RP)—identifies regionalization as a priority. This category is also for extra points, and credits those issues that encourage project teams to focus on their local environmental priorities: up to four points.

LEED Building Design and Construction (LEED BD+C), the document specifically used in this research, consists of 55 targets. Appendix B.7 demonstrates the complete list categorized according to this research.

¹ the two letters abbreviations are vernacular of LEED

Therefore, for this study, LEED has the following advantages and disadvantages:

1. Advantages

- a. LEED was created to make the building environmentally-friendly, giving the industry a point system to rate the critical areas of the building (U.S. Green Building Council, 2017).
- b. LEED considers relevant environmental impacts of the building industry in the main parts of the building project.
- c. LEED encourages internal actions (integrated process), and external efforts (technical evaluation). It also approaches diverse activities that contribute to global sustainable goals, specifically from the environmental perspective.
- d. LEED has a checklist of sustainable targets and indicators with assessment methodologies and forms to help assess them. According to Retzlaff (2009), the use of LEED is for administrative reasons and the advantages to LEED are: it is well known and respected, provides a third-party review of buildings, is well documented and regularly updated.
- e. LEED is internationally recognized as a symbol of sustainable practices, encouraging the organization to obtain the certification.

2. Disadvantages

- a. LEED focuses on the acquisition of specific points in specific areas, limiting the innovation of building. It provides only four points in its rating system for innovation and with no parameter to determine the innovation of the building (Green Modeling, 2013).
- b. The LEED framework addresses many technical actions, having a limited strategic plan at the organizational level.
- c. LEED does not address the organizational structure, and does not guide the organization in the way to manage their structure to implement sustainable development.
- d. LEED focuses on environmental perspectives, with a limited approach to the other aspects of sustainable development, such as the SDGs and OECD.
- e. LEED evaluation is primarily performed in the pre-construction phase, which does not reflect the final “as-built” or “as-maintained” structure.
- f. LEED is not very granular, as it only allows full points or no points for a specific target (a bike rack or no bike rack, even though no occupant cycles to work).

- g. LEED promotes “Credit Hunting ” where designers cherry-pick the low-cost points first, sometimes without consideration of life cycle costs.

Thus, LEED is a third-party certification to assist the organization to manage sustainability indicators, focusing on the environmental perspective. Although it does not have a framework for the strategic level, it supports this study in the procedure management and sustainability indicators.

Envision Rating System for Sustainable Infrastructure (ENVISION)

The Envision Rating System for Sustainable Infrastructure (ENVISION) is a framework that provides a consistent, consensus-based assessment of sustainability and resilience in infrastructure, evaluating and rating the community, environment, and economic benefits of all types and sizes of infrastructure projects (Institute for Sustainable Infrastructure, 2019).

Envision was created between 2008 and 2011 by the Zofnass Program for Sustainable Infrastructure, based in the Harvard Graduate School of Design, in collaboration with the Center for the Environment, the School of Public Health, the Business School and the Law School. It was initiated as a simple sustainable infrastructure rating system, and, in 2011, supported by American Society for Civil Engineers (ASCE), the American Council of Engineering Companies (ACEC) and American Public Works Association (APWA) founded Envision and formed the non-profit Institute for Sustainable Infrastructure (ISI). The first version of Envision was released in 2013. The Institute for Sustainable Infrastructure (ISI) was created to develop and maintain a sustainability rating system that addresses all types of civil infrastructure—roads, bridges, pipelines, railways, airports, dams, levees, landfills, water treatment systems, and other public infrastructure projects (Harvard University’s Graduate School of Design, 2016). The Envision structure closely resembles the LEED structure.

Envision has sustainability indicators organized into five categories and 14 subcategories as follows (Institute for Sustainable Infrastructure, 2019):

- Resource Allocation—materials, energy and water,
- The quality of life—purpose, community and wellbeing,
- Leadership—collaboration, management and planning,
- Natural world—sitting, land and water and biodiversity, and
- Climate and Risk—emissions and resilience.

Furthermore, Envision is a decision-making guide, a planning and design guidance tool to assist the infrastructure industry in assessing and measuring the sustainability impacts in different phases of the projects. Figure 3-6 illustrates the sequence of implementing Envision (Institute for Sustainable Infrastructure, 2015).

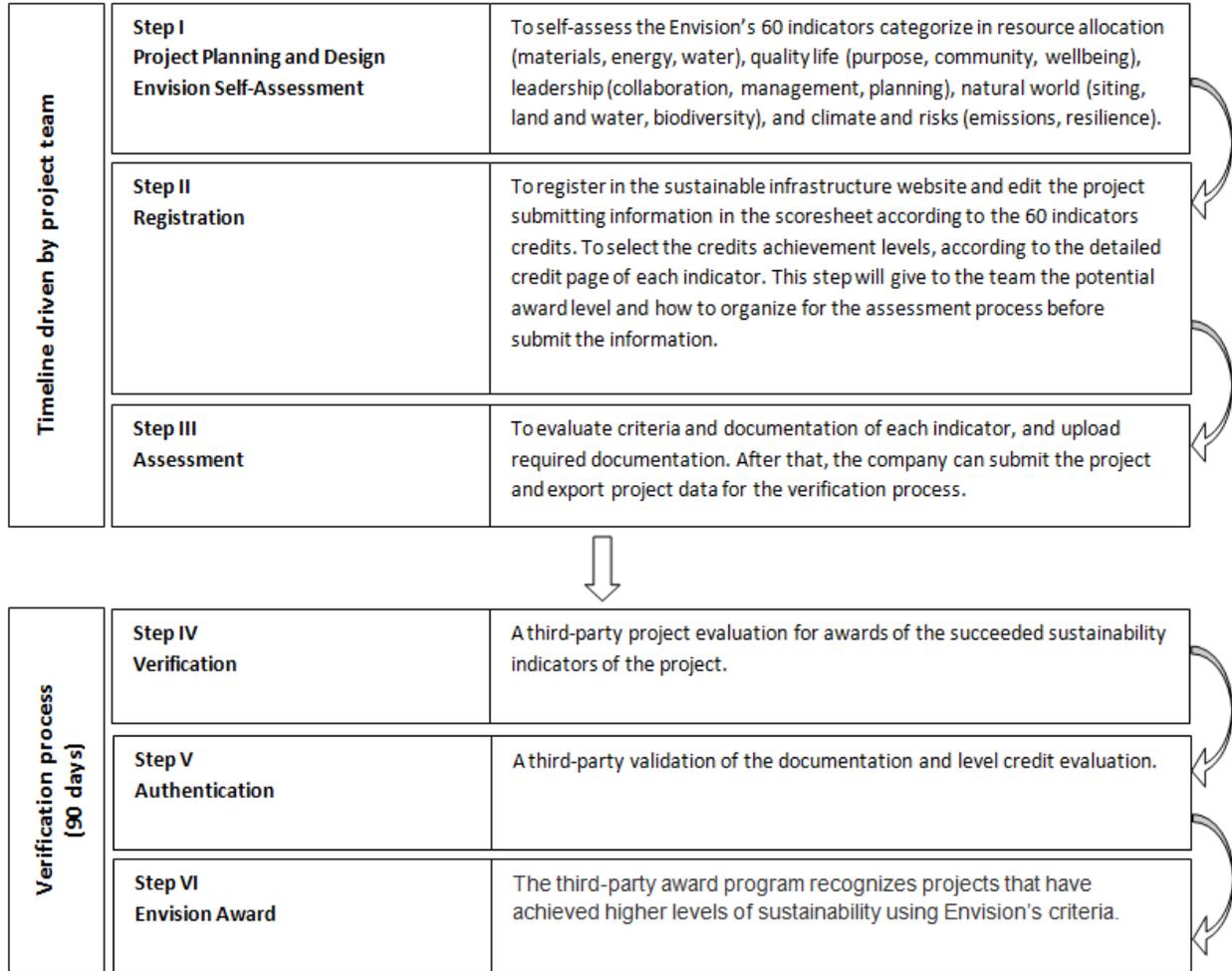


Figure 3-6. ENVISION steps implementation illustrating the six main steps to be certified

Envision recognizes the project according to its impact as improved, enhanced, superior, conserving, and restorative. The project can be certified according to the percentage obtained from the 1000 possible points as following (Institute for Sustainable Infrastructure, 2018):

- Verified Award—20%
- Silver Award—30%
- Gold Award—40%
- Platinum Award—50%

The indicators for the self-assessment and third-party evaluation have detailed evaluation criteria to be assembled, as illustrated in Table 3.7 (Institute for Sustainable Infrastructure, 2018).

Table 3.7. Indicator form

Credit Title and Identification Number	To identify the category and the number of the credit (indicator)
Intent	To identify the purpose of the credit (indicator)
Metric	To identify how to measure the credit (indicator)
Total Possible Points	To identify the total possible points for the indicator
Levels of Achievement	To describe the requirements to achieve each level of achievement: improved, enhanced, superior, conserving and restorative
Description	To explain the sustainability issue addressed by the credit and its significance in infrastructure projects
Performance Improvement	To set the benchmark for performance and provide a general strategy for performance improvements
Evaluation Criteria and Documentation	To specify the requirements to achieve each level of achievement. It also provides examples of documents to submit for verification to prove the achievement of the indicator
Related Envision Credits	To identify the ENVISION credits that share documentation requirements

ENVISION consists of 60 sustainability targets, as listed in Appendix B.8 For this study, ENVISION rating system has the following advantages and disadvantages:

1. Advantages

- a. The system is adaptable. The system weights each category according to its contribution to sustainability. This is valuable because sustainability impact differs according to the particularity of each region. It is useful also in a decision-making process.
- b. The system is a step-by-step guideline. It has an understandable and explanatory of how to meet each criterion, helping the organization to prepare itself for achieving the goals, as mentioned previously in Table 3.7.
- c. The system evaluates the quantitative, qualitative, and “yes/no” request of the requirements, assessing the outcome of the results.
- d. The system evaluates the phases of a project: planning and design phase, construction phase, operations, and decommissioning.
- e. The system evaluates the various infrastructure options and the real necessity of the project (purpose).

- f. The system assesses economic externalities. The system will analyze the effect of the project on the nearby community, considering the social and economic aspects of the project.
- g. The system has tools to guide and to educate the participants: self-assess checklist, rating tools, a credential program for individuals, project evaluation programs, and certification.
- h. The system has an audit program, providing to the users a view of where a project fails and where a project can improve.
- i. The system considers the sustainability triple bottom line: social, economic, and environmental goals.
- j. The system analyzes the stakeholder's input, allowing an approach according to the stakeholder's needs.
- k. The system enlightens each indicator of the checklist, facilitating the indicator's management, including benchmark/feedback, informing how to implement and possible problems; types of documents to report; a list of sources, allowing a user to study the indicator in more detail, if necessary.

2. Disadvantages

- a. Similar to other rating systems, it is a checklist for achieving points. Therefore, it is an outline of criteria and performance to be obtained but does not instruct an organization to prepare itself to implement sustainable development.
- b. The system does not consider the implementation of policies. Policies demonstrate the values of an organization and instruct how to execute an operation.

Hence, Envision is a useful tool for registering assessment indicators in different phases of an infrastructure project. For this study, Envision assists in the proposed model for the task management phase: an assessment plan and an audit program (closing/feedback).

Living Building Challenge

The Living Building Challenge (LBC) is a standard for sustainability performance launched in 2006 and currently has more than 100 certified projects and more than 500 registered projects in 29 countries. The LBC is a certification tool for building projects that are, not only less harmful. Focusing on regenerative performance, LBC aims to transform the way projects are made, resulting in obtaining positive environmental impacts, instead of adverse effects. The guideline is not a checklist of best practices but is

performance-based, and it positions the ideal outcome as an indicator of success, applying to four project scopes: new buildings, existing buildings, interior and landscape and infrastructure (International Living Future Institute, 2019).

The LBC focuses on the actual performance of the building. The project to be certified needs to be operational for at least 12 consecutive months before the audit and must address 20 core imperatives grouped in seven performance categories (called petals after their flower-motif), as follows (International Living Future Institute, 2019):

- Place Petal—realigns how people understand and relate to the natural environment. The Place Petal requires places acceptable for people to build, protecting and restoring the place once developed, and encourages the creation of communities based on the pedestrian rather than the automobile.
- Water Petal—realigns how people use water and redefines “waste” in the built environment.
- Energy Petal—relies on renewable forms of energy and operates year-round in a safe, pollution-free manner.
- Health and Happiness Petal—focuses on the most critical environmental conditions that must be considered to create robust and healthy spaces, rather than addressing all of the potential ways that an interior environment could be compromised.
- Materials Petal—helps to create a materials economy that is non-toxic, ecologically restorative, transparent, and socially equitable throughout their life cycle.
- Equity Petal—transforms developments to foster a genuine and inclusive sense of community that is just and equitable regardless of an individual’s background, age, class, race, gender or sexual orientation.
- Beauty Petal—recognizes the need for beauty as a precursor to caring enough to preserve, conserve, and serve the greater good.

Since the LBC is based on performance, it is flexible to the scope of a project, modifying the requirements with exceptions to several imperatives indicators according to one of the six transects (International Living Future Institute, 2019):

- Natural Habitat Preservation—this transect is either comprised of land that is set aside as nature preservation or defined as wild-lands or sensitive ecological habitat. It may not be developed except in limited circumstances related to the preservation or interpretation of the landscape, as outlined in the Place Petal Handbook of the LBC.

- Rural Zone—this transect is comprised primarily of land that is used for agriculture and food production-based development, as well as the outlying areas of small towns and villages.
- Village or Campus Zone—this transect is comprised of relatively low-density mixed-use development found in rural villages and towns, and low-density neighbourhoods outside of small cities, and may include college or university campuses.
- General Urban Zone—this transect is comprised of light- to medium-density mixed-use development found in larger villages, small towns, or at the edge of larger cities.
- Urban Center Zone—this transect is comprised of a medium- to high-density mixed-use development found in small to mid-sized cities or in the first “ring” of a larger city.
- Urban Core Zone—this transect is comprised of high-to very high-density mixed-use development found in large cities and dense metropolitan areas.

Once the project has completed the construction and has the twelve months performance period, it can be certified in one of the five certification paths described below (International Living Future Institute, 2019):

- Zero Carbon Certification—100% building energy load offset with on-site or off-site renewable and embodied carbon reduction and offset
- Zero Energy Certification—100% building energy load offset with on-site renewable, driving efficiency
- Core Green Building Certification—respond to climate change with holistic and high performance. Projects must meet the requirements of ten core imperatives—up to two core imperatives per category (the petals)—and verify performance for water and energy through a twelve-month performance period
- Living Building Challenge Petal Certification—one pillar of deep regenerative design built on a holistic high-performance foundation, requiring the achievement of the core imperatives, and imperatives in the Water, Energy, or Materials Petal
- Living Building Challenge Living Certification—a summit of holistic aspiration and fully restorative. It requires achieving all the indicators of the core imperatives

The LBC consists of 20 targets, as listed in Appendix B.9. For this study, the LBC has the following advantages and disadvantages

1. Advantages

- a. The LBC focuses on the performance of the building. Therefore, it can be flexible according to the type and location of the project. The framework of this certification program analyzes the individual characteristics of each project.
- b. The LBC has clear targets and approaches the three pillars of sustainability, focusing on the environmental and social aspects of the project.

2. Disadvantages

- a. Similar to other certification programs, the LBC has a framework to assist the organization to identify what a building needs to become more sustainable but does not support the organization to structure itself for implementing sustainability practices.

Thus, the LBC is a third-party certification based on the performance of the building assisting the organization to identify, from the design to the maintenance phase, the way the building can interact with the environment and the community. For this research, it will assist in identifying sustainability indicators and management practices at the tactical level.

Arup Sustainable Project Appraisal Routine

The Sustainable Project Appraisal Routine (SPeAR) is a sustainability appraisal tool developed to monitor and evaluate project performance and informed decision making throughout the project life cycle. The tool was developed by Arup's sustainability experts and software developers and was designed as a decision-making framework to support project development and report results (Arup Group Ltd., 2017). SPeAR was developed in 2000 based on the UK Sustainable Development Indicators from Quality of Life Counts, the UN indicator sets and the Global Reporting Initiative (GRI) indicators (Arup Group Ltd., 2019).

SPeAR reviewed several international best practices such as LEED, GRI, OECD and BREEAM to elaborate its sustainable indicators list. The tool also was developed in consultation with sustainability experts from across the world (Arup Group Ltd., 2017). It is a performance rating system that has five rating levels from +3 to -1, where +3 represents the best case and -1 the worse. Level 0 represents the minimum required standard, as described below (Arup Group Ltd., 2017):

- (+3) The project exceeds the sustainability performance of best practices and advancing knowledge—the colour dark green represents it in the traffic light system.
- (+2) The project has the best practices of sustainability performance—the colour light green represents it in the traffic light system.

- a. It is a holistic basis rating system that helps the organization to identify its impact on the three pillars of sustainability.
 - b. It is a rating system developed to inform the sustainability impacts for making the decision process.
 - c. The software is flexible and able to manage the particularity of each organization.
2. Disadvantages
- a. It focuses on infrastructure projects in general. Therefore, there are limited indicators for the construction industry specifically.
 - b. It is focused primarily on developed countries. This research intends to introduce the generalized contribution of the field at all levels and area.
 - c. It has limited public access to the information about the assessment and calculation of the impact.

Thus, SPeAR is a third-party assessment methodology that assists organizations in identifying their effects on the environment, society and economy, introducing fundamental sustainable indicators, validated by specialists around the world, and flexible enough to allow the organizations to create their indicators.

Green Globes

Green Globes is an on-line assessment and user-friendly assessment protocol utilized primarily in Canada and the USA with three main phases: a self-assessment through a questionnaire-based, the submittal requirements, and the formal certification request (Green Building Initiative - GBI, 2019). The Green Globes system assists the organization with a self-assessment questionnaire at four stages of the integrated design process for building construction: pre-design, concept design, construction documents—leading to design certification, and post-construction—leading to final certification (Green Building Initiative - GBI, 2019).

The Canadian Department of National Defense and Public Works and Government Service supported the creation of the Green Globes in 2000. Its development is based on the 1996 Canadian Standards Association (CSA), group of standards publication of BREEAM Canada. In 2004, the system was also adopted in the USA. The system has more than 150 certified projects at different levels of performance (Green Building Initiative - GBI, 2019).

The main categories of the Green Globes are project management, site, energy, water resources, emissions, and indoor environment. The system has five levels of certification, as follows (Green Building Initiative - GBI, 2019):

- 1 Green Globe—the project must have identified and initiated some measures to improve energy and environmental performance and acquired from 25 to 39% of the points.
- 2 Green Globes—the project has moved beyond awareness and commitment to sound energy and environment design practices. The project should acquire from 40 to 54% of the points.
- 3 Green Globes—the project indicates excellent progress in achieving eco-efficiency results obtaining from 55 to 69% of the points.
- 4 Green Globes—the project indicates leadership in terms of energy and environment design practices and commitment to continuous improvement. The project needs to achieve from 70 to 84% of the points.
- 5 Green Globes—the project will serve as a national or world leader in energy and environmental performance and introduce design practices that can be adopted and implemented by others. The project needs to achieve more than 85% of the points.

Green Globe consists of 47 sustainability targets, listed in 6.3.B.11 Appendix B.11. For this study, the Green Globe system has the following advantages and disadvantages

1. Advantages

- a. The Green Globes assists the organization in identifying the sustainability target for each project and the management practices of the project's execution

2. Disadvantages

- a. The Green Globes does not consider organizational level management, similar to other rating systems.

Thus, Green Globes is a third-party certification that assists organizations to self-assess their sustainability achievement through a questionnaire relating to the targets and performances of the sustainability for each project.

International Organization for Standardization (ISO)

The International Organization for Standardization (ISO) is an independent, non-governmental and international standards developer with standards for business, government and society as a whole. ISO has

a membership of more than 160 national standards institutes from large and small, industrialized, developing and in transition development countries all of the world (ISO - International Organization for Standardization, n/d). Individuals and companies cannot become a member of ISO. The members are leading standards organizations in their countries, and there is only one member per country (ISO - International Organization for Standardization, n/d). In Canada, the member body of ISO is the Standards Council of Canada (SCC), responsible for the accreditations and certifications in the country (SCC - Standards Council of Canada, 2019). In Brazil, the member body of ISO is the Associação Brasileira de Normas Técnicas (ABNT), active in product certification since 1950 (ISO - International Organization for Standardization, n/d).

ISO has produced more than 22,000 international standards, approaching roughly every industry (ISO - International Organization for Standardization, n/d). ISO initiated its operations in 1947 resulting from a meeting with 65 delegates from 25 countries in 1946 at the Institute of Civil Engineers in London to create a new international organization 'to facilitate the international coordination and unification of industrial standards. ISO initiated its existence with 67 technical committees, groups of experts focusing on a specific subject (ISO - International Organization for Standardization, n/d).

In 1971, ISO created its first two technical committees in the environmental field: air quality and water quality. Nowadays, other groups have been joining these committees with experts focusing on diverse subjects, including soil, quality, environmental management and renewable energy (ISO - International Organization for Standardization, n/d).

The ISO 9000 family, the first quality management standard published by ISO in 1987, has become one of the most well known and best-selling standards. The ISO 9000 family addresses diverse aspects of quality management and provides guidance and tools to ensure that organization's products and services consistently meet the observed requirements and that the quality is continuously improved (ISO - International Organization for Standardization, n/d).

ISO launched its environmental management system standard, the ISO 14000 family, in 1996. The standard provides practical tools for companies and organizations of all types to help them to identify and control their environmental responsibilities (ISO - International Organization for Standardization, n/d).

The scope of the ISO 14000 family is environmental management systems standardization in supporting sustainable development. It does not include test methods of pollutants, setting limits values and levels of environmental performance and standardization of products (International Organization for Standardization - ISO, n/a).

The ISO 14001 and ISO 14006 focus on environmental systems. The others in the family focus on detailed approaches such as audits, communications, labelling, life cycle analysis and environmental challenges such as climate change.

ISO has over a thousand standards for the construction industry that provide internationally agreed guidelines and specifications (International Organization for Standardization - ISO, 2019). According to ISO (2019), several standards can contribute to the Sustainable Development Goals. Appendix B.11 demonstrates the complete list.

ISO does not perform the certification process but develops International Standards. External certification bodies complete the certification process. The certification is a formal authentication from an independent agency that the product, service or system in question meets specific requirements. (International Organization for Standardization - ISO, n/a).

The organization chooses a certification body to be certified. The certification body has to be accredited and uses the relevant ISO's Committee on Conformity Assessment (CASCO) standard. CASCO is the ISO committee that works on issues relating to conformity assessment (International Organization for Standardization - ISO, n/a). To find an accredited certification body, the organization can contact the national accreditation body in its country or visit the International Accreditation Forum (IAF). IAF develop an international program of conformity assessment reducing the risk for business and customers, ensuring users a competence and impartial evaluation by the authorized body (International Accreditation Forum, Inc - IAF, n/a).

ISO, in 2014, also published a set of standards to assist organizations to manage their assets: ISO 55000, 55001, and 55002. The ISO 55000 gives an overview of asset management, its principles and terminology, and the advantages of implementing asset management. It may be applied to all types of assets and in all types and sizes of organizations. The ISO 55001 provides a set of requirements of an asset management system, and ISO 55002 provides additional guidance for applying ISO 55001 (International Organization for Standardization (ISO), 2014).

This research considered targets from the standards ISO 14000—CSA PLUS 1144 - Evaluating Environmental Performance: Indicators and Measures (Canadian Standards Association - CSA, 1998)—and ISO 21929 Sustainability in building construction—Sustainability indicators-Part 1, 2. Other standards were not available to the researcher.

For this study, ISO standards have the following advantages and disadvantages:

1. Advantages

- a. ISO standards focus on the management process and standardization. Therefore, the standards will assist this research in the second part of this study, the SDMBOK.

2. Disadvantages

- a. The focus of the standards is to assist the organizations to identify their indicators. It focuses on the managerial level, not contributing as much to the first part of the research—the meta-analysis of the sustainability indicators for the building construction industry, the 100 SDI.

Thus, ISO is a third-party certification that analyzes the best practices at the managerial and processes level assisting the organizations in diverse particularities of the management process. It will contribute to this research in the second part—the SDMBOK.

Legislation and Policies: Federal Sustainable Development Strategy

The Federal Sustainable Development Strategy (FSDS) for Canada is the primary vehicle for sustainable development planning and reporting. It identifies the sustainable development priorities for Canada and establishes the goals, targets and actions to achieve them (Government of Canada, 2019).

The FSDS sets the Canadian sustainable development priorities, establishes goals and targets, and identifies actions to achieve and support the environmentally-focused Sustainable Development Goals (SDG) (Government of Canada - Environment and Climate Change Canada, 2019).

The FSDS goals take a long-term view and address critical challenges and problems regarding sustainable development. It remains attuned to environmental information, data and indicators, reflecting domestic and international priorities and commitments (Government of Canada - Environment and Climate Change Canada, 2019).

Each target intends to be measurable, includes clear periods and a medium-term view, and falls within federal jurisdiction and departmental mandates (Government of Canada - Environment and Climate Change Canada, 2019).

FSDS presents the short, medium and long-term view and is aligned with the Government of Canada. It also introduces the action plans that constitute implementation strategies as required by the Federal Sustainable Development Act (Government of Canada - Environment and Climate Change Canada, 2019).

The FSDS is the Canadian Government plan to support the 2030 Agenda. It is a set of sustainable development goals of the Canadian Government over the three years to support the SDG. According to the Government of Canada (2019), the FSDS goals directly support 12 of the 17 SDGs: SDG 2, SDG 3, SDG 6, SDG 7, SDG 8, SDG 9, SDG 11, SDG 12, SDG 13, SDG 14, SDG 15 and SDG 17.

The 2019-2022 FSDS is organized into 13 targets and acknowledges the responsibility of the government in achieving the SDGs (Government of Canada - Environment and Climate Change Canada, 2019). The complete list is demonstrated in Appendix B.13.

For this study, this governmental document has the following advantages and disadvantages

1. Advantages

- a. Determine the sustainable objectives at the governmental level, which will influence the policies and requirements of the government.

2. Disadvantages

- a. As the targets are at the governmental level, they are broad, and there are no specifications of the requirement for different fields or activities.

Thus, FSDS is the Sustainable Development Strategy of the Canadian Government, which will influence the policies imposed by the government to diverse fields and organizations.

3.2. Research Activities

This research aims to provide a consolidated list of sustainability targets for the full range of sustainable development for the building construction industry. A meta-analysis of several SD standards and certification systems was performed to identify the specific sustainability targets that they address. The meta-analysis focuses mainly on targets and indicators, identifying the assessment methodologies that standards and certification systems specify and assembling these into a single superset list of SD targets. This research calls the consolidated list of the sustainability targets the “100 Sustainable Development Indices”, or the “100 SDI”. The standards included in this meta-analysis are as follows:

- UN Sustainable Development Goals (UN-SDG);
- Organization for Economic Cooperation and Development (OECD);
- International Chamber of Commerce (ICC);
- World Business Council for Sustainable Development (WBCSD);

- Global Reporting Initiative (GRI4);
- Building Research Establishment Environmental Assessment Method (BREEAM);
- Leadership in Energy and Environmental Design (LEED);
- Envision Rating System for Sustainable Infrastructure (ENVISION);
- Living Building Challenge (LBC);
- Sustainable Project Appraisal Routine (SPeAR Arup);
- Green Globe (rating system and guidance for green building design, operation and management);
- International Organization for Standardization (ISO);
- and other related standards and guidelines uncovered in the literature review such as Federal Sustainable Development Strategy.

The detailed descriptions of each sustainability target, indicator and assessment methodology are presented in Appendix B.14. The complete 100 SDI is provided in Appendix A:. This research performed as analysis of each of the sustainability targets forming the 100 SDI through literature review and introduced a mapping diagram to define the contributions of the targets to the SDGs. The mapping diagram uses the idea of the Causal Loop Diagram (CLD), a tool for analyzing and developing an understanding of complex systems and defines the behaviour and how one system can influence another one in a chain of causes and effects (ISixSigma, 2019). The mapping diagram was used to identify and illustrate the connection between each SDI and each SDG.

Therefore, this section of the research, which addresses the first research objective of defining the scope of SDM, is organized based on the two sub-objectives:

- a. Develop a set of sustainability targets that can be used to assess the construction industry’s impact on Sustainable Development.
- b. Identify the impact that these targets (which represent the scope of SDM) have on achieving the United Nations Sustainable Development Goals (UN-SDGs).

3.2.1. Develop a set of sustainability targets that can be used to assess the construction industry’s impact on Sustainable Development

To address the objective of developing a set of sustainability targets that can be used to assess the construction industry’s impact on Sustainable Development, a meta-analysis of existing SD standards and

certification systems was conducted to produce a master list of targets for SD in the construction industry, the *100 Sustainable Development Indices (100 SDI)*.

The methodology and results obtained by this research are presented in the following topics.

Methodology

Through a systematic literature review, this research introduces a set of SD targets for the building construction industry.

SD within the construction industry spans a vast range of goals and objectives and a wide range of solution techniques and technologies across many fields and sub-disciplines. A spectrum of standards and certification systems cover different parts of these topic areas, with no one system emerging as a consensus framework for the full range of SD topic areas. The first step in identifying the current indicators was to determine the main sustainability categories that this research will approach.

According to Brandon et al. (2017), the underlying concept of intergenerational justice that permeates all sustainability discussions—i.e., not penalizing future generations by what we do today—can give rise to several approaches from making people happy to conserving the planet to planning disaster resilience and much more. This spectrum creates difficulties in establishing a procedure that incorporates the broad idea of sustainable development into a specific field.

Continuing with Brandon et al. (2017), the temptation is to approach sustainability with reductionism, which ignores dependencies between complex variables in an attempt to focus on the core issues. For example, attention on climate change may miss the importance of social cohesion; focus on energy production may miss the side effect of other pollutants; concern for crime reduction can lead to buildings that don't enable people to live together and in harmony, etc.

As sustainable development is understood to address all three domains of sustainability—social, environmental, and economic (Circular Ecology Ltd, 2019)—the measurement and assessment of those domains enable the construction industry to determine whether it is making progress and also to make explicit what sustainable development means in this field. This research identifies sustainability targets and indicators of each pillar of SD from different sources of literature, certifications and standards. Therefore, The 100 SDI is categorized into the three pillars of sustainability as well as the governance of the sustainability targets, as follows:

- Social—a socially sustainable system intends to accomplish decency in distribution and opportunity, sufficient arrangement of social services, including health and education, gender

equity, and political responsibility and interest (Harris, 2003). The social perspective of the 100 SDI is divided into human rights, such as adequate standard of living, adequate wages according to the cost of living, career plan, health and safety, maternal health improvement; and social development such as combating poverty, donations to community organizations, education & skills development, historic and cultural resources preservation, stakeholder engagement, strategies for employment opportunities and support to developing countries in their sustainable achievement.

- Economic—an economically sustainable system aims to produce continuing goods and services and to avoid extreme sectoral imbalances, which damage agricultural or industrial production (Harris, 2003). The economic perspective of the 100 SDI is divided into business growth such as cash flow and resources efficiency, operational sustainable consumption - construction footprint, sustainable investment—integrating environmental and social governance; and economic growth such as cooperative and microenterprise incentives, open and competitive markets, project affordability and income and wealth distribution.
- Environmental—an environmentally sustainable system aims to maintain a stable resource base, avoiding over-exploitation of renewable resource or environmental sink functions, which includes maintenance of biodiversity, atmospheric stability and other ecosystem functions (Harris, 2003). The ecological perspective of the 100 SDI is divided into Air Emission such as Construction IAQ Management Plan, Environmental Tobacco Smoke Control, Green Chemistry / Low-Emitting Materials, IAQ Performance, Natural Infrastructure, Pollution Prevention and Ventilation Effectiveness; Biodiversity such as Biodiversity Preservation, Bird Collisions and Combating Deforestation; Energy such as Construction Energy Reduction, Daylight Use, Energy Performance Optimization and Renewable Energy; Local Impact such as Alternative Transportation, Life Cycle Approach, Local/ Regional Material, Recyclables storage and collection and Sustainable Site Selection; Research Consumption such as Building Reuse - Existing Shell, Raw Material Reduction and Recycled and certified Materials; Soil such as Avoid unsuitable development on steep slopes, Control erosion and sediment and Site Disturbance Reduction; and Waste such as Construction Waste Management, Storm-water Management and Water efficiency.
- Governance—A governance system aims to establish policies and a continuous monitoring system of the proper implementation by the members of the governing body of an organization (WebFinance Inc., 2019). The governance perspective of the 100 SDI is divided into Environment such as Energy Air Pollution Policy and Environmental Grievance Mechanisms; Innovation such as Design Innovation and Research, Development and Technology Innovation; Management such as Full Sustainable Cost Methodology, Post Occupancy Management, Sustainability Integrated

Policy, Decision-Making Methodology and Sustainable indicators Metric Accounting and Reporting; and Social Development such as Fighting Corruption and Illicit Financial Flows Policies, Impacts on Society Grievance Mechanisms, Labor Grievance Mechanisms and Sustainability Social Marketing.

The research activity was to identify the sustainability targets of the certifications and standards analyzed by this research and their respective indicators and assessment methodology. The sustainability targets of each one were listed and categorized according to the three pillars of sustainability plus governance.

The initial list of all the sustainability targets, sorted by the category and subcategory, contained more than 800 sustainability targets. By considering overlapping targets, these were consolidated into a set of 99 sustainability targets called the 100 SDI.

The complete list of sustainability targets can be found in Appendix B.14, containing the sustainability targets, indicators, method of assessment and additional information of each sustainability target.

Results

This research introduces a master set of sustainability targets based on current standards and certifications (illustrated in Figure 3-8). The consolidated list is being called the 100 Sustainable Development Indices (100 SDI), and it introduces the sustainability targets for each area of SD (social, economic and environment), the indicators for each target from each of the analyzed document, the assessment methodology and the SDG that is impacted by each targets. The method used to identify the relationship between the SDI and SDG is discussed in the next section.

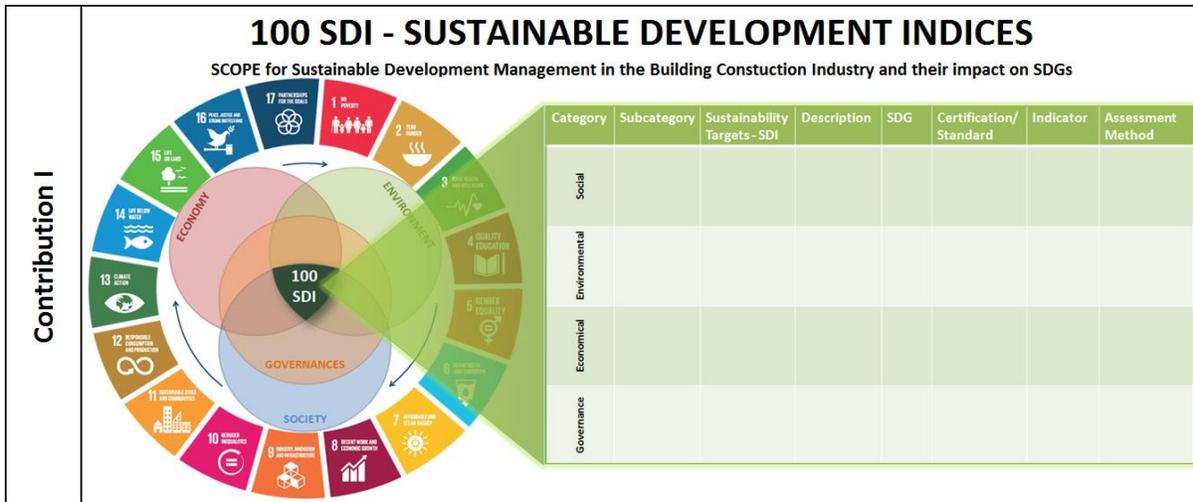


Figure 3-8. An illustration of the first contribution of this research—The 100 Sustainable Development Indices (The 100 SDI) demonstrating the information analyzed by the meta-analysis table on The 100 SDI – meta-analysis appendix

3.2.2. Identify the impact that these targets (which represent the scope of SDM) have on achieving the United Nations Sustainable Development Goals (UN-SDGs)

To address the objective of identifying the impact that these targets (which represent the scope of SDM) have on achieving the United Nations Sustainable Development Goals (UN-SDGs), a detailed analysis and mapping diagrams were developed to identify the 100 SDI and UN SDG interrelationships.

The methodology and results are presented in the following topics.

Methodology

For each of the SDI identified (as above), this research also identified how the SDI influenced the UN-SDGs through mapping the relationship between them. The mapping system used the idea of Causal Loop Diagrams (CLD) to define the relationships between the SDIs and the SDGs. Each target was analyzed individually through a literature review to identify how it could positively impact the SDGs. In total, the literature sources for this analysis utilized 56 references: 12 official websites, 21 books, two conference papers, and 21 journal papers. A list showing the references used for each SDI is provided in Appendix B.15.

Results

The relationship between systems can be a direct or indirect relationship with a reinforcing feedback loop, which means that one system cause changes in the same direction of the other system. For example, if one system increases, the other one will increase consequently. Alternatively, the relationship between

the systems can be a direct or indirect relationship with a balancing feedback loop, which means that one system will affect the other system in the opposite direction (Thwink.org, 2014). The signs plus (+) and negative (-) in the diagram indicates if the loop is reinforcing or balancing.

Figure 3-9 illustrates one example of the analysis performed by this research: the relationship between the SDI 42—Environmental—Soil: Avoid unsuitable development on steep slopes and the SDG 14—Life below Water. The SDI 42 aims to protect steep slopes and hillsides from inappropriate and inadequate development, avoiding exposures and risks from erosion, landslides, and other natural hazards. According to the Capital Regional District (2019), eroded particles of soil, or sediments, can easily be moved off construction and landscaping sites by flowing water and end up in natural water bodies. These sediments can cause damage to receiving water bodies. Sediment in water bodies can reduce the amount of sunlight reaching aquatic plants, clog or abrade fish gills causing suffocation, smother marine feeding sites and spawning areas and interfere with the ability of fish to navigate. Preventing and controlling erosion is essential to the protection of natural streams, rivers and saltwater ecosystems. As SDG 14 aims to conserve and sustainably use the oceans, seas, and marine resources for sustainable development, they are directly connected.

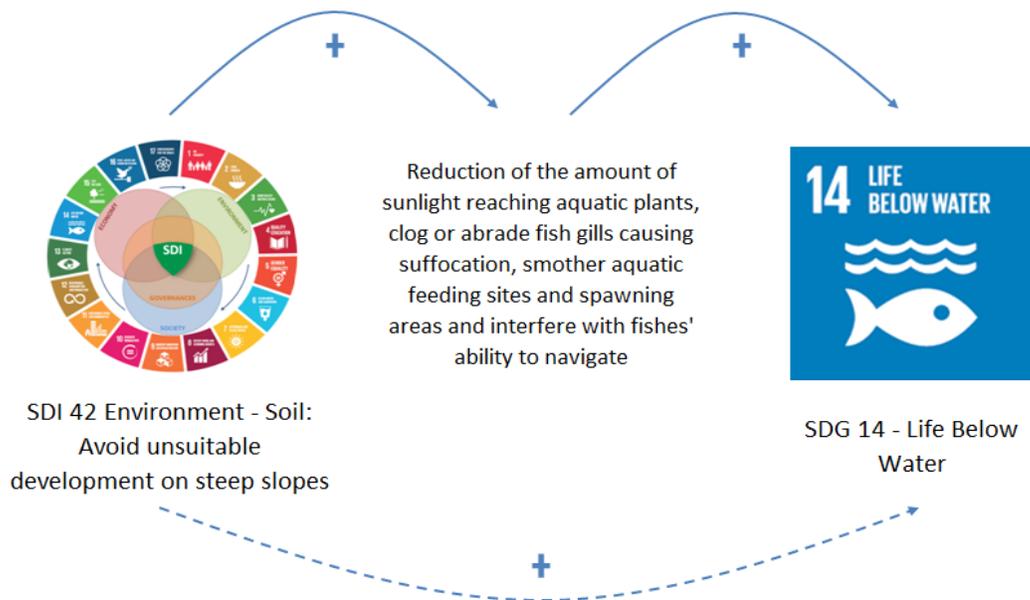


Figure 3-9. An example of the mapping illustration introduced on The 100 Sustainable Development Indices (The 100 SDI) appendix: the relationship between SDI 42—Environmental—Soil: avoid unsuitable development on steep slopes and SDG 14—life below water as mappings. The top arrows exist to catch the attention of an explanation in the middle of the diagram justifying the direct (or indirect) relationship.

The results of this analysis are the identification of each SDI contribution to the SDGs, assisting the organization in managing its sustainable development and report its contribution to the 2030 Agenda for Sustainable Development.

3.3. Deliverable: 100 SDI

The deliverable of this part of the research is a set of sustainability targets for the building construction industry with their contribution to the SDGs. The 100 SDI assists an organization in identifying the focus of sustainable development in the building construction industry and information for elaborating a specific and clear plan to manage and report its contribution towards the SDGs.

Appendix B.14 presents the consolidated list of sustainability targets for the building construction industry, the 100 SDI, accompanying with the sustainability indicators and assessment methodology from certifications and standards analyzed by this research.

Appendix A: presents the 100 SDI along with the contributions of each to the SDGs.

The 100 SDI can benefit the following stakeholders:

- Construction managers and project managers—assisting in identifying the sustainability targets to be managed in the site-building operations;
- Sustainability managers and coordinators—assisting in determining the sustainability targets to achieve in the building projects activities;
- Contractors—assisting in managing and reporting its sustainability impact, identifying the focus of sustainable development targets;
- Architects, designers, and engineers—assisting in identifying the main areas of sustainable development practices in the building construction in the design phase;
- Chief Executive Officers—according to IISD (2019), only 21% of chief executive officers believe business is playing a critical role in contributing to the SDGs, but 71% believe that business can play a crucial role in increasing commitment and action. The 100 SDI can assist the strategic part of the business in identifying the main topic areas to focus on in implementing sustainable development into the building construction industry;
- Construction consultants—according to the Association of Consulting Engineering Companies (2014), the consulting engineering industry has an essential role in developing more sustainable solutions, working alongside the clients on setting challenging design objectives that focus on

sustainable solutions. They state that there is not only the opportunity to participate in sustainable development implementation but also that they have an ethical responsibility to understand and communicate to clients the consequences of the projects that are being delivered. The 100 SDI can assist this industry in identifying the main sustainable development targets for new solutions, assessment management, and report.

- Government—governments cannot be responsible alone for sustainable development. Still, they do have an essential role in delivering a sustainable future by providing mechanisms for informed decision-making and by developing and maintaining strategies and policies that will help sustainable practices implementation. The 100 SDI can assist a government in identifying the sustainability impact of the building construction industry and in managing the effect through policies and assessment of sustainability targets for this industry.

Table 3.8. illustrates a comparison of the certifications studied by this research and the 100 SDI regarding the contribution to each pillar of sustainability. The percentage considers the number of targets for each sustainability category and the total number of indicators for each certification/standard.

Table 3.8. Certifications/Standards and The 100 SDI: a comparison of the sustainability targets and the contribution for each pillar of sustainability

	Total Analyzed Sustainability Targets	Economic	Environment	Social	Governances
BREEAM	54	0%	78%	9%	13%
Envision	60	8.5%	70%	8.5%	13%
LEED	55	0%	84%	5%	11%
OECD	64	19%	28%	48%	5%
ICC	10	50%	30%	0%	20%
WBCSD	17	29%	59%	6%	6%
GRI	93	4%	42%	33.5%	20.5%
LBC	20	5%	85%	0%	10%
Green Globes	47	6.5%	70%	2%	21.5%
SPeAR	24	37.5%	37.5%	25%	0%
ISO	7	0%	71%	29%	0%
FSDS-Canada	13	0%	100%	0%	0%
Average	39	9%	60%	18%	13%
100 SDI	99	9%	43.5%	27.5%	20%

In summary, the 100 SDI provides a set of sustainability targets for the building construction industry, assisting industry stakeholders in identifying and managing their sustainability targets.

3.4. Validation

Independent reviews were conducted by specialists in sustainable development in the construction industry, analyzing the efficiency and acceptance of the 100 SDI. The detailed process of validation for this research is discussed in chapter 5. The reports from the specialists and the curriculum of their experiences can be found in Appendix B.16.

3.5. Contributions

The wealth of information regarding sustainability targets and the various certification programs makes it hard for the industry to understand and address the sustainable development issues. This portion of the research contributes to the solution of this problem through the deliverable of the 100 SDI, which formally defines a scope for sustainable development in the form of a collection of sustainability targets, along with their mapping to the UN-SDGs.

As the Method Evaluation Model (MEM) suggests, the methodological pragmatism of the 100 SDI (Actual efficacy/Performance)—using the systematic literature review and meta-analysis process to develop and validate the list—demonstrates the efficiency and effectiveness of the results.

The analysis of the efficiency and effectiveness, proposed by Moody (2003), of the 100 SDI demonstrated a considerable improvement in the current literature review, introducing a consolidated list of sustainable targets for the building construction industry. Figure 3-10 illustrates this analysis and comparison.

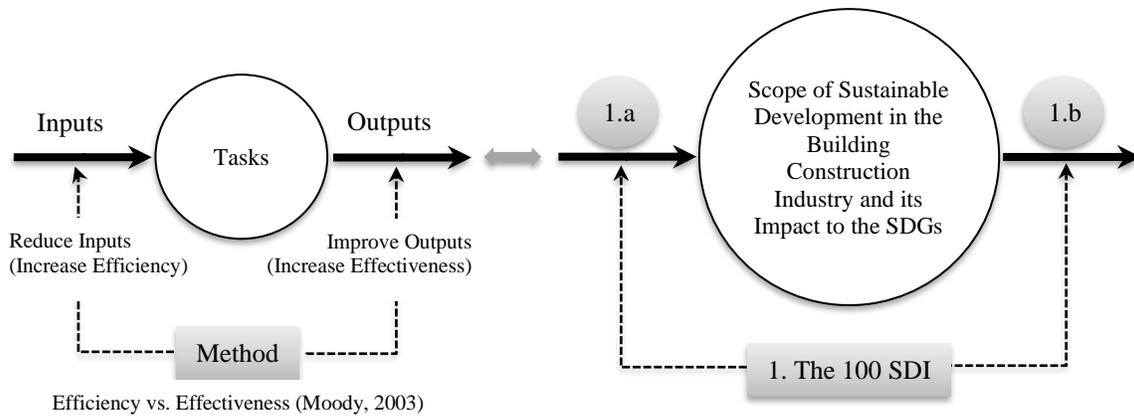


Figure 3-10. The methodological pragmatism analysis of the 100 SDI illustrating the actual efficacy/performance of the first objective of this research

- 1.a. (Reduce Inputs - Increase Efficiency) – The scope of sustainable development studied by this research consolidated sustainability targets from 13 sources of information-analyzing roughly 1000 indicator-to one unique list with 99 targets. Moreover, the list identifies the targets’ contribution to the SDGs. These results help determine the sustainable targets related to the building construction industry in one consolidated list. Therefore, allowing to analyze and identify which target the organization will address and identify which SDGs the organization is contributing, assisting in more objective analysis and reporting the organization’s sustainable impact.
- 1.b. (Increase Effectiveness – Improve Outputs) – The 100 SDI provides the scope of sustainable development management for the building construction industry, addressing the three pillars of sustainability—economic, social, and environmental. Moreover, the 100 SDI identify the contribution of each target to the UN-SDGs. Consequently, the 100 SDI is an effective tool to assist organizations to identify their sustainable goals and design its sustainable development management strategy, the second object of this study.

Therefore, the 100 SDI, as presented in the Appendix A – The 100 Sustainable Development Indices (SDI), is the first main contribution of this research, introducing the scope of Sustainable Development Management focus on the building construction industry; the complete table presents a set of 99 sustainable targets to assess the building construction industry’s impact on sustainable development and introduces a mapping diagram for each of those targets illustrating and identifying the impact of them on achieving the United Nations Sustainable Development Goals (UN-SDGs).

Figure 3-11 illustrates the first contribution of this research.



Figure 3-11. The 100 SDI contribution diagram and the two main contributions as of objectives 1.a and 1.b

3.6. Conclusion

Due to the complexity of the topic, the current literature review approaches aspects of sustainability separately. The ongoing literature review of standards and certification systems cover sustainable development partially, lacking a consensus approach for the full range of sustainable development for building construction industry.

Although the UN acknowledged that the construction industry has an essential contribution in delivering the SDGs and their associated targets (Building Research Establishment Ltd, 2018), the connection with the SDGs was unclear. Current studies do not introduce a consolidated list of the three sustainability pillars relate to the building construction industry activities and business.

This research presents a consolidated list of sustainable development targets, the 100 SDI. It also introduces the connection of the 100 SDI to the SDGs, helping the building construction industry to identify the impact and contribution of the field to the sustainable development and the three sustainability pillars.

Chapter 4: How to Implement Sustainable Development Management?

4.1. Introduction

According to Taylor (1994), the global issues of environmental degradation, economic uncertainty, social unrest, and political instability are not only managerial and technological problems but also a crisis in the current values and ways of thinking. The increasing behaviour of consumption needs to give space for a new set of values for tomorrow's world that integrates redefined concepts of sustainable development (Taylor, 1994).

The concern of understanding and applying sustainable development is increasingly affecting the way the organizations consider their process management and outcomes. An overwhelming amount of literature has examined this concern, aiming to help organizations to implement sustainability concepts and practices into their activities.

This study does not intend to create a new sustainability standard or a framework for measuring sustainable *practices*, but rather to create a framework for *Sustainable Development Management (SDM)* in the construction field, focusing on the building construction industry and addressing both the organizational structure and processes management. This chapter is divided into the following seven parts:

- Introduction—an introduction to the topic
- Points of Departure—the fundamental aspects of management: organizational practices, project and construction management, sustainability and SDM. The literature review identifies the management practices at the corporate level and then process management relating to sustainable development. This discussion provides an overview of current practices and assessment methodologies to overcome the lack of guidance for sustainability management in the construction industry. An analysis of the current understanding of SDM provides an overview of the best practices and opportunities for improvement (Weybrecht, 2014):
 - Organizational Management Practices—the main requirements and conceptual structures for designing process at the corporate organizational level:
 - Corporate Strategy Management—determining the goals and strategies of the organization.
 - Corporate Objectives Management—identifying the priorities and objectives of the organization, based on the organizational strategy.

- Corporate Structure Management—the work breakdown structure (WBS) that provides the organizational structure for achieving the corporate strategy and objectives.
- Corporate Policies and Procedures Management—the set of principles, rules, and guidelines designed to reach the corporate strategy and objectives and guide the defined organizational structure.
- Project and Construction Management—management practices in the construction industry:
 - The Project Management Body of Knowledge (PMBOK)—the management practices well-known in the construction industry, providing a common approach adopted for the Sustainable Development Management Body of Knowledge (SDMBOK).
 - Task Management—the process of managing the organization’s sustainability activities.
 - Indicators and Assessment Management—tools to measure, monitor, control, and assess the corporate objectives.
 - Reporting Management—reporting corporate activities and disclosing organizational performance.
- Sustainability and SDM—the main requirements and conceptual structures for SDM within the construction industry.
- Research Activities—the research activities developed to capture the current management practices focusing on sustainability management.
- Contribution: The SDMBOK—the final contribution of the second objective of this study, the SDMBOK.
- Validation—the methodology of validation of the SDMBOK.
- Conclusion—the findings and a summary of the benefits of the SDMBOK.

4.2. Points of Departure

4.2.1. Organizational Management Practices—The Strategic Layer

Project management coordinates the work of multiple specialists on large projects while dealing with the various challenges such as constrained resources, constrained time, and environmental vulnerability. New types of project organization and innovative practices of management are required to adjust to progressively complex activities and increased risks (Nicholas, 1994). To adapt to the new challenges, the

strategies, business models, and policies need to be adaptable and improved skills must develop (WBCSD - World Business Council for Sustainable Development, 2019). Moreover, as business is part of our broader society, its purpose needs to extend beyond its own interests alone (Drucker, 1974).

Construction management activities can be organized into six hierarchical levels: organizational, project, activity, operation, process, and work task level (Halpin & Woodhead, 1976).

At the organizational level, the business management perspective is considered. The definition of the organization's mission and its purpose can dictate its objectives of crucial areas. The balance of these objectives converts their subjectivity into concrete strategies and resource allocation (Drucker, 1974).

According to the Project Management Institute (PMI) (2017), the quantifiable measurement of the business effort and its benefits defines its value. The benefit can be tangible, intangible, or both. From a project perspective, the business value refers to the advantage that the results of a specific project provide to its stakeholders.

The organizational structure arises from an ongoing process of evaluating the purposes of organization—questioning, verifying, and redefining the manner of interaction with its environments (Miles R. E., Snow, Meyer, & Jr., 1978).

Organizational structure is a highly complex and changeable process. It takes into consideration alternative ways in which the organizations define their strategy (product-market domains) and constructs mechanism (structures and processes) to pursue these strategies (Miles R. E., Snow, Meyer, & Jr., 1978).

The Construction Design and Management (CDM) regulations are part of the legislative framework of the construction industry. The regulations attempt to endorse the holistic, team-based approach for the effective delivery of construction health and safety management. The regulations address the successful delivery as dependent upon shared objectives, delivered through process/tasks integration. They also recognize that such success is continuously challenged by the disparate nature of construction teams and the disenfranchisement. The CDM considers more than the sum of its parts. The regulations focus on communication, cooperation, contribution and coordination aimed at health and safety deliverables (Summerhayes, 2016).

This research helps organizations to understand their sustainable goals, communicate appropriately, and structure their activities with a transparent management process focusing on the sustainable development practices.

Although the organizational structure is a changeable process or an ongoing process of evaluating the organization purposes (Miles R. E., Snow, Meyer, & Jr., 1978), and there is more than one way for a company to define its strategies, objectives, structure, and processes, it is crucial to create a framework that helps the organizations achieve their goals based on underlying patterns (Miles & Snow, 2003).

According to Drucker (1974), the analysis of work consists mainly of (1) identifying all operations necessary to produce a known end; (2) elaborating a rational organization of the sequence of the processes and workflow making it more accessible, smoother, and more economical; (3) analyzing the individual operation and its redesign including the appropriate tools, and the required information and materials; and (4) integrating the processes into particular jobs.

Furthermore, according to Rosenberg (2015), sustainability issues have been evolving for the past decades. Figure 4-1. represents the evolution of the center of attention to sustainability issues.

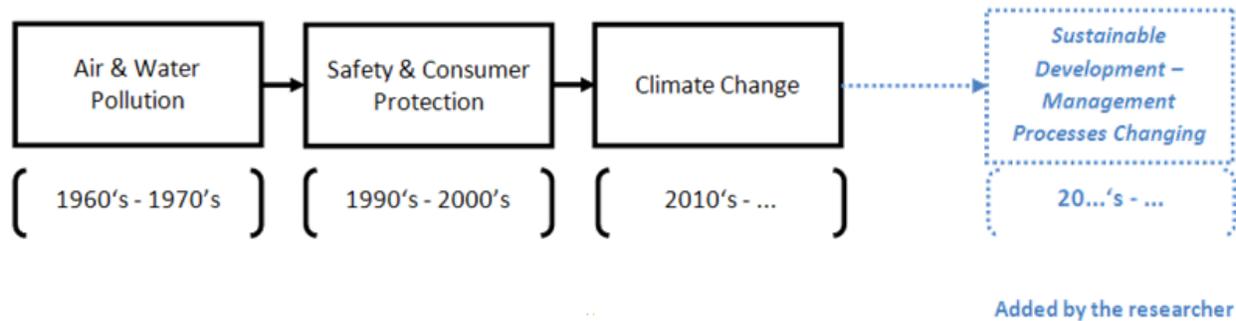


Figure 4-1. Catch the wave—sustainability evolution illustrating the center of attention to sustainability issues during the past six decades (Adapted Rosenberg, 2015)

Hence, sustainability management has become a common concern in several fields. There is an increasing number of articles, books, methodologies, and all kinds of materials trying to achieve the ambitious targets: what defines a sustainable product/service and how to achieve sustainable goals.

This research analyzes two primary levels of management in the organization to evaluate and identify the workforce for sustainability management: at the strategical level—organizational structure, objectives, work breakdown structure (WBS) and policies—and at the tactical level—operations, indicators and assessment, and reporting management.

The demands of rapid and technological complexity require an adaptive management system to be prepared for changes. These new management techniques apply the concepts of general systems theory and systems analysis to the task of management (Nicholas, 1994).

According to Nicholas (1994), the functions of management are divided into planning, organizing, leadership and control, as illustrated in Figure 4-2..

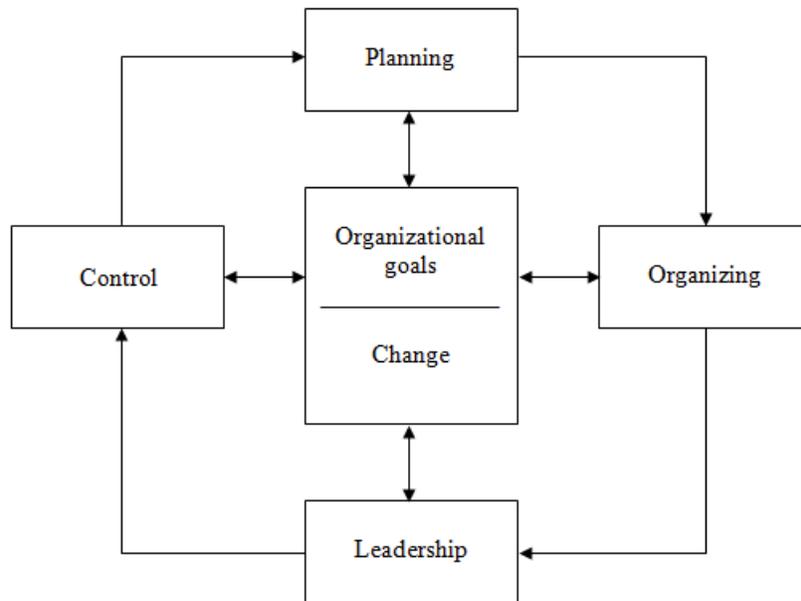


Figure 4-2. An illustration of the functions of management, according to Nicholas (1994), divided into planning, organizing, leadership and control

There are several materials in the literature on managing various features of business—production, marketing, finances, engineering, purchasing, personnel, public relations, and so forth (Drucker, 1974). Therefore, to identify the main features of SDM, addressing the organizational level and task management level is essential for implementing sustainability in the construction industry.

According to the survey report published by APQC (APQC - American Productivity & Quality Center, 2020), the top business process management challenges for 2020 are defining and managing end-to-end processes, establishing a process governance structure and engaging leadership in process management.

Adapting the functions of management demonstrated in Figure 4-2. and the main challenges of management processes, Figure 4-3. illustrates the main features of the management system for achieving SDM in the construction industry and addressed by this study.

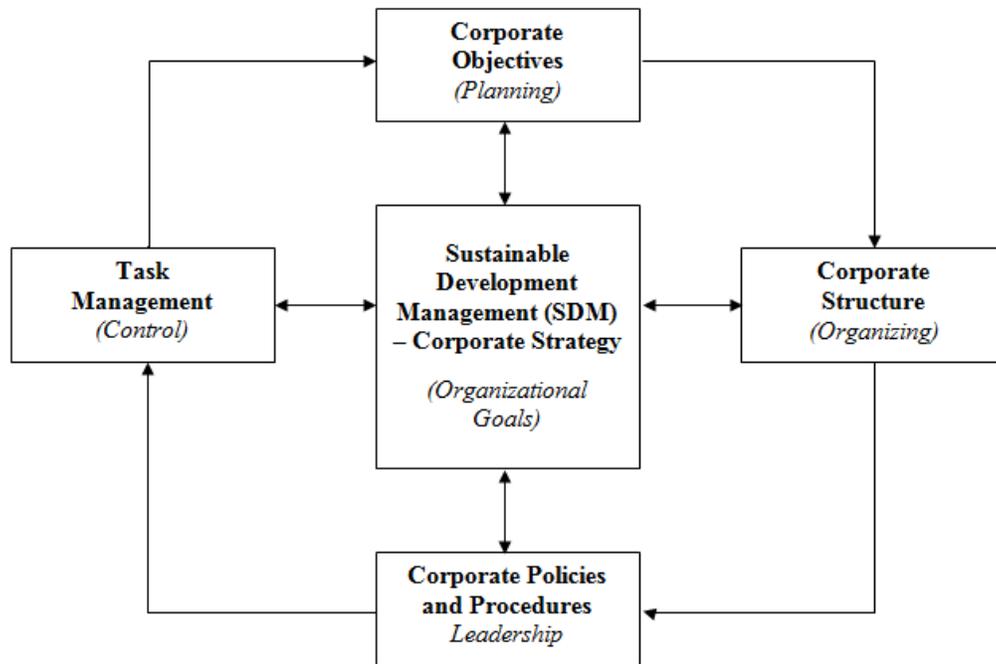


Figure 4-3. An illustration of the sustainable development management features for achieving SDM in the construction industry and addressed by this research

The next topics will explore each of these features.

Corporate Strategy Management

The term organization describes goal-directed, systematically regulated processes when various, initially independent acts are put into a purposeful sequence for achieving specific results (Kühl, 2013). The definition of a system is an organized or complex whole; an assemblage of things or parts interacting in a coordinated way (Nicholas, 1994).

Systems are designed to do something. Moreover, to assist in conceptualizing, creating, or investigating a system, the organization must have a clear and concise statement of the objectives of the system. The purposes can be broken down into a hierarchy of goals, each relating to a subsystem (Nicholas, 1994). Systems and subsystems all have characteristics and properties that distinguish them. Those attributes of a system may be used to monitor and measure system behaviour and performance. The most common components used to describe a system similar to a project are cost and progress—schedule (Nicholas, 1994). However, the nature and the environment of project have been changing, and other attributes are expecting to be considered, such as the three pillars of sustainability: social, economic, and environmental issues and opportunities.

An understanding of the purposes of organizations provides the examination of the main areas where the behavioural expectations are unclear. (Kühl, 2013).

From a sustainability perspective, to formulate a successful sustainability strategy is, in part, to choose which issues the company will address, identifying the values and commitment of the organization (Epstein, 2008). The future of many companies depends on balancing the sustainability concerns and institutionalizing the corporate responsibility that can lead to improved operations and profitability. The increase in global sustainability concerns is enlarging the number of regulations, forcing companies to change their practices and analyze the implications of their activities (Epstein, 2008).

Organizational governance of a company is conducted by a board of directors to ensure accountability, fairness, and transparency to its stakeholders, providing direction and control through policies and processes to meet strategic and operational goals. The organizational governance influences the enforcement of legal, regulatory, standards, and compliance requirements; the definition of ethical, social and environmental responsibilities; and the specifications of operational, legal, and risk policies (Project Management Institute, Inc., 2017).

According to Epstein (2008), there are three stages of implementing sustainability strategy into the organizations:

- Stage I—Managing regulatory compliance: when the organizations acknowledge the financial implications of sustainability matters, identifying the possible risks such as litigation and clean-up costs associated with the current activities of the organization. At this stage, the organizations focus on minimizing costs and meeting regulatory standards rather than on developing innovative strategies.
- Stage II—Achieving competitive advantage: when the organizations realize that they can gain a competitive advantage by using resources more efficiently and being socially responsible. At this stage, the organizations focus on cost avoidance in approaches such as life-cycle cost management and design for the environment. The organizations can achieve substantial advantages through improved social and environmental performance reflected by improving product quality, production yields, and profitability—the result of redesigned processes and products.
- Stage III—Completing social, economic, and environmental integration: when the organizations fully integrate social and environmental components into corporate life. Social and environmental issues, large or small, become part of day-to-day decision-making.

The main objective of strategic management is to provide a long-term company success, and according to Grünig & Kühn (2015), it can be broken down into strategic planning, strategic implementation and strategic control, as illustrated in Figure 4-4.



Figure 4-4. An illustration of the strategic management steps for providing a long-term company success, according to Grünig & Kühn (2015)

This research divides the implementation of the corporate strategy into definition, promotion, and reporting, as demonstrated in Figure 4-5.

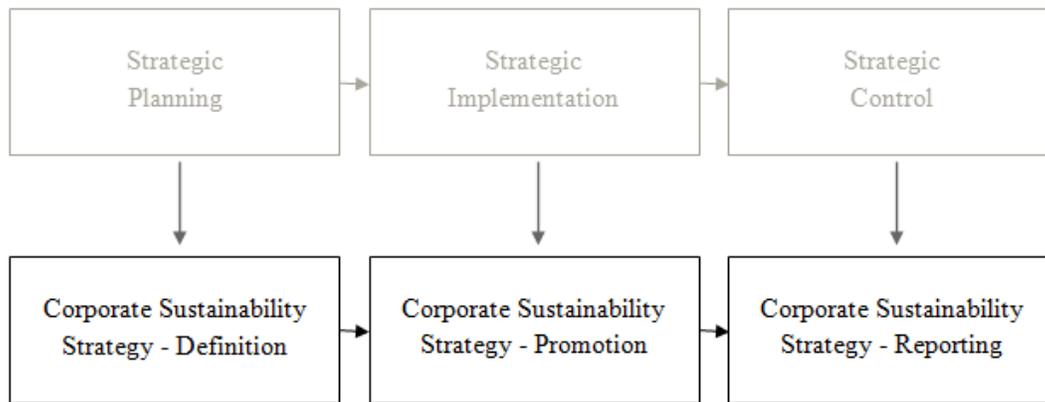


Figure 4-5. An adaption of the strategic management steps by Grünig & Kühn (2015) for implementing the corporate sustainability strategy introduced by this research

Successful strategic planning needs to emphasize a systematic approach. The following features characterize the strategic plan, according to Grünig & Kühn (2015):

- Systematic Process—the decision based on intuition or power is not strategic planning.
- Long-term orientation—the primary investigation and the rules created by the strategic plan must be long-term oriented.
- Macro Perspective—the planning process analyses the broad perspective of the company and essential parts of it, avoiding getting lost in the details.
- Process Management—crucial tasks in the process should be performed in large part by the management.

To provide for a need or demand for any market is the primary purpose of any organization. As awareness of sustainability issues has grown, the need and value of sustainability practices have increased. The sustainability practices consider the environmental, social, economic, and regulations perspectives, requiring the organizations to adapt their strategies and their way of managing the business. A transparent organization's strategy, rather than just intuition, describes the genuinely successfulness of an organization that can endure and grow for a long time. Only a clear definition of the mission and the purpose of the organization make possible clear and realistic organizational objectives (Drucker 1974).

The commitment of senior executives and the board of directors to the sustainability process begins with the development of a strategy that will decide whether the company should be sustainable, how sustainable it should be, and what resources are available and will be allocated to achieve sustainability (Epstein, 2008).

Corporate sustainability strategies are used to set organizational policies, change corporate culture, and integrate sustainability impacts in managerial decisions at all levels (Epstein, 2008). According to BHP Billiton (Epstein, 2008), corporate strategy comprises two attributes—business and sustainability—that contribute to bottom-line performance. The first attribute, the business dimension, includes traditional contributors to a profitable business such as acquisitions, assets, and customer growth. The second attribute, the sustainability dimension, represents nonfinancial aspects such as effective risk management. Integrating both of them in the management process will incorporate the critical importance of sustainability in overall corporate financial performance.

Moreover, poor communication at the beginning of any implementation, when goals are defined for example, can cause later correction and it is challenging and costly, resulting in slowing the process of implementation or causing rework. (Kliem, 2008). Therefore, any communication plan of the sustainability strategy of the organization can effectively guarantee the implementation of sustainability practices. The communication requires determining who, what format, when, and the feedback of the message to ascertain the effectiveness of the communication (Kliem, 2008). The complexity of communications is reflected in the different thinking styles of people, the way they collect and process information and the response of the receiver. Because of this complexity, it is essential to execute a communication plan for promoting sustainability values at different levels of receivers.

Furthermore, the company must control the progress and performance of its activities: stakeholders should be periodically informed about the status of the organization. A single organization is not able to make all of society sustainable. Still, each one can examine its inputs, outputs, process, and effects on the

more extensive system in which it operates (Hitchcock & Willard, 2009), and formulate a transparent report to present its sustainability performance. Therefore, it is critical to analyze and organize information on sustainability for improved resource allocation decisions and to provide clarity in its activities, reporting the corporate sustainability strategies and actions (Epstein, 2008).

Appendix D.2 represents the current practices from case studies, literature review and the introduced model, the SDMBOK, for the features of SDM addressed by this research.

Corporate Objectives Management

An Organizational Strategy will define and reaffirm the purpose of the company. A Sustainability Strategy will determine the sustainability purpose of an organization and guide the business decisions of its activities—short and long term. According to Drucker (1974), the strategy is the central importance of thinking through "what our business is and what it should be." However, as Drucker (1974) states: the basic definition of the business and of its purpose for itself is not enough. It has to be translated into objectives; otherwise, they remain as good intentions that will never become an achievement.

The organizational strategy and objectives are defined at the corporate level. The strategic goals are characteristically the business direction to be translated into the operating domain (Mitchell, 2015).

Continuing with Drucker (1974), five characteristics can define objectives:

- Objectives must be derived from the business strategies and its mission and values;
- Objectives must be operational. It must be able to convert into specific indicators and specific tasks;
- Objectives must make a possible concentration of resources and efforts so that the critical human, financial and physical resources can be determined and concentrated;
- It cannot be a single objective. There must be multiple objectives rather than only one. The business needs to balance a variety of needs and goals.
- Objectives are needed in all areas on which the company operates.

The objectives enable the business to do the following (Drucker, 1974):

1. Organize and explain the business strategy in a small number of general statements (objectives);
2. Test these statements (objectives) in the current experiences;
3. Predict behaviour;

4. Analyze the reliability of decisions while they are still being made; and
5. Let managers at all levels analyze their own experience and, as a result, improve their performance and give feedback to the organizational objective.

Moreover, the objectives provide direction to the corresponding work, and work has to have specific, precise, unambiguous, measurable results: that is a deadline and a particular assignment of accountability (Drucker, 1974). The objectives and strategy usually are established above the operating level and demand constant improvement. All the objectives must be reviewed at regular intervals, improved, and redefined as needed (Mitchell, 2015).

The objectives and their performances have to be balanced against each other and between areas. In setting objectives, the organization needs to balance the short- and long-term range. Therefore, setting objectives requires a decision on where to take risks, which immediate results should be sacrificed for the sake of long-term growth, or how much long-term growth should be jeopardized for short term performance (Drucker, 1974).

As Drucker (1974) states, each business requires its own balance of objectives, and it may require a different balance at different times. The dynamic of business activities requires that the corporate objectives are specific for their reality, tracking the results and updating accordingly. The objectives must direct attention to factors that contribute directly to enterprise, facility, organizational, and operational objectives (Mitchell, 2015).

The Balanced Scorecard (BSC) is a holistic management system utilized to align the organization's strategy with its tactical activities. The BSC includes the organizational goals, measurement (indicators and assessment methodologies), objectives and initiatives that can assist the organization to reach its goals (Smartsheet Inc., 2020).

The BSC assists organizations in three main challenges that are: (1) effectively measuring organization performance, (2) tracking the value of intangible assets, and (3) successfully implementing strategy. Besides, this management system assists an organization to implement its strategy by utilizing the concept of cause and effect—demonstrating relationship among objectives and measures throughout four perspectives—financial, customer, internal processes and employee learning and growth, as illustrated in Figure 4-6. (Niven, 2006).

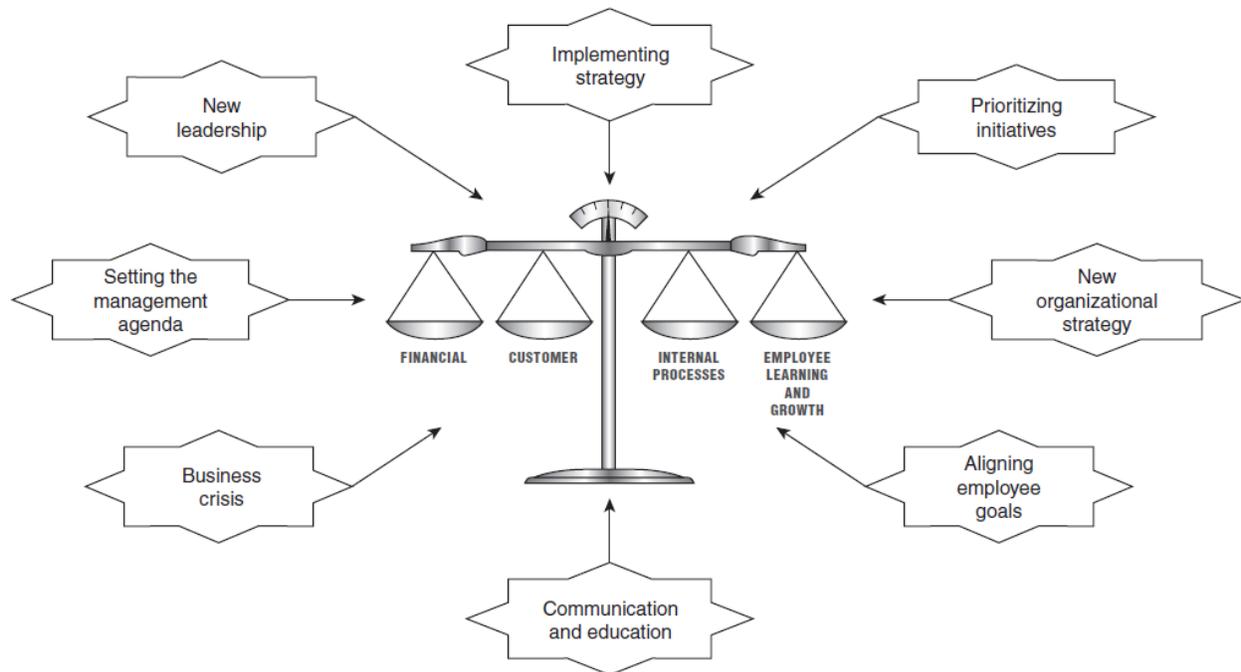


Figure 4-6. The rationale for the Balanced Scorecard, by Niven (2006), illustrating the relationship among objectives and measures throughout four perspectives—financial, customer, internal processes and employee learning and growth

A short explanation of those perspectives is as follow (Smartsheet Inc., 2020)

- The financial perspective indicates whether the strategy improves the organization's bottom line and how the strategy will be implemented and executed. For-profit organizations usually design this perspective first, while non-profits design it last.
- The customer perspective analyzes the value proposition given to the organization's customers. In a non-profit, this perspective will drive the rest of the scorecard.
- The internal processes perspective assists the organization in ensuring the stability and sound operation of its business, guaranteeing that the products and services meet the customer's expectations.
- The learning and growth perspective assists the organization to ensure that its employees have the skills and development necessary to keep pace and exceed the competition through training and improvement of the workforce.

In the construction industry, sustainability, to a large degree, is still a practice of meeting governmental targets (Wilson & Rezgui, 2013), creating barriers to connecting with the values and strategy of the organization. The sustainability objectives need to be aligned with the organizational strategy as well.

For this research, the SDMBOK defines the organization's strategy and assists in implementing its tactical activities considering the four perspectives of sustainable development: environmental, economic, social, and governances, creating a new perception of the BCS, the Sustainability Balanced Scorecard (SBSC), as demonstrated in Figure 4-7.

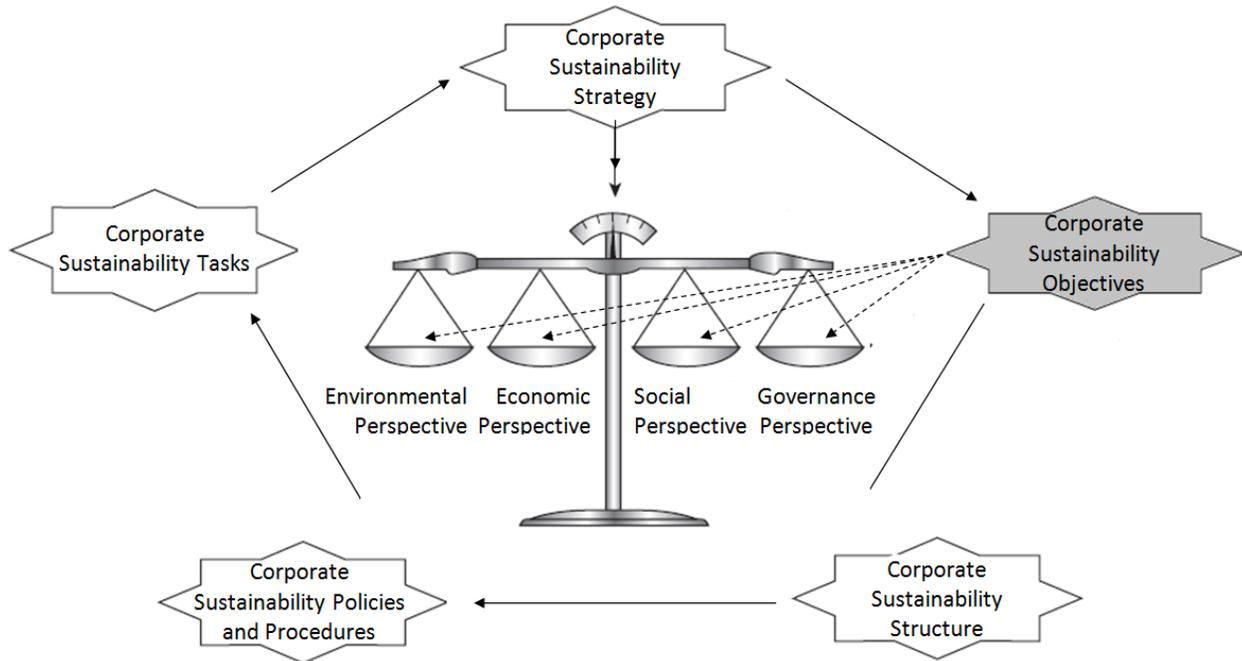


Figure 4-7. An adaptation of the Balanced Scorecard, by Niven (2006), illustrating the rationale for the Sustainability Balanced Scorecard (SBSC) of SDMBOK

Therefore, the Sustainability Corporate Objectives assists in identifying and aligning the sustainable development perspectives to the organization's strategies, identifying, organizing, measuring and reporting its sustainability values and objectives.

Appendix D.2 represents the current practices from case studies, literature review and the introduced model, the SDMBOK, for the features of SDM approached by this research.

Corporate Structure Management

As discussed in the previous topic, the objectives need to be translated into work with a particular assignment of accountability (Drucker, 1974).

An organization structure is a way an organization attempts to achieve its objectives and respond to problems and demands in the environment (Nicholas, 1994). The organization needs to recognize and decide how the jobs and obligations are distributed and coordinated, as well as, the way the information flows between the various levels of management (WebFinance Inc., 2018).

The primary objective of the organizational structure is to define the managerial flow of the organization, considering the organization's goals and strategy. The work breakdown structure (WBS) provides the structure for managerial control (Ahuja, 1976).

The concept of organizational structure applies to all kinds of organizations and their subunits, and the most common representation of the structure is in a chart that reveals both the organizational hierarchy and groupings for specialized tasks (Nicholas, 1994).

Moreover, there is no best organizational structure, but the most appropriate structure to the organization's goals, type of work, and environment. The organizational structure will identify the range of activities in which the organization is involved, the management hierarchy, the relationship between units and subunits, the major subdivisions, the type of work and responsibility of each subdivision, and so on (Nicholas, 1994).

The organization structure determines how the firm divides big tasks into smaller tasks either by specialization or product, and also indicates the formal communication patterns (Burton, DeSanctis, & Obel, 2006).

The organization structures are developed and evolved through a combination of plans and responses to ongoing problems. Specific units are created to suit the expertise and resources needed to resolve particular demands. As the organization grows or the environment changes, additional subdivisions, new groups, or combined units are implemented to better handle emerging demands (Nicholas, 1994).

Nevertheless, two critical features of the structure definition are noted: differentiation—the subdivision of organizations into specialized subunits; and integration—the linking of subunits to coordinate actions. The organizational structure analyzes two main points: (1) how to divide a large task into smaller basic tasks and (2) how to coordinate these smaller tasks to efficiently achieve the more significant task that it is the organization's goals and objectives (Burton, DeSanctis, & Obel, 2006).

Some organizations define sustainability management as an operational function responsibility, creating a subdivision for each issue: such as an operation function for environmental performance, a human resource for labour performance, and a community affairs function for community interaction. However, this structure often allows a reactive position regarding sustainability issues and fails to notice significant opportunities to integrate sustainability into their business practices (Epstein, 2008). Some studies found that sustainability outcomes were significantly improved when more than two departments had functional responsibility for sustainability performance (Epstein, 2008).

The choice of the organizational structure is a critical decision for enabling the firm to perform well its strategies and objectives and to determine who is responsible for what and how they communicate with each other (Burton, DeSanctis, & Obel, 2006).

According to Burton et al. (2006), there are four basic configurations of the organizational structure considering the functional specialization and product/service orientation: simple, functional, divisional, and matrix, as illustrated in Figure 4-8.

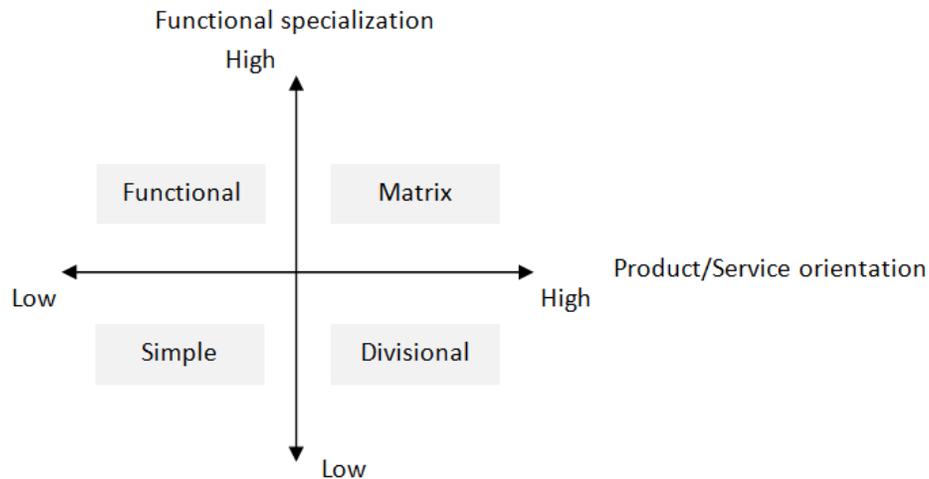


Figure 4-8. A graphic illustration of the four basic configurations of the organizational structure considering the functional specialization and product/service orientation (adapted Burton et al., 2006)

The main characteristics of each of those essential structures are illustrated in Figure 4-9 (Burton, DeSanctis, & Obel, 2006).

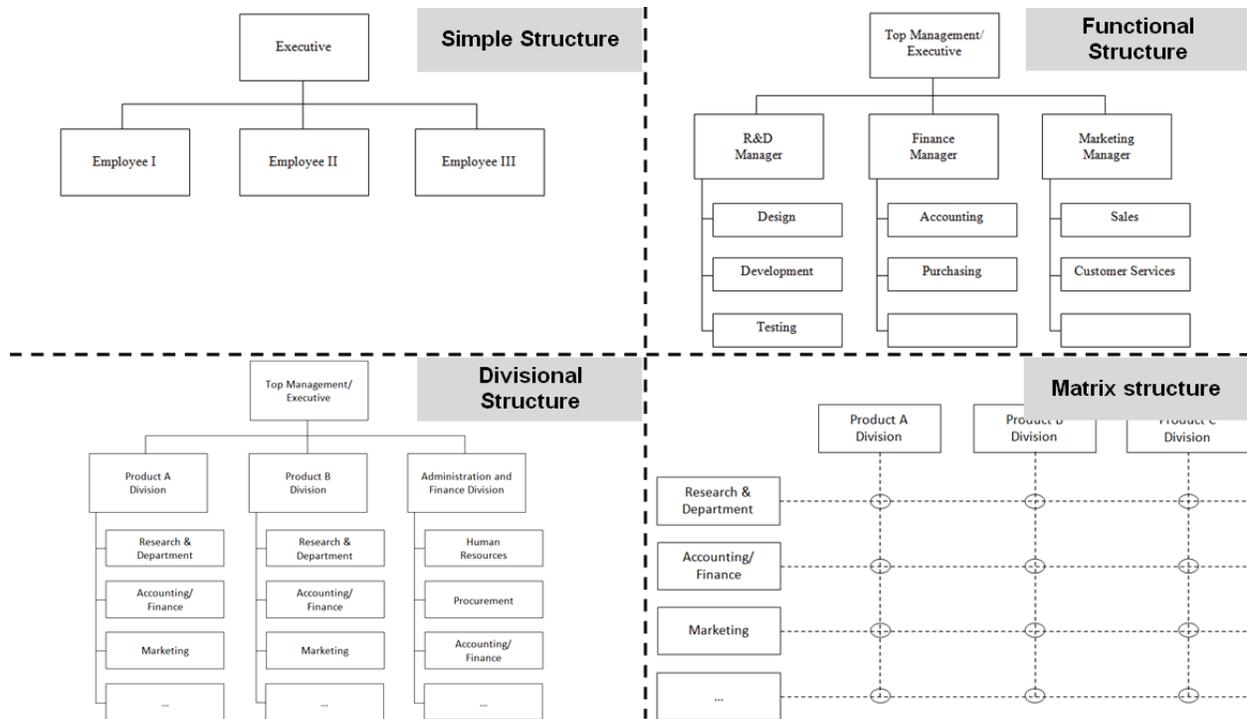


Figure 4-9. A graphic illustration of the organizational chart for each configuration of the organizational structure presented by Burton et al. (2006)

- **Simple Structure:** low on the product/service orientation and low on the functional specialization dimension. This structure is usually used by a small organization, consisting of an executive and perhaps a few other individuals. The executive delegates the tasks and manages the ongoing operations, not having a specific task distribution among the employees. The simple structure is flexible but not usually efficient or effective. Moreover, the efficiencies of specialization are not realized, as the employees are asked to do many tasks.
- **Functional Structure:** low on the product/service orientation and high on the functional specialization dimension. It is more composite than the simple structure concerning information processing where it has department managers with specified subunits, each of which with well-defined jobs. The entire organization's tasks are broken down and assigned to subunits. The determined hierarchy accomplishes coordination. This structure can accommodate large-scale organizations as well as a high degree of information processing. This structure provides specialization divisions and an intense reliance on the skill of the executive. The challenge is to determine how many divisions are indeed necessary for the operation of the organization.
- **Divisional Structure:** high on the product/service orientation and low on the specialization dimension. This structure does not focus on the internal specialization but the outside product/service that the organization produces/serves. The subunits of this structure are independent of each

other, and the executive oversees them all. Each subunit, or unit, has its strategic business unit, product, customers—its own business. The advantage of this structure is that it aims to be effective with its external focus on the product, customer, or region, becoming more market-responsive. The disadvantage is that each division is relatively independent of the order in its operations and market and usually does not handle interdependencies well, becoming a challenge to prioritize activities and budget.

- Matrix structure: high on both product/service and functional specialization dimensions. This structure suggests a need for a high information-processing capacity to achieve both efficiency and effectiveness. This structure has both the functional hierarchy and the divisional hierarchy for the same organization. The executive, or top manager, is not involved in the details of the operations but oversees the entire firm. The advantage of this structure is that it can handle complex coordination problems. The Matrix managers make multiple tradeoffs that involve both the function and the division; therefore, the decision can be more flexible, dealing with new information and adjusting to new situations quickly. However, this structure can lead to poor performance due to the coordination across both functions and divisions, leading to conflicts of priorities. Additionally, it can require extensive involvement by the top executive, overloading the decisions at the top as the managers are not able to solve problems.

Independently of the model used by the organization, it is necessary to have someone responsible for managing and coordinating activities, either centralized in the top management or a specialized unit or a functional dimension.

Once the organization decides the type of organizational structure to perform its business, the organization needs to break down a broad task into smaller tasks to get the work done.

One of the reasons the organizations do not achieve their goals is the lack of a clear understanding of what has to be managed. The Work Breakdown Structure (WBS) is well known for project management, but in practice, often it either is not used, or it is misused. (Buchtik, 2013).

The WBS assists the organization to assign the work. It facilitates the organization to explain what the job is for each WBS component. Moreover, it serves as a tool to monitor, measure, and control the performance of the activities (Buchtik, 2013).

The WBS determines the actual work packages, dividing broad, complex objectives into its components for coordination. When more information becomes available during the analysis, more levels can be added to the work breakdown structure (Ahuja, 1976).

There are several WBS software that can assist the organizations to identify their WBS, simplifying the creation and maintenance process. The crucial components the organization should consider is to focus on the organization's objectives, the main activities/tasks, the flow of information and how the tasks link to each other, having control of the whole process and the people responsible for each deliverable (Buchtik, 2013).

Another well-known method to define the management plan and codify the organization's objectives into tasks is the Direct and Manage Project Work feature from Project Management Body of Knowledge (PMBOK). The key benefit of this process is to provide overall management of the project work and deliverables, improving the probability of successfully implementing and controlling the defined tasks (Project Management Institute, Inc., 2017).

The PMBOK Guide considers inputs such as the project management plan (objectives), the organizational process assets, and the environmental factors to determine the work performance data, management plan update, corporate process assets updates and deliverables (Project Management Institute, Inc., 2017).

Making work productive is the second major dimension of the management task for achieving the organization's objectives. The workforce is undergoing more considerable changes since the beginning of the industrial revolution two centuries ago (Drucker, 1974), and has been more significant with the sustainability issues.

Continuing with PMI (Project Management Institute, Inc., 2017), to achieve the project's objectives and contribute to organizational learning, it is essential to implement a knowledge management process, assisting the organization to identify the knowledge and information needed as well as the interpersonal skills.

The knowledge management process of the PMBOK Guide considers the following factors as an input of information, among others (Project Management Institute, Inc., 2017):

- Deliverables: the valid process and requirements to achieve the organization's objectives;
- Resource Breakdown Structure: information about the breakdown structure;

- Project Team Assignments: type of competencies and experience available and needed;
- Organizational Standards Policies, Process, and Procedures: access to information flow of the organization;
- Personnel Administration: employee development and training requirements;
- Interpersonal and Team Skills: professional skills needed to perform each task such as active listening, facilitation, leadership, networking, political awareness.

This process provides the organization with information on the knowledge and skills needed to perform the task to achieve the organization's objectives.

Another form of guaranteeing the knowledge and skills required to achieve the goals is hiring a consultancy firm. Consultancy firms are commonly considered in the context of strategy projects (Grünig & Kühn, 2015) and sustainability implementation, bringing their expertise and know-how experience in specific areas. However, considering the possibility of a consultant specialist, the organization should clarify the functions of the consultant before hiring the consultant firm (Grünig & Kühn, 2015).

The consultant can assist the organization by planning the project, moderating working sessions, making recommendations, applying a new method, or assessing results (Grünig & Kühn, 2015):

- Planning the project or making recommendations: strategy consultancy firms mainly contribute to the development of the content. The consultancy firms have excellent knowledge of the theoretical foundations of strategies and access to empirical data, assisting organizations in the evaluation of strategic options;
- Moderating working sessions: increasing the level of interaction and assisting the sessions in delivering the message appropriately and having the discussion more productive;
- Applying a new method: the methodological contributions of the consultant firms may include specifying the techniques to use and providing support in their application;
- Assessing results: the consultant firms can contribute with knowledge of markets and technologies, evaluating and comparing the results with other performances.

A clear idea of the function and objective of hiring a consultant firm facilitates the choice of the appropriate consultant, and also to define the contractual arrangements.

Furthermore, to make work productive, according to Drucker (1974), requires four separate activities: *analysis*—to know the specific operations, their sequence, and their requirements; *synthesis*—to bring the operations together into a process; *control*—to build the management of direction, quality and quantity, standards, and expectations into a process; and *tools*—to identify if the appropriate mechanisms have been provided.

Therefore, managing knowledge work can focus on developing the right policies and practices, the next topic approached by this research.

Appendix D.2 represents the current practices from case studies, literature review and the introduced model, the SDMBOK, for the features of SDM approached by this research.

Corporate Policies and Procedures Management

Developing policies and practices assist the organization to manage work definition and the knowledge required to perform it.

According to Cambridge Dictionary (2018), a policy is a set of ideas or guidance in particular situations that has been agreed by a group of people, a business organization, a government, or a political party.

A set of policies and procedures are principles, rules, and guidelines formulated or adopted by an organization to reach its long-term goals. Policies and procedures influence significant decisions and actions. All the activities take place within the values and principles set by the organization. Procedures are the specific methods to put in practice the policies in the day-to-day operations of the organization (WebFinance Inc., 2020).

The governing body of an organization will be translated into steps to achieve the organization's goals through the implementation of policies and procedures (WebFinance Inc., 2020).

A complete definition of the organizational goals provides a framework to determine the policies and procedures. Yülek (2018) argues the need for a comprehensive definition of sustainability that assists the organization to define its policies that fit with the organization's goals.

Sustainable policies aim to reduce the accompanying environmental and social damage that economic growth and productivity cause (Yülek, 2018). According to the OECD (2010), depending on the type of policy, the organization needs to analyze sustainability impacts.

The success of selecting among given policy alternatives is a result of a collaborative process in consultation with the involved stakeholders, especially at the beginning of the policymaking process (Pluchinotta et al., 2019) (Pluchinotta, Kazakçi, Giordano, & Tsoukiàs, 2019). A good policy design process has a significant impact on the quality of the considered policy alternatives. Therefore, policy design is a critical step that enables the formulation of effective policy alternatives (Pluchinotta, Kazakçi, Giordano, & Tsoukiàs, 2019).

Although processes and situations can be similar to each other, no two conditions are the same. Therefore, policy creation is designed to guide general principles to a specific set of circumstances, workflow and the use of technology to support the guidance (International Organization for Standardization, 2010). Hence, a policy is a set of principles and strategies guiding the execution in achieving a given goal. (International Organization for Standardization, 2010).

Recently studies identified the importance of a decentralized process, involving the actions of the stakeholders, and replacing the previous top-down processes with bottom-up, as a collaborative and essential way to the policy design (Pluchinotta, Kazakçi, Giordano, & Tsoukiàs, 2019).

ISO 29383:2010—*Terminology Policies: Development and Implementation* provides organizations guidelines and a methodology for the development and implementation of a comprehensive policy or strategy concerning the planning and management of terminology essential for the communication of the organization's goals. This standard divides policy development and implementation into four steps: preparing, formulating, implementing and sustaining (International Organization for Standardization, 2010).

Furthermore, the Canadian Standards Association (CSA) Plus 1113—*First Steps to Environmentally Responsible Management: A Comprehensive Workbook for Environmental Policy Development* is based on ISO 14001—*Environmental Management Systems: Requirements with Guidance for Use*, and provides workbook guidance to an organization for policy development. The standard divides the process of developing an environmental policy into five steps: commitment and the policy; policy plan—the action plans of the policy; implementation—the people, systems, strategies, and resources to be applied to the organization's objectives; measurement and evaluation—internal reviews and assessments; and review and improvement—as a continual improvement (Canadian Standards Association (CSA), 1996).

There is no one framework to define or guide the policy formation because the conditions and values diverge from one situation to another. However, it is possible to identify similarities in the documents to elaborate a basic guideline for developing organizational policies:

- Identify the organization's values and targets—principles,
- Identify and clarify main terminologies,
- Identify the workflow, technology and standards used,
- Identify the stakeholders' concerns,
- Identify legal requirements.

Moreover, the policies should be developed to consider and integrate the three sustainability dimensions: environmental, social and economical. The impact of the policy should be assessed on those three dimensions (2010). Although not all the policies require sustainability assessment, the necessity for sustainability assessment should be analyzed for all policies in order to manage policymaking. The steps used by this research to assess sustainability policy are based on SIA described on the previous section Organization for Economic Co-operation and Development (OECD).

Appendix D.2 represents the current practices from case studies, literature review and the introduced model, the SDMBOK, for the features of SDM approached by this research.

4.2.2. Sustainable Project and Construction Management—The Tactical Layer

At the strategic level, the organization's processes focus on the broad structure and objectives, attempting to standardize all the processes and make the organization's goals more transparent. Conversely, at the tactical level, the organization processes focus on implementing these objectives in the form of specific projects and business function activities. At this level, sustainability management must be addressed as a component of project management and task management.

Projects, Project Management, and Sustainability

Characteristics of Projects

Some characteristics of a project differ from other human activities, such as the purpose, complexity, distinctiveness, life cycle of a project (Nicholas, 1994):

- A project includes a single, definable purpose, end product or result, generally specific in terms of cost, schedule, and overall performance requirements.
- Project complexity frequently arises from the complexity of advanced technology which is based on task interdependencies and might introduce new and distinct problems.

- A project is unique. Even in "routine" projects, particularities such as terrain, access, zoning laws, labour market, etc. make every project different.
- As a project differs from what was formerly done, it also involves unfamiliarity.
- A project is temporary, and it includes temporary activities.
- A project is a process of working to achieve a goal.

However, even with all uniqueness and particularities of a project, all of them have something in common: all require management. The role of management is to integrate resources and tasks to attain the organization's goals. Every project is sufficiently complex and needs to have the breakdown of its tasks and its internal and external relationships well outlined and registered (Ahuja, 1976). According to Nicholas (1994), the management of business and engineering projects is divided into elements such as:

- Organization Structure
- Roles, Responsibility, and Authority
- System and procedures, including work definition, scheduling, budgeting, project control, project evaluation, reporting and termination

The three dimensions of project goals illustrated in Figure 4-10. demonstrates the project management system approach integrating resources and emphasizing on the "wholeness" of project goals (Nicholas, 1994).

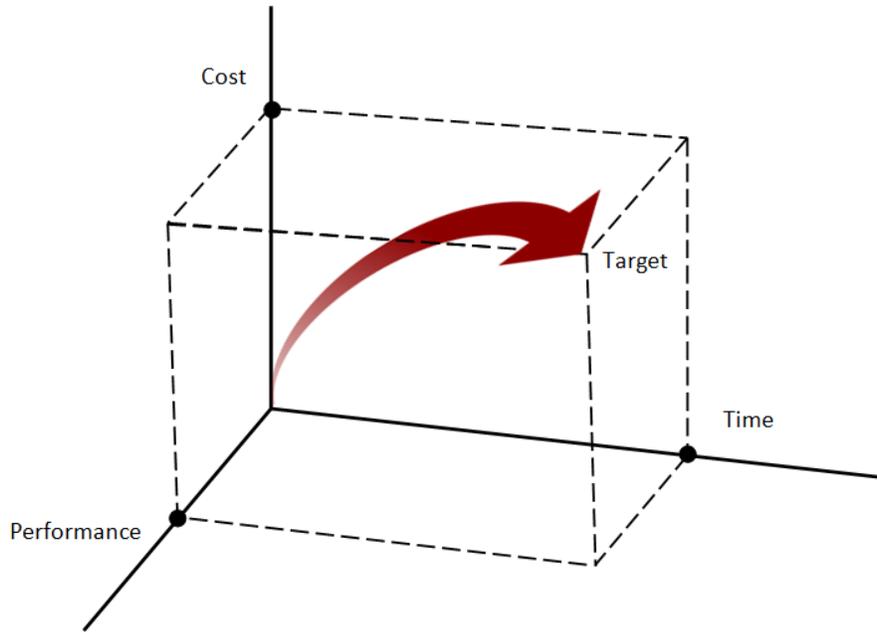


Figure 4-10. The three dimensions of project goals by Nicholas (1994), demonstrating the integration of resources in the project management system approach (Adapted Nicholas, 1994)

Traditional project management is budget and time-oriented. However, projects are becoming progressively more complex and need the utmost in planning skills (Ahuja, 1976) in order to adapt to new challenges, such as sustainability issues. Sustainability raises another set of concerns that may not be reflected in the traditional measurements (Brandon & Lombardi, Evaluating Sustainable Development in the Built Environment, 2011), as illustrated in Figure 4-11.

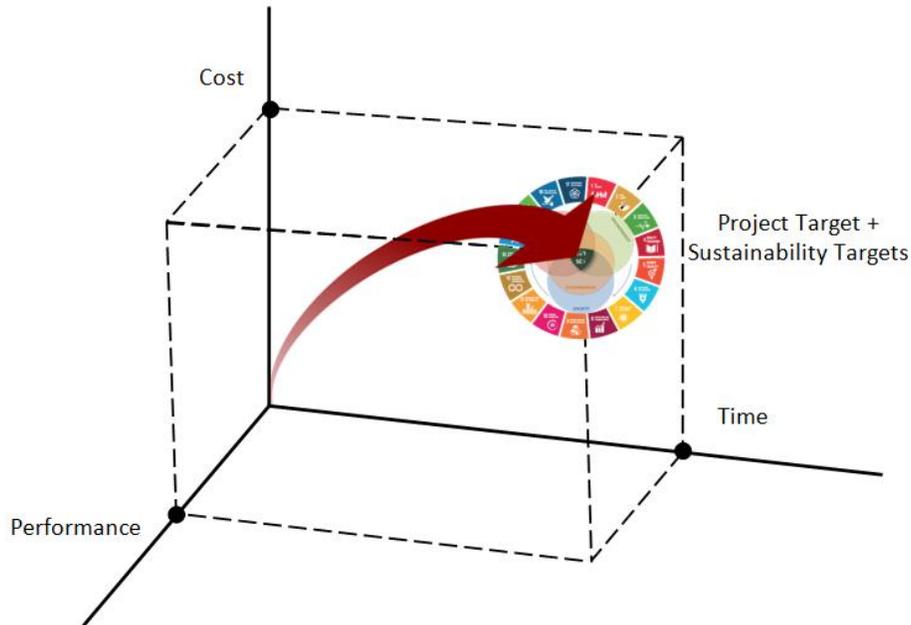


Figure 4-11. An adaptation of resource integration in the project management system approach, presented by Nicholas (1994), Adding the Sustainability Concerns into the Dimensions (Adapted—Nicholas, 1994)

The Project Management Body of Knowledge (PMBOK)

The Project Management Institute (PMI) is an association that assists and supports professionals in project, program or portfolio management through global advocacy, collaboration, education and research (Project Management Institute, Inc., 2020). The PMI created the Project Management Body of Knowledge (PMBOK), an essential resource for effective project management in any industry. It was developed by active practitioners and subject matter experts and reviewed by the project management community, assuring it reflects the current state of the profession (Project Management Institute, Inc., 2020). However, the PMBOK is not part of an American National Standard (ANS), and it has not been processed following the American National Standards Institute (ANSI) requirements for an ANS.

By the mid-20th century, project managers started to seek recognition for project management as a profession. One aspect of being recognized as a profession was obtaining agreement on the content of the frame of the body of knowledge (Bok) called project management. This BOK was called the Project Management Body of Knowledge (PMBOK). The PMI produced a baseline of charts and glossaries for the PMBOK. Project managers soon realized that no book could include a complete PMBOK. Therefore, the PMI evolved and published A Guide to the Project Management Body of Knowledge (PMBOK Guide), currently in its sixth edition (Project Management Institute, Inc., 2017).

The PMBOK identifies a subset of recognized traditional practices that are widely applied as well as innovative methods that are emerging in the profession (Project Management Institute, Inc., 2017). According to the PMI (2017), the PMBOK is not a methodology but a foundation upon which the organizations can build methodologies, policies, procedures, regulations, tools and techniques needed to practice project management.

The project life cycle is managed by executing a series of project management activities identified as project management processes (Project Management Institute, Inc., 2017). Project management is divided into five process groups:

- Initiating—the process of defining a new project or a new phase of an existing project
- Planning—the process of establishing the scope of the project, defining the objectives and the course of actions
- Executing—the process of identifying the activities and plan to implement what was established in the project requirements
- Monitoring and controlling—the process of defining the way to track, review, and regulate the progress and performance of the project
- Closing—the process of formalizing the closure of the project

Moreover, project management is divided into ten knowledge areas: project integration, project scope, project schedule, project cost, project quality, project resource, project communications, project risk, project procurement and project stakeholder management (Project Management Institute, Inc., 2017).

According to the PMBOK (2017), the project management processes are logically connected by the outputs they produce—the output of one process generally results in either an input to another process or a deliverable of the project or project phase. The whole knowledge areas and structure of the PMBOK follows the system of input; tools and techniques; and outputs, as illustrated in Figure 4-12.

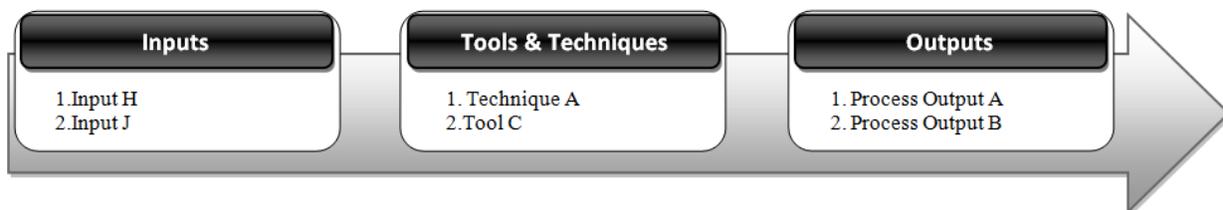


Figure 4-12. An illustration of the project management processes followed by the PMBOK and logically connected with the system of input; tools and techniques; and outputs (Adapted Project Management Institute, Inc., 2017)

Project management, according to the PMI, is the combination of knowledge, skills, tools, and techniques applied to project activities to meet project requirements. It is accomplished through the use of techniques such as initiating, planning, executing, controlling, and closing. Managing projects usually involves competing demands for scope, time, cost, risk, and quality; and it entails stakeholders with differing needs and expectations and necessities. Hence, task management covers such factors as meeting challenging requirements that call for the application of knowledge, skills, equipment and strategies by using mapping of assignment (output) to undertaking (input) (Project Management Institute, Inc., 2006).

This research utilizes the same structure of Input—Tools & Technique—Output to introduce the main knowledge areas of the SDMBOK framework to implement SDM. The main areas of the task management features addressed by the SDMBOK—operations, indicators and assessment, and reporting management—are discussed in more detail in the following topics.

Corporate Sustainability Tasks

As stated, organization's strategic processes focus on the broad structure and objectives, but at the tactical level, the organization focuses on task management, which by definition, is the process of managing work tasks by planning, testing, tracking, and reporting the organization's goals through its life cycle (Maus, Aalst, Wil, Alan, & V, 2005). These constitute a coordinated set of process activities that are connected to achieve the organization's goals (Elmagarmid & Du, 1998).

The organizational tactical level (sustainability management processes) of this research focuses on four main features:

- Operations Management—relating to the workflow, or work-break structure of the sustainability activities
- Indicators Management—relating to the management of sustainability indicators of the organization's activities
- Assessment Management—relating to the assessment management methods for managing the indicators
- Reporting Management—relating to the reporting process of the organization's sustainability activities, creating continuous improvement in the process.

The following topics address those four features of task management.

Operations Management—WBS

Once the organizational objectives are set, they need to be translated into particular and well-defined work units, dividing the overall goals into sub-elements that can be managed and measured (Nicholas, 1994). The work breakdown structure (WBS) divides the organizational objectives into small activities that are possible to coordinate, assess, and report the performance of the activities. The division of the activities assists the organization to keep track of the organization's goals (Nicholas, 1994).

When a new project is defined, it is necessary to visualize all the operations of the project, arrange those operations in their proper sequence, connect each activity, and manage to perform each procedure through systematic planning (Ahuja, 1976).

The complexity of project management generates the necessity for specialization, and each specialty has its particularity and communication style. Therefore, it is essential to breakdown the activities of the project and analyze the impact of each expertise for each element of the work breakdown (Ahuja, 1976).

The division of the activities converts the organization or project objectives into manageable sub-elements, assisting the organization to focus on the right results. It is to define and align the work assignments with the set of objectives of the organization, with deadlines and clear accountability (Drucker, 1974).

The key benefit of the work breakdown is to provide a framework of what has to be delivered. This process is performed once or at predefined points in the project (Project Management Institute, Inc., 2017).

Figure 4-13 illustrates the input and output of creating the WBS of a project. Figure 4-14 is an adapted practice considering the sustainability input into the process.

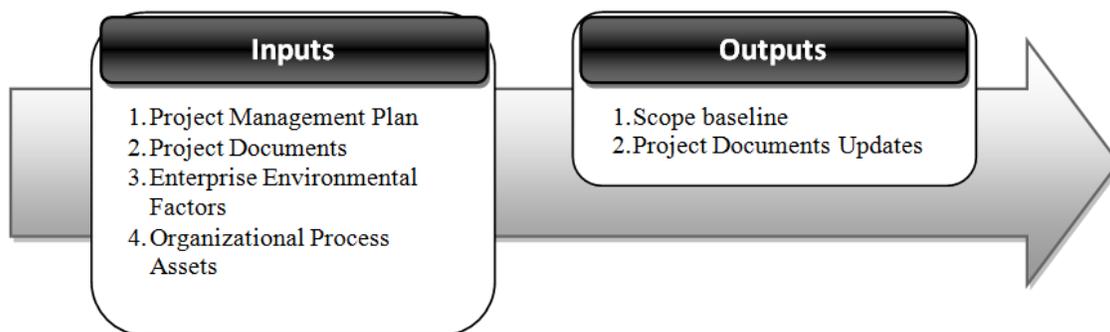


Figure 4-13. an illustration of the input and output system of creating a WBS used by the PMBOK (Project Management Institute, Inc., 2017)

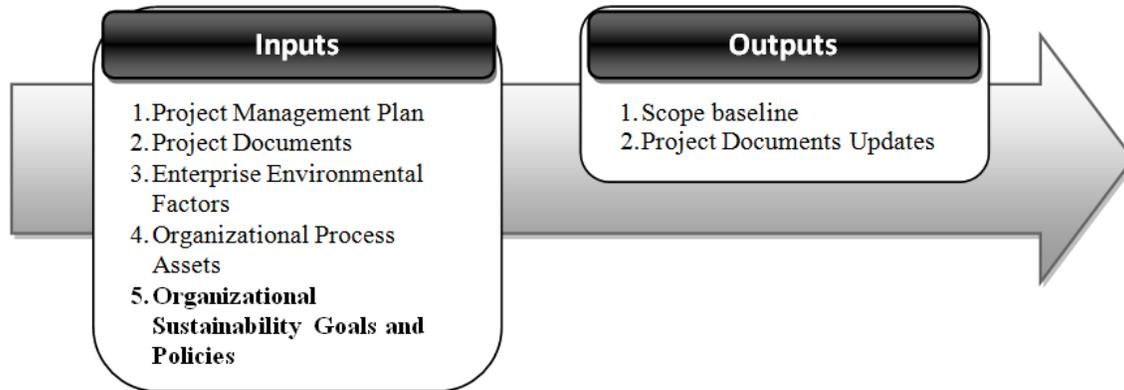


Figure 4-14. An adaptation of the input and output system of creating a WBS used by the PMBOK considering sustainability goals (Adapted, Project Management Institute, Inc., 2017)

The Project Management Plan provides the project scope as an input for creating the WBS and the Project Documents provide the project requirements (Project Management Institute, Inc., 2017). The Organizational Sustainability Goals and Policies are the outputs of the corporate sustainability strategy with the goals, values and policies identified at the strategic level.

The WBS is a central feature of the project planning and control process, used for three primary purposes (Nicholas, 1994):

- As the basis for identifying the functional managers and others who will execute and be involved in the activities, ensuring accuracy and completeness of the work definition and increasing their commitment to the project and its objectives;
- As the basis for identifying and controlling the project budget and schedule; and
- As the basis for project control, giving an estimate of time, cost, and schedule variance.

Roughly every construction project is sufficiently complex that its breakdown and its internal relationship must be recorded. Many planning methods have been used for more than a half-century (Ahuja, 1976).

The work breakdown being divided into levels allows advancements over the standard bar charts used to manage the activities of one project, enabling planners to make a more detailed analysis to produce better plans and schedules. In this way, it becomes easier to evaluate the progress against the plan and to predict effects on downstream activities. Other tools used to manage the control the project activities are (Ahuja, 1976):

- Labour schedules

- Material schedules
- Equipment schedules
- Financial schedules
- S curve, which indicates the forecast and actual cumulative percent completed

Nicholas (1994) reinforces the importance of dividing the WBS into work packages to represent jobs of approximately equal magnitude of effort and of relatively small cost and short duration compared to the total project. This method assists in controlling the work activities in more detail. The work package represents the work to be performed either by outsiders (subcontractors) or by the insiders (internal units). A typical work package description includes (Nicholas, 1994):

- A summary of the work to be accomplished
- Inputs required from other project tasks (predecessors)
- The manager and organizational unit responsible
- Product specifications
- Subcontracts and purchase orders
- Resource estimates for labour, material, equipment, and facilities
- Total cost and budget
- Work orders
- Schedule dates and milestone events
- Specific results, such as hardware, software, tests, documents, drawings, deliverables, etc.

Table 4.1. demonstrates a partial description—the time, cost, and labour estimates—as a result of a Work Breakdown Analysis.

Table 4.1. activities, time, labor requirement, and cost—result of work breakdown analysis (Adapted, Nicholas, 1994)

Activity	Time (weeks)	Weekly Labor Requirement (workers)	Weekly Direct Cost (\$K)	Total Cost (\$K)
H	10	5	10	100
I	8	4	8	64
J	6	8	16	96
K	4	2	4	16

L	2	6	18	36
Total Direct Cost				\$312K

This research suggests adding the sustainability activities to this analysis, as demonstrated in Table 4.2.

Table 4.2. activities, time, labor requirement, cost, and sustainability activities analysis—result of work breakdown analysis (Adapted, Nicholas, 1994)

Activity	Time (weeks)	Weekly Labor Requirement (workers)	Weekly Direct Cost (\$K)	Sustainability Activity (Corporate Goals)	Organizational Sustainability Policy Related	Additional Sustainability Practice Costs	Total Cost (\$K)
H	10	5	10	-	-	-	100
I	8	4	8	S.1	Policy S.1	1	65
J	6	8	16	S.2	Policy S.2	-2	94
K	4	2	4	-	-	-	16
L	2	6	18	-	-	-	36
Total Direct Cost							\$311K

Identifying the sustainability activities for each work package assists in managing the sustainability activities and identifying the indicators of measuring the organizational sustainability performance. The following topic discusses the management of indicators management in more detail.

Indicators and Assessment Management

The construction industry is under constant pressure to improve its practices and performance. The search for methodologies to enhance its coordination and management can follow two paths. One approach presumes that the construction industry is unique, and the principles from other sectors such as manufacturing are not particularly helpful. A converse approach recognizes that the transfer of practices and theories from different industries can contribute to the improvement of the field (Cooper, et al., 2005). The latter has been steadily exploited within construction companies alongside the new technologies taken from manufacturing (Cooper, et al., 2005).

The focus on process management practices has become, for the last decade, equally crucial to information systems, supporting the traditional information modelling systematically. For instance, Business Process Management (BPM) adopts the basic workflow concepts in a broader perspective, incorporating different types of analysis (Weske, 2007). Figure 4-15 illustrates the overall methodology of implementing BPM.

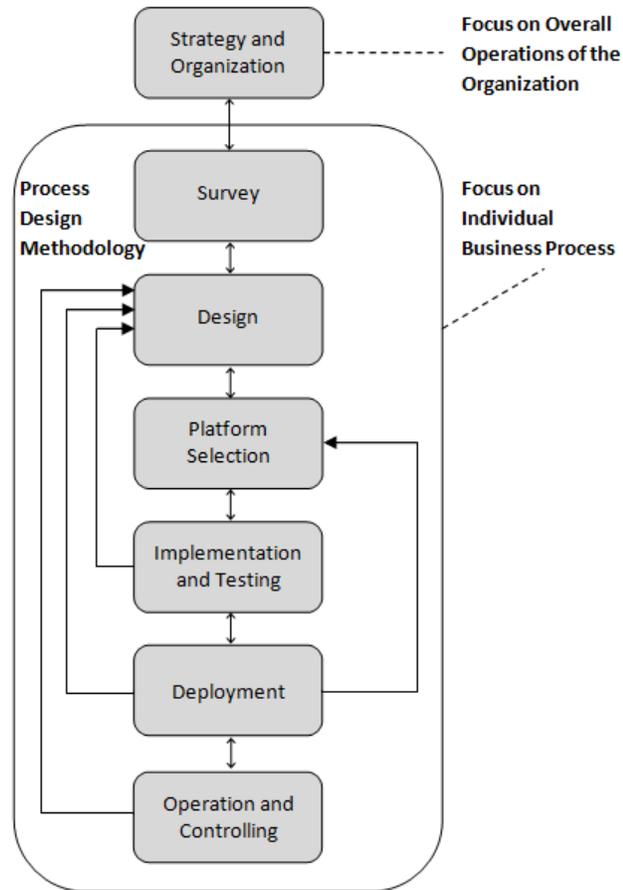


Figure 4-15. A graphic representation of the basic workflow overall methodology for implementing a Business Process Methodology (BPM) (Weske, 2007)

The *Strategy and Organization* stage described in the Business Process Methodology illustrated in Figure 4-15 refers to the first phase of the methodology, and it is independent of particular operational business processes. It focuses on the identification of the overall business strategy and goals.

The *Survey* phase is the first phase that addresses individual business processes, defining the project goals, the project team, and the information about the business process environment, providing a common understanding of the terms and concepts.

The *Design* phase analyzes, consolidates and represents the business process models, addressing the actual process and the technical and organizational environment in which business processes are enacted.

The *Platform Selection* phase uses the previous information to select a technological platform on which the business process will be adopted.

The *Implementation and Test* phase is required to enhance the business process models with information to make the executable.

The *Deployment* phase deploys the business process into the target environment. Technical and organizational aspects are taken into consideration in this phase, analyzing the context of the process and the skills and expertise of the knowledge workers need to implement the process.

In the *Operation and Controlling* step, the business process is executed, and information is gathered, which is useful in improving the process creating a feedback loop of improvement.

This research focuses on the process of identifying the main tasks, assessing the performance and reporting the results for learning and improvement process. Figure 4-16 is an adaptation of the Business Process Methodology and the correlation of the phases considering the approach of this research and discussed in more detail on the next topic, the research activities section.

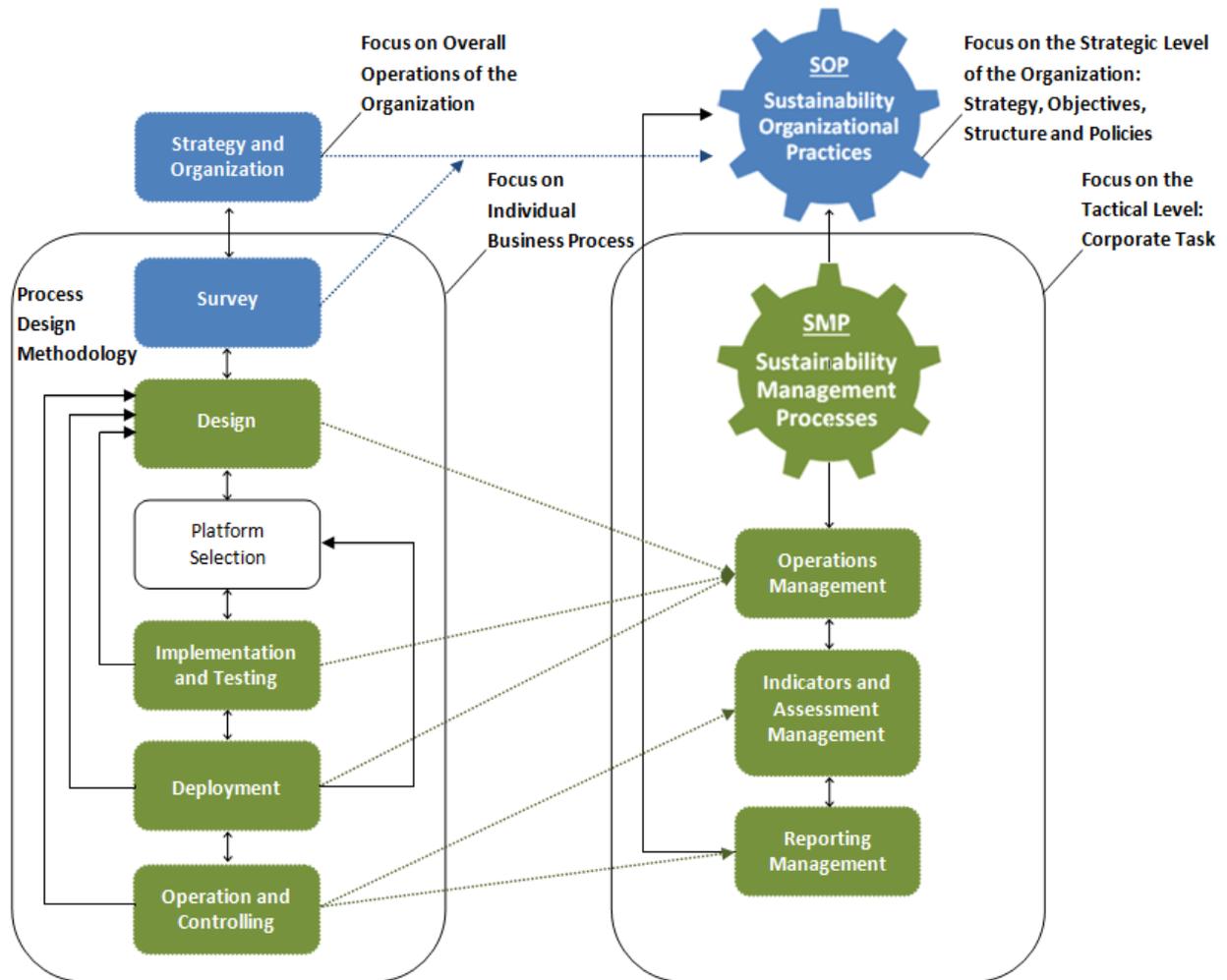


Figure 4-16. An adaptation of the basic workflow methodology of implementing a BPM considering the sustainability aspects addressed by this research

The external (macro) and internal (micro) environments influence the organization’s performance and the standardization of processes assists the organization in achieving its results. Simon’s behavioural theory states that the use of standardization aims to reduce uncertainty (Espindola, Albuquerque, Xavier, Melo, & Medeiros, 2019).

Following the requirement of identifying the process and task management of an organization, it is crucial to determine how to assess the indicators to the stakeholders. During the analysis of the indicator’s assessment, the organization has a clear idea of how to evaluate the activity and what it should expect from the results (Espindola, Albuquerque, Xavier, Melo, & Medeiros, 2019).

Indicators and assessment management assists the organization to manage the performance of the organization’s objectives, providing clarity of what to evaluate, how to measure and coordinate the

performance of an activity. Some features are standard in identifying the indicators and assessment methodology, as in the indicators management presented by Espindola et al. (Espindola, Albuquerque, Xavier, Melo, & Medeiros, 2019), BREEAM (Building Research Establishment Ltd, 2016), LEED (USGBC - United State Green Building Council, 2019), ENVISION (Institute for Sustainable Infrastructure, 2015), ISO 14001 (CSA Group, 2016), etc. The requirement information for identifying the indicators and assessment methodology is as follow:

- Identify the related department
- Identify the responsible for managing the indicator
- Describe the indicator
- Describe the aim of the indicator
- Identify the measurement unit
- Identify the measurement frequency
- Identify the target—expected performance for the indicator
- Identify the calculation or method used to identify the performance—the assessment criteria
- Identify the format of the report of the performance

The next topic addresses the reporting phase of task management.

Reporting Management

The reporting management process is part of the monitoring and controlling process group in the PMBOK. According to *Part 2—The Standard for Project Management* of PMBOK, monitoring is collecting project performance data, producing performance measures, and reporting and disseminating performance information (Project Management Institute, Inc., 2017).

This process allows stakeholders to understand the current state of the project and to recognize the actions necessary to address any performance issues (Project Management Institute, Inc., 2017).

Figure 4-17 illustrates the monitoring and controlling process group of the PMBOK standard.

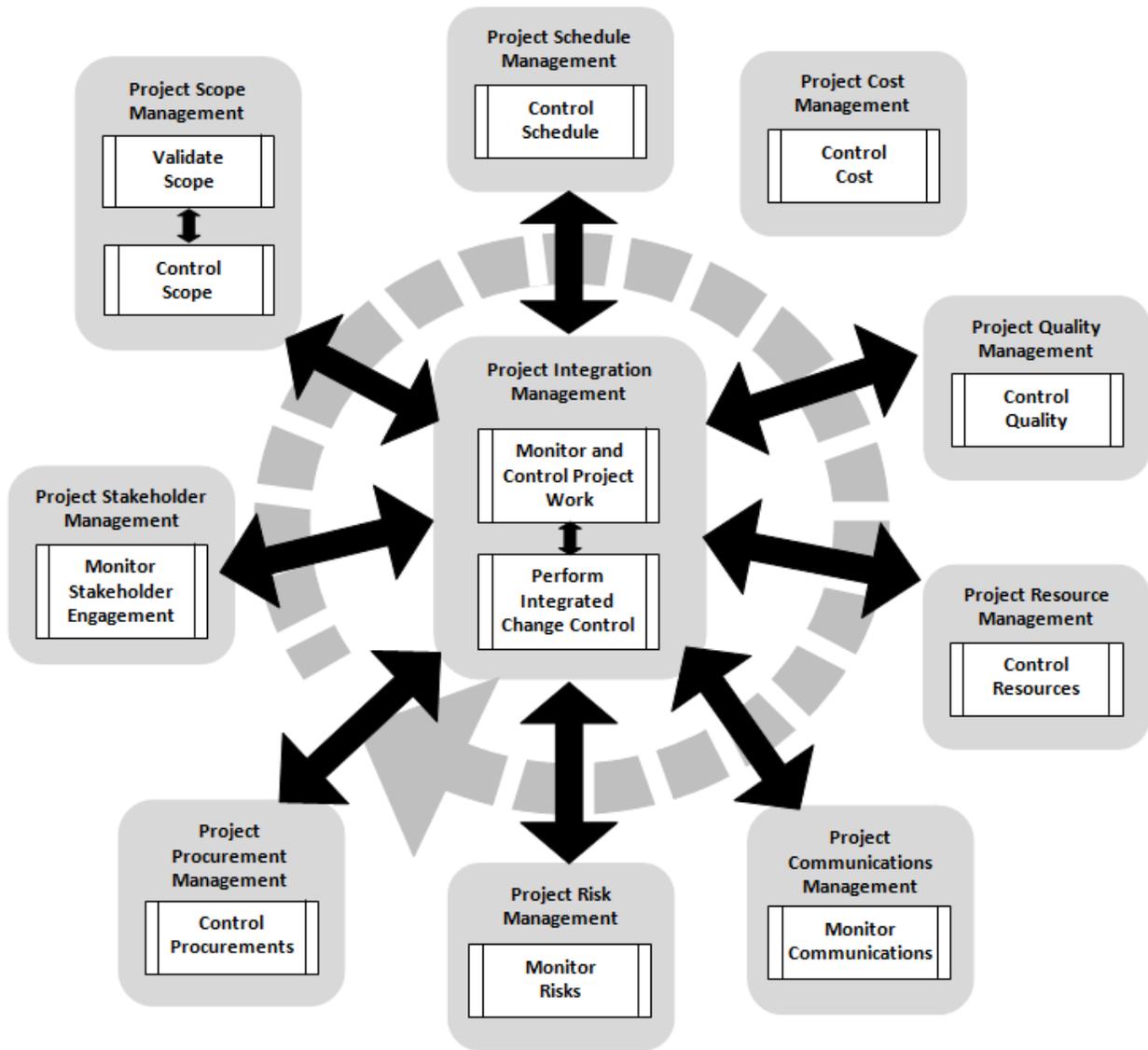


Figure 4-17. An illustration of the monitoring and controlling process group of the PMBOK for collecting project performance data, producing performance measures, and reporting and disseminating performance information (Project Management Institute, Inc., 2017)

This research approaches the integration of the organizational sustainability goals information to monitor the sustainability goals. Through the indicator and assessment management, the organization can report the performance to track and review the overall progress of the organizational sustainability performance of the project activities. Figure 4-18 is an adaptation of the monitoring and controlling process group approached by this research.

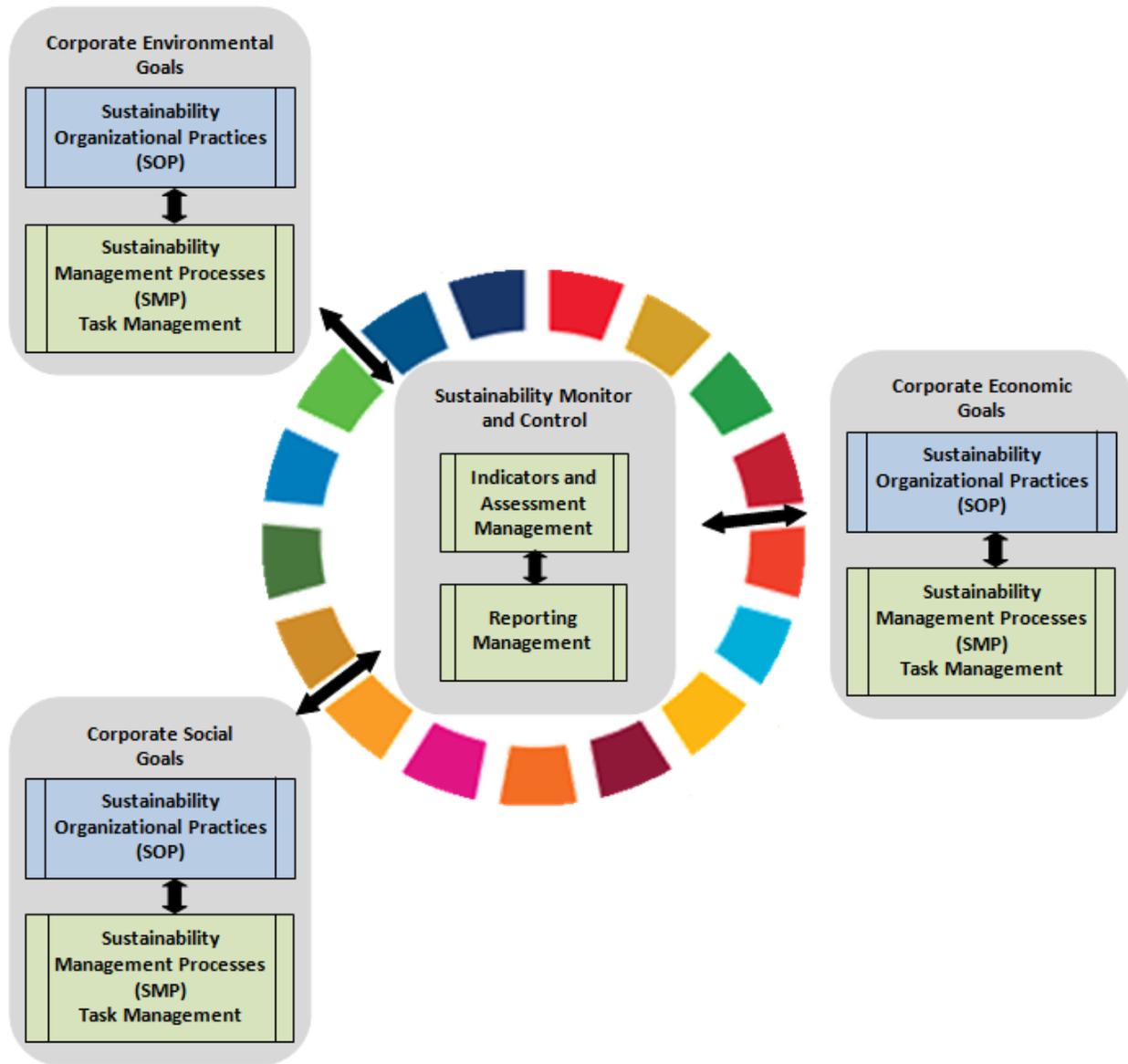


Figure 4-18. An adaptation of the monitoring and controlling process group of the PMBOK considering the sustainability management aspects approached by this research

The reporting process improves managerial decision-making regarding operations, products and resource allocation. Moreover, the pressure for organizations to disclose their social and environmental performance is increasing for the past decades (Epstein, 2008).

According to GRI, the main two elements to elaborate on a sustainability report are to identify what to report and how to communicate the results (Global Reporting Initiative - GRI, 2014). Furthermore, according to the AA1000 Assurance Standard, some principles are fundamental to assure that the reporting is comprehensible (Epstein, 2008):

- Materiality. Provide information on all the areas of the organization’s sustainability performance that stakeholders need to judge
- Completeness. Provide complete and accurate information to assess and understand the organization’s performance in all the sustainability areas
- Responsiveness. Provide information regarding the organization’s response to stakeholders’ concerns and interests.

According to CAN/CSA-ISO 14001:16 (CSA Group, 2016), the organization should evaluate its environmental management system and its performance. Moreover, the organizations should communicate relevant environmental performance information both internally and externally, retaining evidence of the monitoring, measurement, analysis and evaluation results process/documents.

A corporate sustainability reporting and verification system involves internal and external reporting and audits, providing to the organizations the area of concern, improvement, and information for managerial decision-making (Epstein, 2008). For this research, the reporting management is approached in two levels, as illustrated in Figure 4-19.



Figure 4-19. A representation of the corporate sustainability reporting and verification system involving internal and external reporting management approached by this research

The internal corporate reporting is appropriate to measure and monitor the performance of the projects and the sustainability performance of the organization at the tactic level. The information collected at this level will provide information for external corporate reporting. The external corporate reporting provides consolidated sustainability performance of the organization to the stakeholders, assisting the organization

to monitor processes and performance, reporting progress to relevant managers and stakeholders (Epstein, 2008).

The reporting process requires that the organization determine the frequency that it will be evaluated, the desired performance and required actions, if needed, and retain documented information as evidence of the evaluation results (CSA Group, 2016).

The Sustainability Reporting Management is the last step addressed by this research, used as a collection of information to monitor the performance of the organization and provide information for updating corporate strategies and making-decision process.

The next section addresses the research activities and the complete proposed model for SDM in the construction industry relating to both the organizational structure (strategic level) and process management (tactical level).

4.3. Research Activities

4.3.1. How to Develop a Framework that can Leverage the Knowledge Base of SDM?

Management is a broad discipline. This research conducted a literature review of several management frameworks to identify the types of management activities that should comprise a management framework for SD in construction. Based on these resources, a taxonomy for the SDMBOK framework was developed that defines and organizes the main management knowledge areas to be addressed.

The management knowledge areas are organized into two distinct layers. One layer covers the management processes related to the SD-related strategy, organizational structure, and management practices—independently of the specific individual topic areas. This layer of the SDMBOK is called the Sustainability Organizational Practices (SOP). Other management processes include the management tasks required to address specific SD topic areas, such as those defined in the 100 SDI. Although these management tasks for any specific topic area diverge from other topic areas, some generic elements can be identified for managing and assessing these tasks. This layer of the SDMBOK is called the Sustainability Management Processes (SMP).

Challenge

There are many ways for an organization to define its strategies, objectives, structures and methods to grow within a particular industry or environment. However, an essential requirement for a management

system is to create a framework that assists organizations to achieve their goals based on underlying patterns (Miles & Snow, 2003).

According to Bentivegna et al. (2002), there remains considerable scope for debate over the meaning of sustainable development, the objective goals associated with the concept, and how to achieve the desired goals in a specific area. The field is abundant with models, reports and opinions, which are partial and unstructured (Brandon & Lombardi, 2011).

The literature review of sustainable development is abundant. However, it is inclined to a reductionism view allowing the holistic approach to be lost. According to Brandon and Lombardi (2011), the lack of a systematic method of the subject as a whole suggests a collection of apparently unrelated and not connected topics.

An approach that incorporates the business strategy and assists the organization to structure the functionalities to implement sustainable development is still missing. The achievement of sustainable development is co-determined by the targets set by policy-makers and by the assessment systems and methodologies that are used to evaluate progress (Bentivegna, Curwell, Deakin, & Lombardi, 2002).

This research intends to address sustainable development in business and operation perspectives of the construction industry. The purpose is to introduce a framework that addresses both the strategic and tactical levels.

Methodology

This research developed a framework based on two primary information sources. First, an extensive literature review provided the primary source of the main SDM topics and issues that were assembled to create the overall structure of the conceptual model. Second, case studies were used to build out each area of the conceptual model with actual practices in the form of inputs, tools and techniques, outputs, and templates.

The initial literature review was to understand sustainability and sustainability management in general, followed by an exploratory literature review of sustainability management in the construction industry. Then, the study focused on the strategic level, followed by the tactical level.

The proposed framework focuses on three features of the project management practices: target, team, and tasks, as described below (Froese, 2016):

- Target—objectives established to guide the process activities

- Team—human resources available to execute the tasks
- Tasks—activities performed by the team

At the strategic level (Sustainability Organizational Practices—SOP), the proposed framework considers a business management perspective. The definition of the organization’s mission and its purpose can define objectives of crucial areas (Drucker, 1974). 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 SOP is organized into four broad categories: strategy, objectives, organizational structure (team), and policies/practices.

At the tactical level, the Sustainability Management Processes (SMP) determine the processes an organization may implement and repeatedly update, if necessary, on each project for articulating its sustainability goals and identifying a mechanism to achieve them. It focuses on sustainability management processes, and it is divided into three categories of task management: activities (operation), indicators and assessment, and report management.

Because the SMP can potentially include a great many of the target areas identified in the 100 SDM, the scope is vast, and this research does NOT attempt to explore all of this scope. Instead, it explores only some generic elements that would be common across many SMPs.

Contribution

This research developed a framework divided into two layers: SOP—Sustainability Organizational Practices; and SMP—Sustainability Management Processes, as illustrated in Figure 4-20. The framework takes into consideration the sustainability impacts of the construction industry and the issues that are significant for sustainability management in the construction field, identified in the literature review and case studies.



Figure 4-20. The taxonomy (main knowledge areas) of the Sustainable Development Management Body of Knowledge (SDMBOK) for the construction industry

The proposed framework introduces the taxonomy—or main knowledge areas—of SDM for enabling the construction industry to implement the current sustainability development goals into the company’s strategies and daily activities.

4.3.2. How to Facilitate the Construction Industry to Implement the SDGs into the Companies' Strategies and Tactical Management?

This research also identified the current industry practices for SDM through interviews with companies in the building construction industry, facilitating the implementation of the SDGs into the construction industry's strategies. The resulting data assisted in identifying and defining specific management practices for the types of management activities outlined in the SDMBOK structure to complete the SDMBOK framework.

Since the expansive scope of the SMP layer is beyond the scope of this research, this section of the study is limited to the SOP layer. The depth of the analysis can be found in the methodology section in this chapter and the appendix The SDMBOK - Meta-Analysis Table.

In addition to the descriptions of the management practices, the SDMBOK includes a series of template forms to help guide companies wishing to implement the framework at the strategic level.

Challenge

Governments have agreed to and are already working on the SDGs. However, the achievement of the SDGs depends also on the action of businesses and society. To facilitate the implementation of sustainability at the heart of the organization's strategies, the organizations need a tool to implement the SDGs into their strategy and tactical management.

As discussed earlier, there is no unique way to implement a strategy and management process into an organization. The challenge is to analyze a vast number of materials involving business and project and construction management models, identifying the critical features for the implementation of the SDM.

The literature review analyzed aimed to identify common features, and the case studies the methodologies already used currently.

The methodology utilized in this research is described in the following topic.

Methodology

This research presents an SDM structure that reflects the current practices of SDM at the strategic level as identified through case study interviews. The identification of current practices is a key to successfully change or improve initiatives, using the experience and methods from others, not just for reducing costs and cycle time, but also to have a competitive advantage (Coers, Gardner, Higgins, & Raybourn., 2001).

The case studies were performed by interviews with CEOs, Project Managers, or Sustainability Project Managers of the organizations' participants of this research. The highlighting of the case studies is as follow:

1. Interview

a. The questionnaire includes the following heading questions related to the strategic level (SOP). See Appendix Appendix D: for the complete questionnaire.

- i. To identify the pattern of the current practices for managing the corporate sustainability strategies
- ii. To identify the pattern of the current practices for managing the corporate sustainability objectives
- iii. To identify the pattern of the current practices for organizing the corporate sustainability structure (team management)
- iv. To identify the pattern of the current practices for managing the corporate sustainability policies and procedures

b. Construction Industry Participants

- i. The selection of the participant construction industries considered the years of experience in the construction industry. This research invited more than 25 organizations. Thirteen agreed to participate, and 10 continued the study until the end. The profile of the organizations participating in this research is described in Table 4.3.

2. Data Analysis—Building out the Framework

a. To assess the initial structure of the SDMBOK and to modify this as needed, the results of the case studies were considered. The identified practices populated the management structure with the inputs, tools and techniques, outputs, and documents for each SDM knowledge base area, defining the framework based on the actual current practices found in the case studies. Appendix D.2 is the complete data collection from the literature review and the case studies, demonstrating the input, tools and techniques, and outputs for each feature of the SDMBOK

3. Templates

- a. A series of forms that support the application of the SDMBOK based on the literature review and case studies were developed to accompany the contents of the SDMBOK framework. The templates can be found in the appendix D.4.

Table 4.3. Construction industry participants profile

Organization							Interviewee		
Code	Location	Years in the Construction Market	Number of executed building projects	Category	Number of completed green Projects	Green building certification or other certification	Role	Year of experience in green projects	Green Certification or Other Certification
BO.1	Northeast of Brazil	Since 1994	>66	Residential (Luxury and popular)	-	ISO 9000, 9001. Implement ISO 14000, but not certified	Engineer	7	ISO 9001, ISO 14000, PBQPH, NBR15575
BO.2	Northeast of Brazil	Since 1996	>22	Residential (Luxury and popular) and Commercial Buildings, Infrastructure Projects	-	BPQH, ISO 9001	Engineer and Owner	7	Masters in project and construction management
BO.3	Northeast of Brazil	Since 2014. However, 35 years of experience (the company separate the business)	4	Residential Buildings (Popular)	-	-	Engineer and Director	25 in construction. 0 in green buildings	Masters in project and construction management and MBA

Organization							Interviewee		
BO.4	Northeast of Brazil	Since 1982	> 30	Residential (Luxury and popular)	3	2 (Selo Verde), 1 AQUA (High Environmental Quality)	Quality Coordinator	14	ISO, Quality Auditor, Environmental Auditor, Not Conformity Management
BO.5	Northeast of Brazil	Since 1989	9	Residential (Luxury)	0	ISO 9001, but not certified	Engineer—Manager	18, but 0 in green buildings	Masters in Civil Engineering and MBA (in progress)
BO.6	Northeast of Brazil	Since 1977	>77	Residential (Luxury and popular)	1	ISO 9001, Selo Verde (Sindcon—IMA), SIAC (PBPQH)	Engineer and Director	5	MBA
BO.7	Northeast of Brazil	Since 1998	>20	Residential (Luxury and popular)	-	ISO 9001 e PBQP-H	Architect—Project Coordinator	11, but 0 in green buildings	MBA
CO.1	Vancouver	Since 1989	>45	Residential (Luxury and popular) and Commercial/Industrial Buildings, Civic and Institutional Projects	18	LEED, Building Green	Senior Project Manager	>9	LEED Associate

Organization							Interviewee		
CO.2	Vancouver	Since 2010 with the current name. More than 40 years in total	>1000	Architectural Design Projects	50	LEED, Leaving Building, Envision, AIA	Architect— Director	>22	LEED Associate
CO.3	Vancouver	Since 1997	>160	Civil, infrastructure, and demolition projects	-	-	CFO	-	-

Contribution

The SDMBOK for the Construction Industry is a framework to assist the construction industry to initiate, plan, execute, control, monitor, and report sustainable activities of its operations. The framework is a combination of two layers; strategic level and tactic level, as illustrated in Figure 4-21, arising from question 2.b.



Figure 4-21. Elements of the SDMBOK, showing the two main layers, the taxonomy (organization of main knowledge areas), the current practices, and the implementation templates

At the strategic level, the introduced framework, SDMBOK, presents four layers in its taxonomy based on literature review and case studies. It also introduces templates for implementation of the level into the organization.

At the tactic level, the SDMBOK introduces three layers in its taxonomy based on common features identified in the literature review.

Appendix D.2 introduces the complete input, tools and technique, and output identified from both literature review and case studies, in the latter for the SOP level. The next topic approached in detail the SDMBOK and its features.

4.4. Deliverable: Sustainable Development Management Body of Knowledge

A framework is a supporting structure, a system of rules, ideas, or beliefs that are used to plan and implement something (Cambridge University Press, 2018). It is a subset of tasks, processes, tools and templates used in combination with team management and various methodologies and approaches to

initiate, plan, execute, control, monitor, and terminate the activities throughout the management life-cycle (MyManagementGuide.com, 2018).

The SDMBOK assists the construction industry to initiate, plan, execute, control, monitor, and report.

The SDMBOK describes the commonly accepted principles of project management for the construction industry, focusing on SDM. The general framework follows the knowledge areas from a business model, project management such as PMBOK, project and construction management, and sustainability management, providing a broad foundation for managing sustainability at the organizational and processes management levels.

The SDMBOK is composed of definitions (tasks and processes), procedures, and templates organized as following:

1. Definitions (Tasks and Processes)—based on the literature review related to business model (standards, certifications, etc.), project and construction management (e.g., PMBOK), and sustainability management.
2. Procedures—a combination of methodologies based on the literature review and case studies presented in the format of Input, Tools and Techniques, and Output.
3. Templates—a collection of forms with methods or procedures based on the literature review and case studies to help the organization to implement SDM.

The framework is a combination of two layers; Sustainability Organizational Practices (SOP) and Sustainability Management Processes (SMP), as demonstrated earlier in Figure 4-20.

The objective of the SDMBOK is to provide the full range of information needed for implementing SDM into the organization successfully. The SOP focuses on the corporate organizational structure divided into four areas: Corporate Sustainability Strategy, Corporate Sustainability Objectives, Corporate Sustainability Structure, and Corporate Sustainability Policies and Procedures. The SOP assists the organization in identifying its sustainability goals, the human resources to execute the sustainability tasks, and the methodology of identifying and implementing the sustainability values and policies into the organization.

The SMP focuses on Corporate Sustainability Tasks, assisting the organization in identifying its sustainability working system, identifying the tasks and the methodology to implement, manage, control, and report the sustainability activities of the organization.

The detail of the information and processes analyzed in each of the SDMBOK layers is different. Figure 4-22 represents the level of information analyzed and the details for each of the SDMBOK layers.

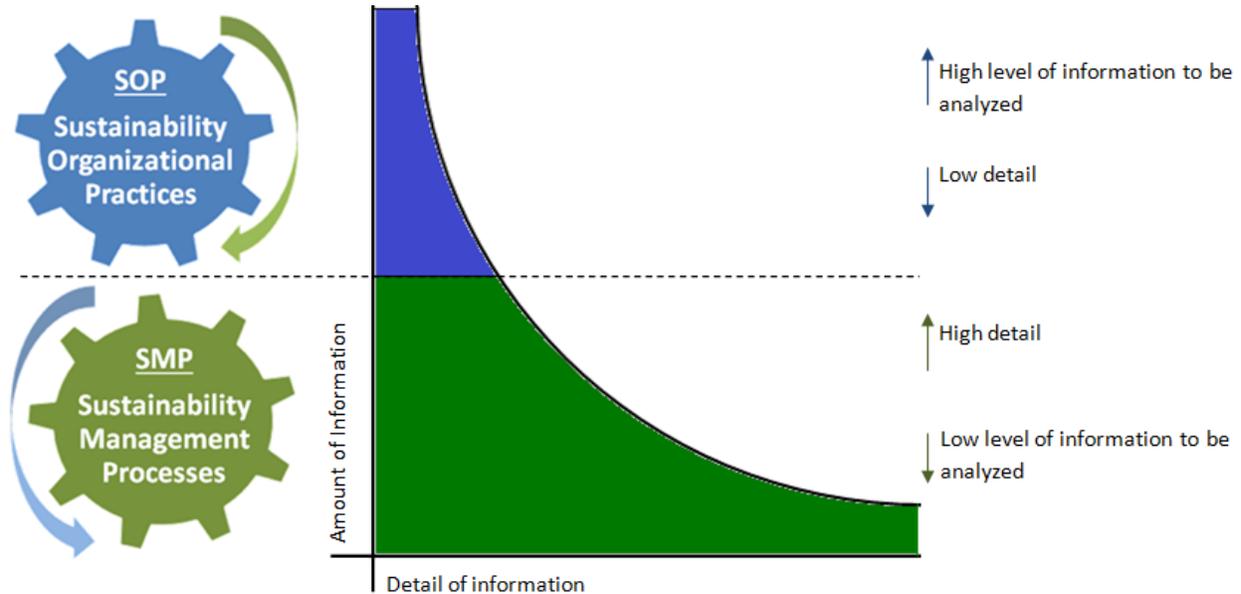


Figure 4-22. A graphic representation of the level of information details analyzed for each of the SDMBOK layers considering the amount of information and the information detail needed

At the organizational level, the focus is on the analysis of the strategy. The Sustainability Organizational Practices (SOP) is analyzed by the board of directors to ensure accountability and transparency through direction and control of policies and processes to meet the strategic goals, as stated in PMBOK, regarding organization governances. The objective of this analysis is to provide a long-term direction through strategic planning, implementation and control. The analysis is from a macro perspective, identifying the organization as a whole and avoiding the details of the operation. The SOP is the level where it is decided whether the organization should be sustainable and how sustainable it should be. Macro external and internal perspectives are considered, and the focus on details at that moment would not make possible an easy or practical analysis. The detailed analysis is considered at the next level when the individual processes are determined.

The Sustainability Management Processes (SMP) level analyzes and defines the processes in implementing the sustainability goals in the daily activities of the organization, focusing on the details of the operation and assessment. The information analyzed is based on the main goals of the organization, breaking-down to the details of the procedures to achieve the organizational goals.

The following topics address in more detail the definition of each layer and feature of the SDMBOK. The complete SDMBOK with the inputs, tools and techniques, outputs and templates can be found in Appendix C:

4.4.1. SOP Module—Sustainability Organizational Practices

Sustainability Organizational Practices (SOP) establish the organization’s sustainability approach, identifying the human resources to execute the tasks and the methodology for implementing the sustainability values and policies into the organization. The SOP is a conceptual model that involves investigating the requirements of the stakeholders and developing a management system that responds to these requirements. The SOP focuses on the organizational structure, bringing business concepts for implementing sustainability management processes into the organization.

The module is divided into four areas: Corporate Sustainability Strategy; Corporate Sustainability Objectives; Corporate Sustainability Structure; and Corporate Sustainability Policies and Procedures, as illustrated in Figure 4-23.

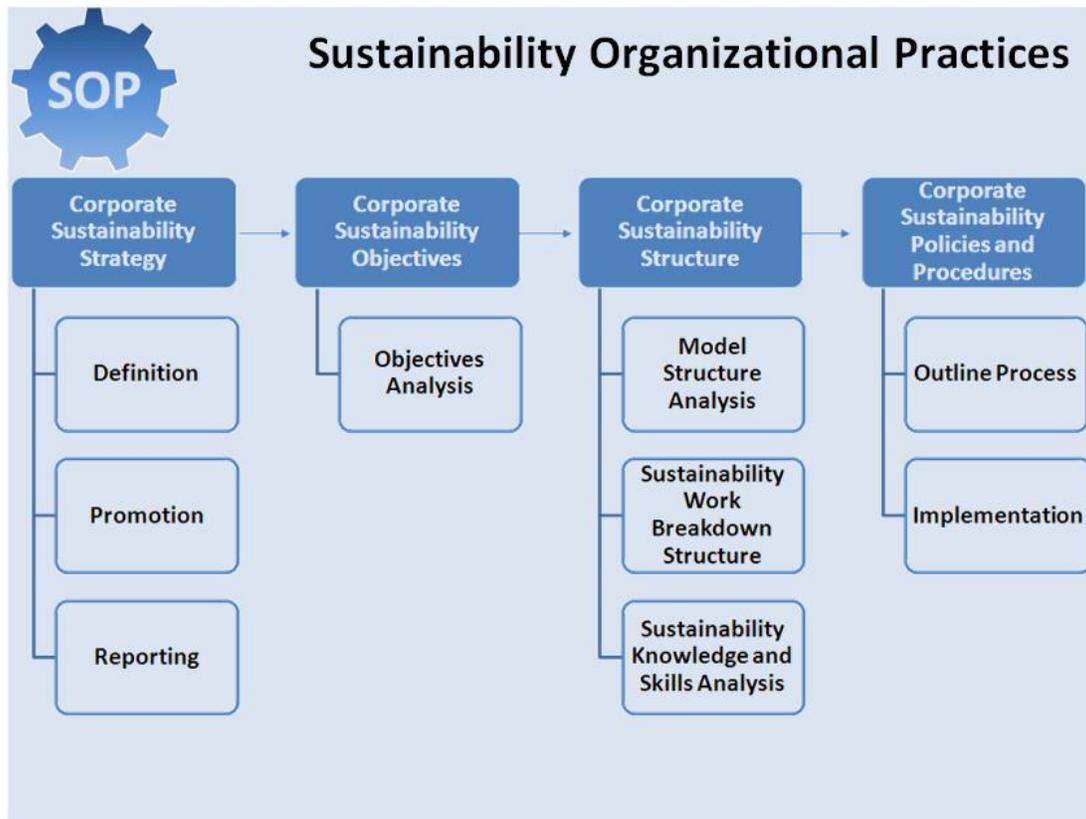


Figure 4-23. The Sustainability Organizational Practices (SOP) taxonomy—the first layer of the SDMBOK

The following topics address each feature of the SOP taxonomy.

Corporate Sustainability Strategy

Corporate strategy is the overall scope and direction of an organization and how its various business operations work together in achieving particular goals (WebFinance Inc., 2020). Corporate Sustainability Strategy is the scope and direction of the sustainable goals of the organization.

The Corporate Sustainability Strategy is the process of documenting the actions necessary to identify, promote, and report the sustainability organization strategy and its general sustainable goals, considering its market, values, external regulations, external and internal initiatives, and its primary sustainability focus. The Corporate Sustainability Strategy becomes the primary source of direction for the sustainability activities plan.

Implementing sustainability management into the organizations' daily activities is necessary initially to identify which issues the organization will address, identifying the values and commitment of the organization, how to promote those commitments and what and how to report the organization's sustainability impact.

Figure 4-24 illustrates the SDMBOK three steps for implementing the Corporate Sustainability Strategy: definition, promotion, and reporting.

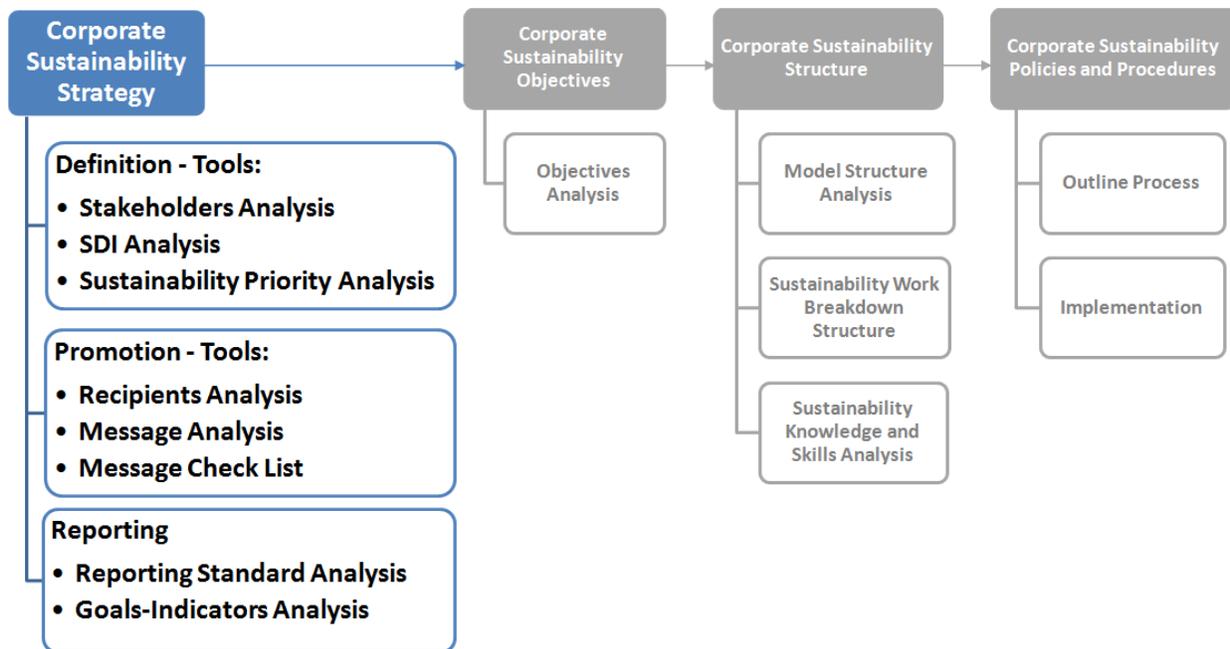


Figure 4-24. The steps for implementing the corporate sustainability strategy: definition, promotion, and reporting-the first part of the SOP module

This research structures each element of the framework in a format of inputs, tools and techniques, and outputs—similar to the approach taken by the PMBOK. The discussion related to the tools and techniques is presented in this section of the thesis. The complete listing of inputs, tools and techniques, and output is contained in Appendix C: along with templates to assist organizations in implementing each element.

- Definition

Corporate Sustainability Strategy Definition is the process of identifying and documenting the sustainability issues that the organization will address, considering the organization's market, its values, external regulations, external and internal initiatives, and its primary sustainability focus. Some tools were identified by this research to assist the organizations in identifying, organizing and prioritizing the sustainability goals, as follows:

- Stakeholders' Analysis.

Stakeholders can be internal or external, may have a direct or indirect, and a positive or negative impact on the organization. Therefore, it is essential to identify the stakeholders that can affect or be affected by the organization's activity.

The stakeholders analysis will focus on identifying all the individuals, groups, or organizations that may affect or be affected by the organizations' activities. It will prioritize them according to importance and influence, using the Stakeholders Analysis Matrix, and it will identify the sustainability values of each one that the organization has chosen to address.

Figure 4-25 illustrates the Stakeholders Analysis Matrix, which assesses the impact on the organization. Based on the analysis and the category of the stakeholder, the organization can decide its approach to each stakeholder, as follows:

- High level of importance and high level of influence—manage closely. They are the top priorities, and the organization should manage them closely.
- High level of importance and low level of influence or high level of influence and low level of importance—keep informed or satisfied, respectively.
- Low level of importance and influence—monitor the impact of the organization's activities on the stakeholder.



Figure 4-25. Stakeholders analysis matrix—a graphic representation of the stakeholders category and the way an organization should address them

- SDI Analysis.

The sustainable development indices analysis assists the organization to identify the sustainability targets that will be addressed and how they contribute to the current international sustainable goals. This information provides the scope for the organization to prioritize the sustainability issues to be addressed.

This research introduces the 100 SDI (Appendix A:) as a scope for the sustainability targets for the building construction industry. It can be used to analyze the priorities to be addressed according to the strategy of an organization.

- Sustainability Priority Analysis.

Once the scope of the sustainability targets for the organization’s activities has been defined, the organization should prioritize the targets so that it can focus on the targets to be addressed for the next steps of the sustainability management implementation.

This research suggests analyzing the target contribution according to four perspectives:

- Regulation implications—to identify the external policies and governmental implications regarding a specific issue.
- Corporate mission statement—to determine the impact of the target relative to the corporate mission statement.
- Stakeholders’ values—to identify the effect of the target on the values of the stakeholders previously analyzed.
- Financial implications—to determine the financial significance of addressing or not addressing the target issue.

A simple weighting method where the organization defines a relative weighted value for each of these categories can assist the organization to prioritizing the targets with higher overall sustainability value.

- Promotion

Corporate Sustainability Strategy Promotion is the process of identifying and documenting the internal communication plan that establishes a service orientation focusing on achieving effective internal exchanges between the organization and its employees. Promoting the organization's sustainability values influences employee's work attitude, awareness, and commitment to the Corporate Sustainability Strategy.

This research suggests some tools to assist the organizations in promoting its sustainability values, as follow:

- Recipients Analysis.

Analyzing the recipients assists the organization to promote its sustainability values. Each sustainability target will affect stakeholders, and identify who are the ones that need to be informed or educated for each target assists the organization to determine the most effective message.

For internal communication, some information needs to be analyzed, such as:

- Identify the department that will be receiving the message
- Identify the level of knowledge and education the recipients have so that the message will be elaborate accordingly
- Identify if the message needs an additional format such as visual representation
- Identify if the recipients have access to technology so that the message can be appropriately elaborated
- Identify any kind of barrier, such as cultural differences, which should be addressed while transmitting the message.

- Message Analysis.

The message analysis identifies the specifics of each message. It analyzes each of the organization's sustainability targets and determine which ones and in which way they should be promoted.

Some information needs to be analyzed after identifying the corporate mission statement and the sustainability targets and the related departments that need to be informed or educated:

- Characteristics of the message—identifies the feature of the message in order to identify the appropriate type of message (informational, persuasive, entertain), the format for disseminated (formal, informal, electronic, hard copy, training, etc.), and the message content.
- Feedback Process—analyzes if responses and feedback from the message needs to be assessed and how it would be assessed.
- Message Maintenance—defines who is responsible for promoting the message and with which frequency it should be updated and promoted again.
- Message Check List.

The checklist analysis assists the organization to evaluate if the message is appropriate with respect to all the aspects formerly analyzed, such as the type of the message, the format, the feedback process, and the quality of the message.

- Reporting

Corporate Sustainability Strategy Reporting is the process of identifying and documenting the economic, environmental and social impacts caused by the organization's activities—be they positive or negative. The report presents the Corporate Sustainability Strategy, the measurement performance, and results in sustainable development, increasing transparency about the effects of its operations on sustainability issues.

The next step is to identify in more detail the initiatives and activities to implement to achieve the organization's sustainability objectives, described in the following topic.

Corporate Sustainability Objectives

Objectives are more specific and more measurable than goals. Objectives underlie all planning and strategic activities to achieve within a time frame and with available resources. They serve as the basis for creating policy and evaluating performance (WebFinance Inc., 2018).

The Corporate Sustainability Objectives section of the SDMBOK describes the actions necessary to identify the sustainability objectives according to the organization's sustainability strategy and to identify the strategic activities to achieve them. Figure 4-26 illustrates the subset suggested by this research in implementing the Corporate Sustainability Strategy.

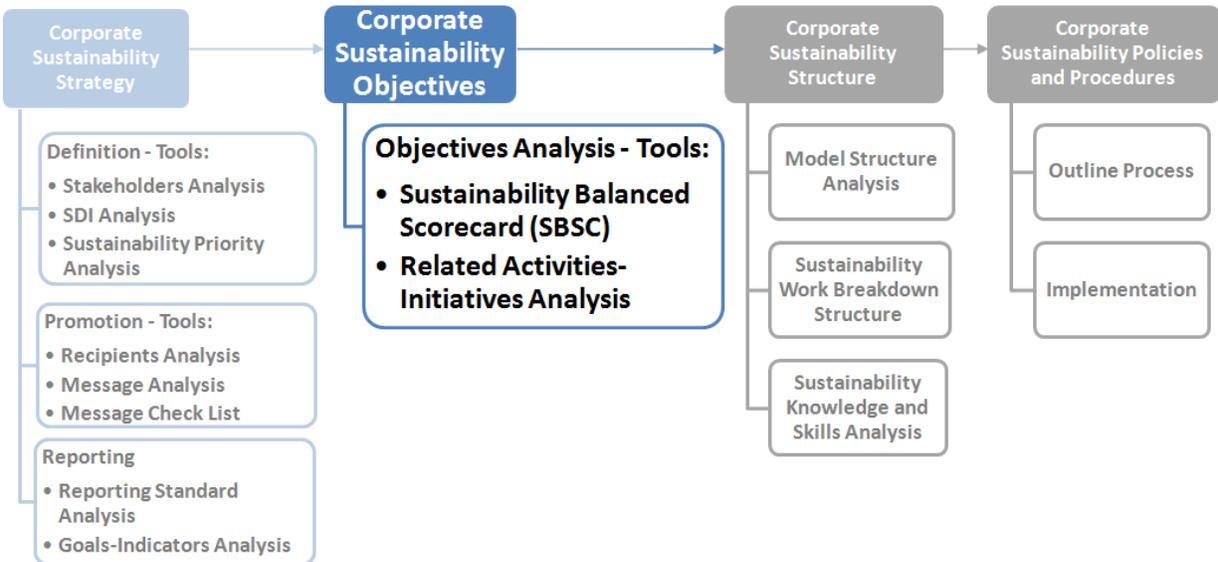


Figure 4-26. The steps for implementing the corporate sustainability objectives-the second part of the SOP module

- Objectives Analysis

Corporate Sustainability Objectives Analysis is the process of identifying and documenting the priority strategic goals of the organization in more detail, determining the initiatives of the organization to achieve the specific objective and the activities involved in implementing the sustainability goals. The corporate sustainability objectives analysis tools were identified by this research to assist the organizations in identifying, organizing and prioritizing the sustainability goals, as follow:

- Sustainability Balanced Scorecard (SBSC)

The Sustainability Balanced Scorecard assists the organization to identify the indicators and assessment methodology to manage the sustainability goals of each sustainability perspective and, based on the priority goals identified previously by the organization, to identify the organization’s initiatives for implementing and managing the goals.

- Related Activities-Initiatives Analysis

The related activities-initiatives analysis assists the organization to identify the organizational units where the initiatives (project or activity) will be implemented.

The next step is to identify the corporate structure that assists the organization in implementing the activities identified in the Corporate Sustainability Objectives step. The following topic approaches the Corporate Sustainability Structure subset.

Corporate Sustainability Structure

An organizational structure depends on the organization's objectives and strategy. It identifies the way the roles and responsibilities are assigned and coordinated, and the way the information flows between levels of management.

The Corporate Sustainability Structure identifies the sustainability activities of the organization based on its sustainability strategies and objectives and the required knowledge, skills, and roles for managing its sustainability performance.

The Corporate Sustainability Structure section of the SDMBOK outlines the actions necessary to define the allocation, coordination and supervision of the activities for achieving the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The organizational structure focuses on the required sustainability knowledge, skills, training, certifications, roles, and department for managing sustainability practices. It assists the organization to adapt its organizational chart to be efficient and flexible to achieve sustainable competitive advantage.

Figure 4-27 illustrates the subset suggested by this research in implementing the Corporate Sustainability Structure.

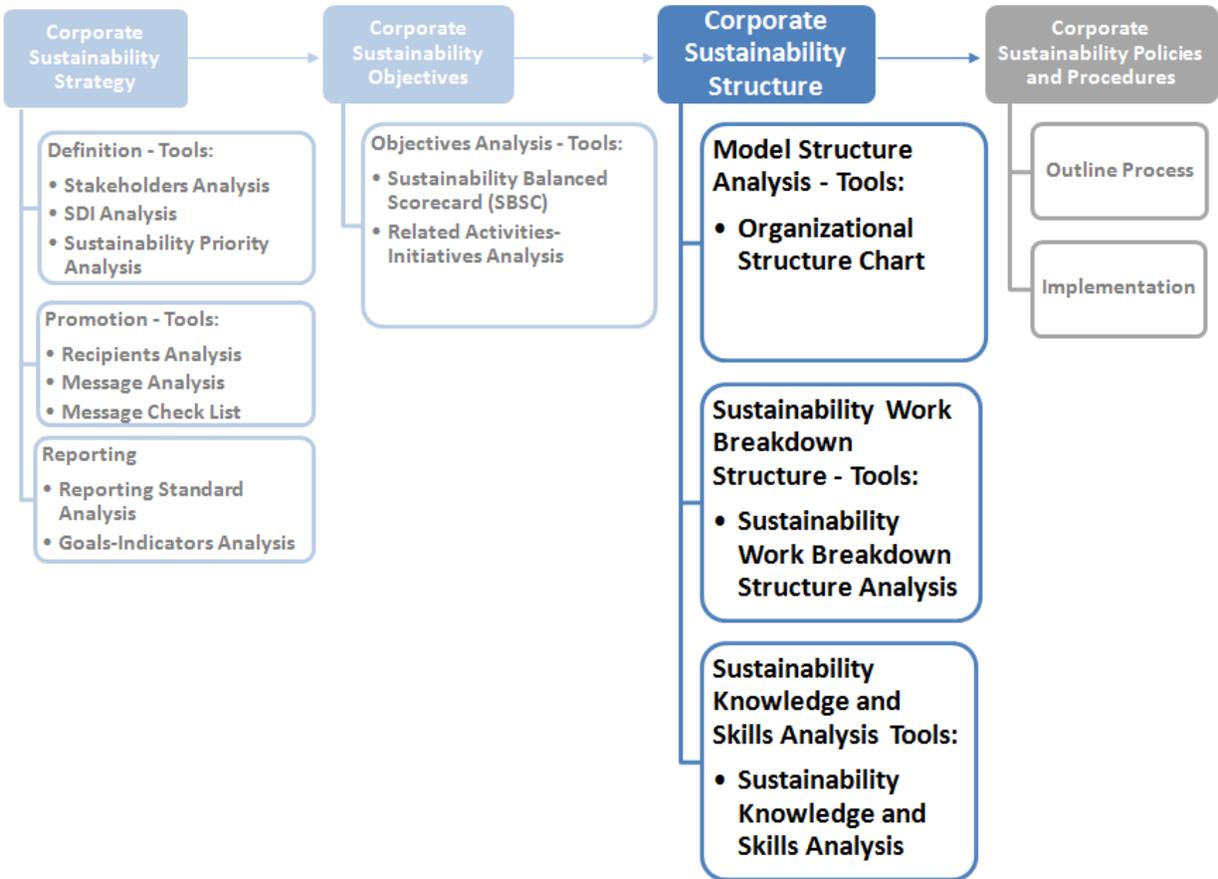


Figure 4-27. The steps for implementing the corporate sustainability structure-the third part of the SOP module

- **Model Structure**

The organizational structure definition assists an organization to execute its strategies and objectives, determine who is responsible for what and the way they communicate with each other. The organizational structure should be defined, and the sustainability management activities should be located within this structure.

- **Organizational Structure Chart**

The organizational chart assists an organization to visualize the organizational structure and its components, demonstrating the connection between departments and the relationship between them. It does not indicate the activities; however, it illustrates the flow of information in the organization as a whole.

- **Sustainability Work Breakdown Structure**

Corporate Sustainability Structure—Sustainability Work Breakdown Structure is the process of identifying and documenting the sustainability work package from the general division to its

smallest components, identifying and dividing the sustainability activities to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives. It assists the organization to identify the roles and responsibilities for managing the sustainability activities of the organization to accomplish the Corporate Sustainability Strategy and Corporate Sustainability Objectives.

- Sustainability Work Breakdown Structure (WBS) Analysis

The WBS analysis assists the organization to determine the work packages, dividing the organizational strategy and objectives into its components for coordination. It considers the organization's goals, the main activities, the flow of information, the parties that have control of the entire procedure and the individuals answerable for every deliverable.

- Sustainability Knowledge and Skills

Corporate Sustainability Structure—Sustainability Knowledge and Skills Analysis is the process of identifying and documenting the technical expertise and the required tools to enhance the sustainability performance determined by the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The Corporate Sustainability Structure—Sustainability Knowledge and Skills Analysis assists an organization to identify the sustainability skills, knowledge, and competencies for managing the Corporate Sustainability Strategy and Corporate Sustainability Objectives.

- Sustainability Knowledge and Skills Analysis

Following the Sustainability Work Breakdown Structure Analysis, the Sustainability Knowledge and Skills Analysis tool assists the organization to identify the essential skills and the additional tools, technologies, and standards need to manage each of the corporate sustainability goals.

The next step is to elaborate the corporate sustainability policies and procedures to assist the organization in implementing the sustainability goals to be addressed by the organization. The following topic addresses the Corporate Sustainability Policies and Procedures elements of the framework.

Corporate Sustainability Policies and Procedures

Corporate Policies and Procedures are formal documents designed to influence and guide the behaviours, transactions, initiatives, and protocols (WebFinance Inc., 2018). The corporate sustainability policies and procedures are a set of principles, rules, and guidelines designed to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives. It is a process of documenting the actions

necessary to determine the corporate sustainability principles, rules, and guidelines for the organization based on the sustainability goals and objectives. Figure 4-28. The steps for implementing the corporate sustainability policies and procedures subset-the fourth part of the SOP module illustrates the subsets suggested by this research in implementing the Corporate Sustainability Policies and Procedures.

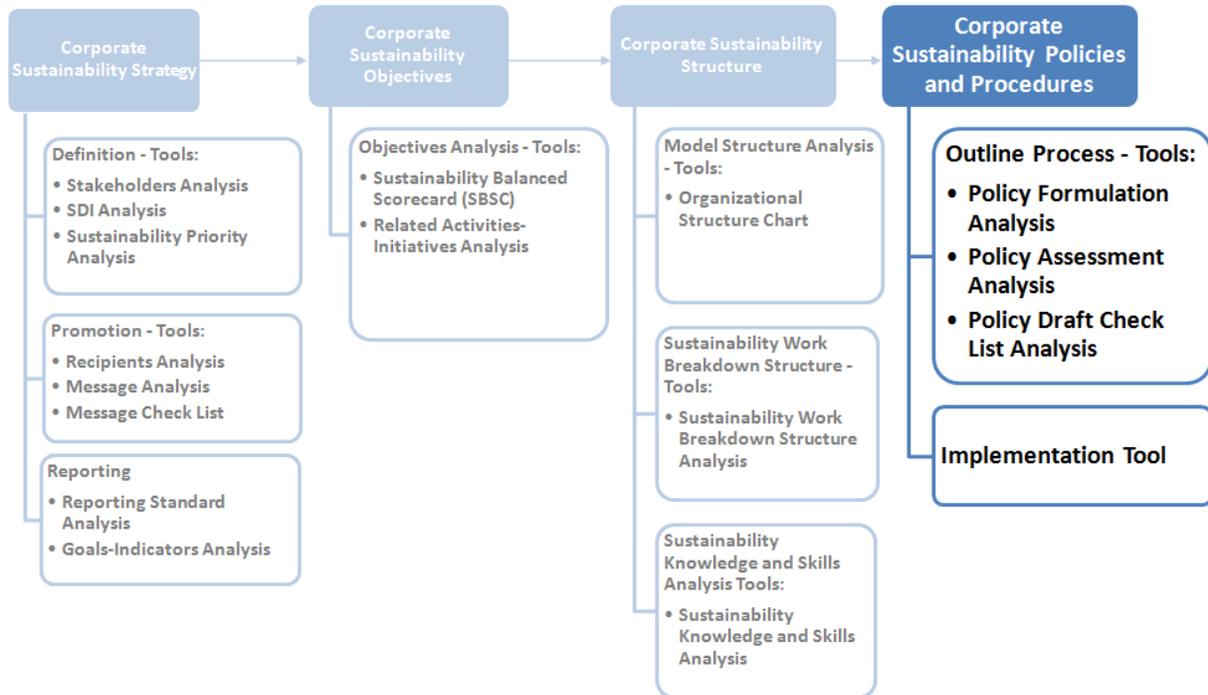


Figure 4-28. The steps for implementing the corporate sustainability policies and procedures subset-the fourth part of the SOP module

- Outline Process

The outline process is the process of identifying and documenting the set of principles, rules, and guidelines to achieve the sustainability strategy and objectives. The Corporate Sustainability Policies and Procedures—Outline Process determines a guide of how to define the rules and principles regarding the sustainability practices, the expected behaviour and responsibilities of managers and employees.

This research divided into three steps the process of formulating a policy: the policy analysis, assessment analysis and a checklist analysis, as following described.

- Policy Formulation Analysis

The policy formulation analysis assists the organization to identify the primary information to be considered to elaborate a policy. It will describe the sustainability structure to be analyzed, the values of the stakeholders being approached, the skills and tools necessary to implement

the rules and principles of the policy, the legal requirements, terminologies, workflow and the internal registration of the new policy, such as the corporate code, title, version, and status of the new policy.

- Policy Assessment Analysis

Once the policy was elaborated, as discussed in previous topics, it is essential to assess the impact of the policy in the three perspectives of sustainability, analyzing the overall effect on sustainable development. This research suggests the methodology used by OECD, the SIA, to evaluate the impact of the determined rules.

- Policy Draft Checklist Analysis

The policy draft checklist assists the organization in verifying if the elaborated policy considered essential steps before implementing it. The checklist assists the organization in verifying:

- Did the policy consult the direct stakeholders and considered their values and concerns?
- Was the policy assessed according to the three pillars of sustainability?
- Who was responsible for the approval?

Once the policy draft was accessed and verified, it can be implemented and promoted in the organization.

- Implementation

The implementation tool assists the organization to identify the related department to implement the policy, how to implement, who is responsible for the implementation, and when the policy should be reviewed. This is important for the maintenance of the policy.

The Corporate Sustainability Policies and Procedures is the last step of the SOP layer, creating a feedback process where an organization will keep reviewing and updating according to the dynamics of the market, regulations, and activities. Collectively, these elements make up the strategic layer or design of the SDM system of an organization. Based on the information analyzed and determined in this layer, the next step is to define the process to implement in specific projects of procedures at the tactic layer. The following topics addresses the organizational tactical layer or operation for the SDM system.

4.4.2. SMP Module—Sustainability Management Processes

Whereas the Sustainability Organizational Practices (SOP) layer provides a generic framework for an organization’s overall sustainability strategy, the Sustainability Management Processes (SMP) provides a framework for managing an organization’s sustainability initiatives and practices. Like the SOP, the SMP is also a generic framework that defines elements of a general management approach that can be applied to any specific sustainability activity—it does not address the task-specific details (e.g., of a waste-reduction program or a life cycle analysis activity).

The SMP assists the organization to identify its sustainability working system by identifying the tasks and the methodology to implement, manage, control, and report the sustainability activities of the organization.

The SDMBOK divides the SMP task management into three subareas: operations management, indicators and assessment management, and reporting management, as illustrated in Figure 4-29.



Figure 4-29. The Sustainability Management Processes (SMP) taxonomy—the second layer of the SDMBOK

The following topics discuss each feature of the SMP taxonomy. As with the SOP, this research introduces the subsets in a format of inputs, tools and techniques, and outputs. The discussion related to the

tools and techniques is presented in this section of the thesis while the complete listing of inputs, tools and techniques, and output is contained in Appendix C:

Corporate Sustainability Tasks

A task is the smallest identifiable piece of work (WebFinance Inc., 2018) managed at the tactical level or project management level. The Corporate Sustainability Tasks is the process of documenting the actions necessary to evaluate the organization's activities, the Corporate Sustainability Strategy and the Corporate Sustainability Objectives. This research divides the task management into three subsets: operations management, indicators and assessment management, and reporting management, as illustrated in Figure 4-30 and described in the following topics.



Figure 4-30. The steps for implementing sustainability task management of the SMP module

Sustainability Operations Management

Corporate Sustainability Tasks—Sustainability Operations Management is the process of identifying and documenting the work breakdown structure of the activities that provide sustainability management in the construction phase and assist the organization to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The Corporate Sustainability Tasks—Sustainability Operations Management section of the SDMBOK provides a process for identifying specific sustainability activities and sustainability processes, assisting the organization to go from general or ethical goals to tangible and practical actions.

- Sustainability Activities Analysis

The Sustainability Activities Analysis assists the organization to subdivide project deliverables and project work in smaller, specific and more manageable elements. This process is determined at the stage of elaborating and organizing the project management at the tactical level. To analyze the activities breakdown involves determining some critical information such as:

- A summary of the work to be accomplished
- Inputs required from other project tasks (predecessors)
- The manager and organizational unit responsible
- Sustainability activity (corporate goals)
- Related organizational sustainability policy
- Resource estimates for labour, material, equipment, and facilities
- Total cost and budget
- Work orders
- Schedule dates and milestone events

Sustainability Indicators and Assessment Management

Corporate Sustainability Tasks—Sustainability Indicators and Assessment Management is the process of identifying and documenting a reliable mechanism to identify and manage the sustainability measures and indicators. The Corporate Sustainability Tasks—Sustainability Indicators and Assessment Management section of the SDMBOK guides organizations to measure, monitor and control the performance of the organization's sustainability goals.

- Sustainability Indicators Analysis

For an activity's performance to be managed, it is essential to have a clear definition of the objective and the way the performance will be measured. The clarity of the goal and the measurement unit and frequency allows the organization to communicate its objective and analyze the performance without confusion or misinterpretation.

Some requirement information assists an organization in defining the indicator to manage the performance of any activity, such as:

- Identify the sustainability target to be addressed
- Identify the related department

- Identify the related activity
- Identify the responsibility for managing the indicator
- Identify the indicator of measurement to determine the performance of the activity
- Describe the indicator
- Describe the aim of the indicator
- Identify the measurement unit
- Identify the measurement frequency
- Identify the target—expected performance for the indicator
- Sustainability Assessment Analysis

The sustainability assessment analysis assists an organization to identify and document the essential requirements, expectations, potential influence, and a reliable mechanism to measure, monitor, and control the sustainability indicators, determining the assessment methodology of the sustainability activities and their indicators of performance.

Once the performance indicators have been identified, some additional information assists an organization in defining the assessment method to measure and report the performance:

- Identify if there are any regulations or standards for measuring the specific indicator
- Identify the calculation or method used to assess the performance—the assessment criteria
- Identify the format of how the performance will be reported

Sustainability Reporting Management

Sustainability Reporting Management assists an organization to report and disseminate performance information relating to its sustainability activities. Monitoring is collecting project performance data, producing performance measures, and reporting the data. The reporting stage allows the organization to register for future analysis, gives feedback for future updates, analyzes the performance of the activity, understands the current state of the project, and recognizes the actions to address any performance issues.

- Sustainability Performance Disclosure Analysis

The sustainability performance disclosure analysis assists an organization to define what to report and how to communicate the results.

Once the indicators and assessment methodologies are identified, the next step is to define the reporting format of the results. The materiality, completeness, and responsiveness for comprehensive reporting needs some essential information, such as:

- Identify the indicator of performance
- Describe the objective and assessment methodology of the indicator
- Describe and explain used terminology, measurement unit, and illustrations
- Describe the frequency, responsible and performance of the indicator
- Describe concerns and interests about the results
- Describe future actions to respond to the concerns and interests issues

The information reported at the tactical (SMP) level assists an organization to provide information for external corporate reporting at the strategic level (SOP).

Sustainability Reporting Management is the last step addressed by this research, and it is the step in which the organization evaluates its activities and results according to the defined sustainability goals, creating a feedback loop process to monitor and update the organization's sustainability strategy.

The next topic discusses the validation process of the second deliverable of this research—the SDMBOK. It introduces the methodology used to identify the main knowledge area, subsets and primary information used in the SDMBOK and the methods used to validate them.

4.5. Validation

This research used two validation processes for the proposed framework. First, a systematic literature review and data analysis methodology was used, concentrating on collecting data and giving an organized and normalized approach for breaking down earlier discoveries in a particular subject of the framework using the literature review and case studies—at the SOP level. The assessment may not exclusively be quantitative but qualitative, uncovering the inclinations, qualities, and practices of existing examinations.

Appendix D.2 is a complete table with the data from the literature review and case studies for the SOP level and literature review for the SMP level considered by this research to build up the framework.

The validation of any methodology does not demonstrate that the method is wrong or right, but that the technique achieves its objectives on improving efficiency, effectiveness, and quality of the results (Moody, 2003).

The second validation process used by this research is the Technology Acceptance Model (TAM). This model uses a literature review to synthesize the previous measurement items and to evaluate the methodology's reliability and strength. This model has practical support for various studies as a theoretical basis and foresees user acceptance (Moody, 2003).

According to Moody (2003), one of the problems in validating a model is the challenge of defining the “dependent variable” to determine whether the model is efficient or not. Moody considers two factors to achieve the objective of the model: efficacy—whether there is an improvement of the task performance; and adoption in practice—whether the method is practical. The theoretical model MEM (Method Evaluation Model) integrates both factors, and how the acceptance of the SDMBOK framework was validated.

This research utilized the Method Evaluation Model to validate the acceptance of the proposed framework through a survey with a group of specialists. The group of the specialists is described below:

- CEO
- Engineer—Sustainable Business
- Sustainability Manager
- Academic

The detailed process of validation for this research is discussed in chapter 4. The reports from the specialists and the curriculum of their experiences can be found in Appendix D.3.

4.6. Contributions

The second objective of this research was to identify the primary body knowledge for implementing sustainable development management. This research has contributed the deliverable of the SDMBOK—a framework for implementing sustainable development management within the construction industry. Even though the topic has been exhaustively addressed in different areas, at different levels, for various fields, identifying the main knowledge areas to assist in implementing sustainable development goals was the initial challenge for this part of this study. With new types and volumes of management and administrative tasks that the organizations are being impacted, combining essential knowledge areas for implementing the

SDM was a gap identified in the current literature with a lack of a clear framework for implementing SD at both the strategic and tactical levels.

Table 4.4 illustrates the primary source of information utilized by this research, considering models for sustainable development management implementation to consolidate it into the SDMBOK.

Table 4.4. Primary source of information utilized by this research to consolidate the taxonomy of the SDMBOK

Model	Category	Source Type	Main Source of Information
SOP - Sustainability Organizational Practices	Corporate Sustainability Strategy – Goals	Case Study	Interview (Brazilian and Canadian Construction Organizations)
		Literature Review	Ahuja, 1976
			Drucker 1974
			Epstein, 2008
			GRI, 2007
			Grünig & Kühn, 2015
			Hitchcock & Willard, 2006
			ICC, 2015
			International Chamber of Commerce, 2015
			Kliem, 2008
	Nicholas, 1994		
	PMBOK Guide, 2017		
	Corporate Sustainability Objectives	Case Study	Interview (Brazilian and Canadian Construction Organizations)
		Literature Review	Drucker 1974
			Mitchell, 2015
			Smartsheet Inc., 2020
	Niven, 2006		
	Corporate Sustainability Structure	Case Study	Interview (Brazilian and Canadian Construction Organizations)
		Literature Review	Ahuja, 1976
			Buchtik, 2013
Burton, DeSanctis, & Obel, 2006			
Drucker, 1974			
Grünig & Kühn, 2015			
Nicholas, 1994			
Project Management Institute, Inc., 2017			
Corporate Sustainability Policies and Procedures	Case Study	Interview (Brazilian and Canadian Construction Organizations)	
	Literature Review	Canadian Standards Association (CSA), 1996	
		Epstein, 2008	

			International Organization for Standardization, 2010
			OECD, 2010
			Pluchinotta, Kazakçi, Giordano, & Tsoukiàs, 2019
			Yülek, 2018
SMP - Sustainability Management Processes	Sustainability Task Management	Literature Review	AA1000 Assurance Standard (Epstein, 2008)
			Ahuja, 1976
			CAN/CSA-ISO 14001:16 (CSA Group, 2016)
			Drucker, 1974
			Georgakopoulos & Tsalgaidou, 1998
			Nicholas, 1994
			Project Management Institute, Inc., 2017
			Weske, 2007

This research utilized the Method Evaluation Model (MEM) for identifying the methodological pragmatism of the SDMBOK (Actual efficacy/Performance)—using the systematic literature review and meta-analysis process to develop and validate the taxonomy presented by the SDMBOK—demonstrates the efficiency and effectiveness of the results.

The analysis of the efficiency and effectiveness, proposed by Moody (2003), of the SDMBOK, demonstrated a considerable improvement in the current literature review, introducing a taxonomy of sustainable development management body of knowledge and a package of templates assisting in implementing the taxonomy in the strategic level of the organization. Figure 4-31 illustrates this analysis and comparison.

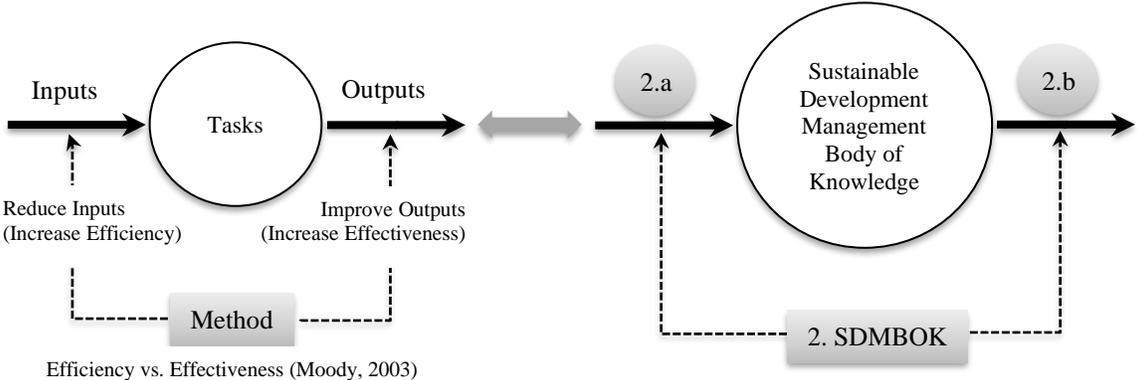


Figure 4-31. The methodological pragmatism analysis of the SDMBOK illustrating the actual efficacy/performance of the second objective of this research and its contribution

- 2.a. (Reduce Inputs - Increase Efficiency) – The taxonomy of sustainable development management body of knowledge consolidates knowledge areas such as organizational structure analysis, corporate activities impact analysis, business process management, policies analysis, reporting management, the project management body of knowledge, WBS, WFMS, focusing on sustainable management and addressing both strategic and tactical level. Therefore, the introduced SDMBOK makes it easier and faster to organize the tasks sustainable development management, facilitating the analysis and implementation of the activities.
- 2.b. (Increase Effectiveness – Improve Outputs) – The Sustainable Development Management Body of Knowledge (SDMBOK) addresses strategic and tactical levels. It introduces templates for implementing the strategy into the organization's activities at the strategic level. Consequently, SDMBOK is an effective tool to assist in designing an organization's sustainable development strategy.

Therefore, the SDMBOK, as presented in Appendix B – The Sustainable Development Management Body of Knowledge (SDMBOK), is the second main contribution of this research, introducing a framework with a taxonomy of the knowledge base for sustainable development management; the framework introduces tools and techniques, and templates to facilitate the implementation of the SDM into the organization’s strategic and tactical management level.

Figure 4-32 illustrates the second contribution of this research.

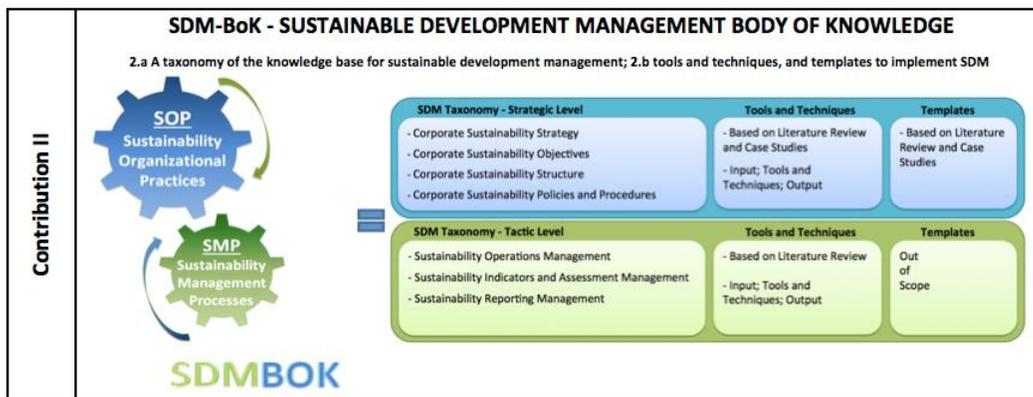


Figure 4-32. SDMBOK contribution diagram and the two main contributions of the framework as of objectives 2.a and 2.b

4.7. Conclusion

This research collected an extensive body of information about SDM in the construction industry through both literature-based activities and case studies of current practices.

In summary, the contribution of this research is a framework for implementing SDM in the building construction industry. The framework assists the building construction companies to implement their SDM practices, considering the main knowledge areas of strategic management and project and construction management identified by this research. The complete table of the data analysis of practices based on literature review and case studies can be found in appendix D.2.

The Sustainable Development Management Body of Knowledge (SDMBOK) assists the organizations in identifying and implementing the sustainable development targets relating to both the strategic and tactical levels. It is intended to support organizations to elaborate their values, objectives, structure, policies and procedures, creating a tangible model for implementing SD into the organizations' activities.

Figure 4-33 illustrates the SDMBOK workflow and the main layers and subsets of each module.

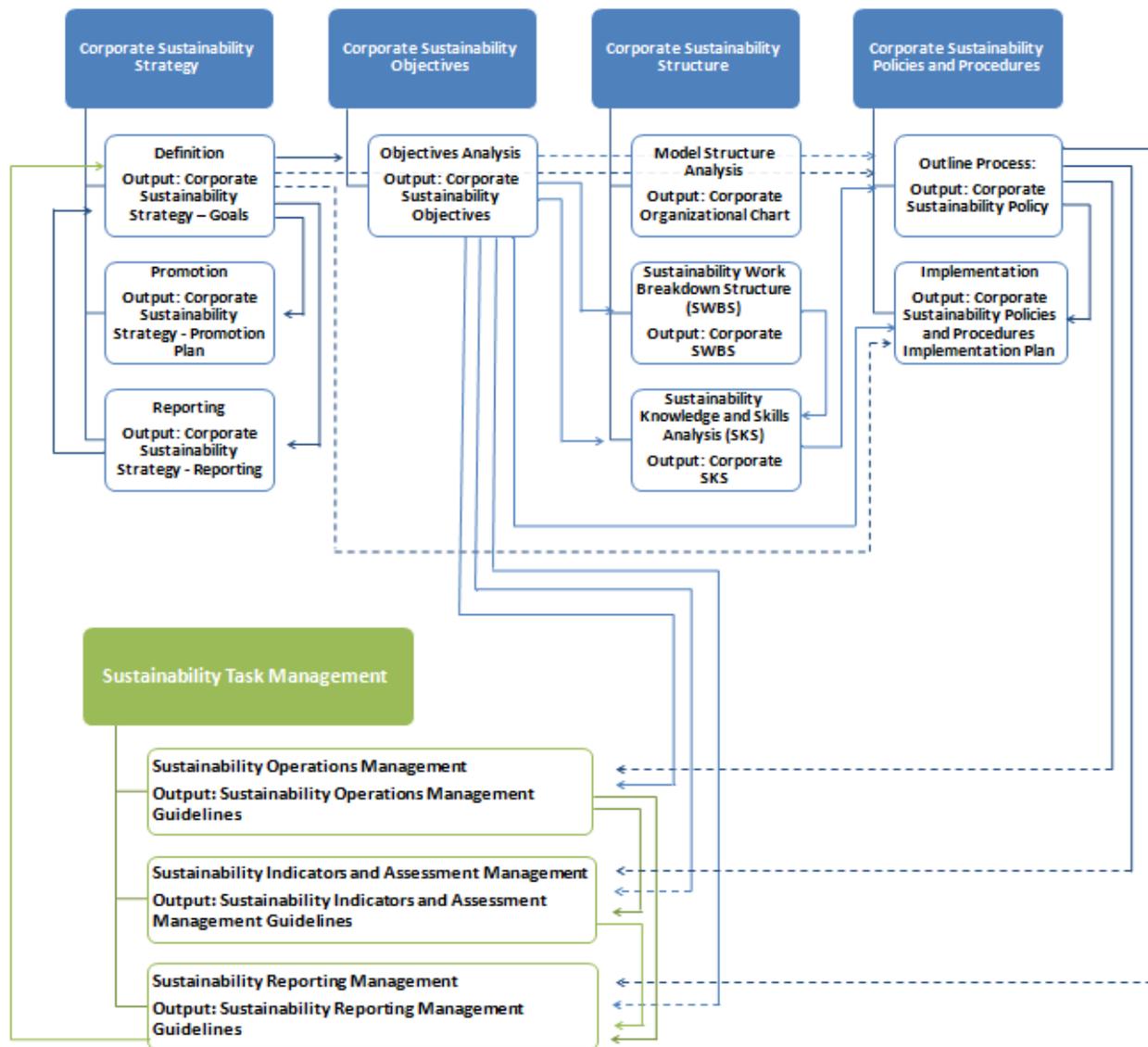


Figure 4-33. A graphic representation of SDMBOK workflow and the main layers and subsets of each module identifying the way they are correlated

This research identified the lack of a consistent framework and understanding of identifying and implementing sustainable development practices in the construction industry. The difficulty of consolidating the primary information of sustainability management is due to the abundance of information—a difficulty that created the most challenging activity of this research.

To compile the diverse information in different knowledge areas, connecting those different sets and creating a workflow that assists the organization to analyze, structure and implement its sustainability targets, values, and procedures was very demanding. The primary objective of this research was to organize

and consolidate the essential knowledge areas of implementing sustainability management into the organization's activities:

- Sustainability Organizational Practices (SOP)—a conceptual model at the strategic level that assists an organization in investigating the requirements of the stakeholders and developing a specification of the future system, the conceptual schema for the design process of the system modelling.
- Sustainability Management Processes (SMP)—a conceptual model at the tactical level that assists an organization in specifying the requirements to implement a working system, identifying the tasks and the methodology to implement, manage, control, and report the sustainability activities of the organization.

The analysis and consolidation of this research considered three main knowledge areas of management:

- *Business model management* such as organizational structure, stakeholders management, team management, policies management, and reporting management;
- *Project and construction management* such as PMBOK, project and construction management models, integrated project, construction codes and standards;
- *Sustainability management* such as sustainability management in the construction industry, SDM, certification and standards.

In conclusion, the framework addresses both the organizational structure and processes management, assisting an organization to implement SDM practices into its activities. The framework introduces the main knowledge areas at both strategic and tactical levels, as well as a set of templates to help an organization to implement the sustainability organizational practices (SOP).

This research intends to fill the gap of a consistent framework that helps an organization to identify the sustainable development impact of its activities and assists in implementing and reporting its sustainability practices and contributions.

Chapter 5: Research Validation

As a qualitative research approach, this study established a research process and validation to achieve the objectivity required of any Design Science Research (DSR): validity and reliability (Quintero, 2018).

Due to the difficulty in implementing the proposed solutions in a corporate organization—requiring long term embedment in the organization, access to numerous and confidential strategic documents, and willingness of an organization to share its practices—this research used the Document Analysis Method following by the Method Evaluation Model (MEM) for validation, as described earlier in chapter 2.

5.1. Document Analysis Valid—Research Methods and Findings

The valid research methods and findings step of this study consisted of an investigation based on multiple data sources, consolidating diverse source of information existing in the current literature, focusing on the three perspectives of sustainability—environmental, economic and social and addressing the lack of a unifying understanding of the scope of SD in the construction industry, thereby impacting the implementation of SD into organizations.

The document analysis method for reviewing and assessing the current literature review was used by this research as expository and analytical techniques. The document analysis provided background and context, additional information to be observed, supplementary data, tracking changes and developments, and support to other data sources.

The data collection and data analysis of this research utilized the systematic literature method and meta-analysis methods, respectively.

Table 5.1. is a sampling of documents and data analyzed for the two parts of this research, explained in more detail in the previous topics.

Table 5.1. Sampling of documents and data analysed in this research

Part I—The 100 SDI		Part II—SDMBOK	
Selected Documents	Analyzed Data	Selected Documents	Analyzed Data
BREEAM	It was analyzed for more than 80 sustainability targets: 2% economic targets, 66% environmental targets, 16% social targets, and 16% governance targets. This document focuses on the environmental perspective.	Organizational Structure Analysis	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at the strategic layer.
Envision	It was analyzed for more than 120 sustainability targets: 8% economic targets, 63% environmental targets, 15% social targets, and 14% governance targets. This document focuses on the environmental perspective.	Stakeholders Analysis Matrix	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at the strategic layer.
LEED	It was analyzed for more than 50 sustainability targets: 0% economic targets, 82% environmental targets, 7% social targets, and 11% governance targets. This document focuses on the environmental perspective.	Corporate Activities Impact Analysis	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at both the strategic and tactical layers.
OECD	It was analyzed for more than 80 sustainability targets: 18% economic targets, 29% environmental targets, 46% social targets, and 8% governance targets. This document focuses on the social perspective, following an environmental perspective.	Balanced Scorecard	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at the strategic layer.
ICC	It was analyzed for approximately 20 sustainability targets: 29% economic targets, 12% environmental targets, 24% social targets, and 35% governance targets. This document focuses on the governance perspective following economic and social aspects.	SWOT Analysis	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at the strategic layer.
WBCSD	It was analyzed for more than 30 sustainability targets: 23% economic targets, 33% environmental targets, 17% social targets, and 27% governance targets. This document focuses on the environmental perspective following governance and economic perspectives.	Business Process Management (BPM)	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at both the strategic and tactic layers.

Part I—The 100 SDI		Part II—SDMBOK	
Selected Documents	Analyzed Data	Selected Documents	Analyzed Data
GRI	It was analyzed for more than 100 sustainability targets: 4% economic targets, 46% environmental targets, 32% social targets, and 19% governance targets. This document focuses on the environmental perspective following the social perspective.	OECD— Policy Analysis and GRI— Reporting Analysis	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at both the strategic and tactical layers.
Living Building Challenge	It was analyzed for more than 40 sustainability targets: 13% economic targets, 55% environmental targets, 16% social targets, and 16% governance targets. This document focuses on the environmental perspective.	ISOs and Canadian Standard Association (CSA)	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at both the strategic and tactical layers.
Green Globes	It was analyzed for around 70 sustainability targets: 7% economic targets, 61% environmental targets, 5% social targets, and 26% governance targets. This document focuses on the environmental perspective.	PMBOK	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at both the strategic and tactical layers.
SPeAR	It was analyzed for around 19 sustainability targets: 11% economic targets, 47% environmental targets, 24% social targets, and 18% governance targets. This document focuses on the environmental perspective following the social perspective.	Work Breakdown Structure (WBS)	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at the strategic layer.
ISO	It was analyzed for around 20 sustainability targets: 0% economic targets, 71% environmental targets, 29% social targets, and 0% governance targets. This document focuses on the environmental perspective.	Workflow Management System	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at both the strategic and tactical layers.
FSDS-Canada	It was analyzed for more than 10 sustainability targets: 0% economic targets, 100% environmental targets, 0% social targets, and 0% governance targets. This document focuses on the environmental perspective.	Sustainability Management	The literature analyzed in this topic assisted in building up the taxonomy of SDMBOK at both the strategic and tactical layers.
-	-	Interviews	The interviews assisted in building up the taxonomy of SDMBOK at the strategic layer.

Part I—The 100 SDI		Part II—SDMBOK	
Selected Documents	Analyzed Data	Selected Documents	Analyzed Data
Summary	It was analyzed for more than 1000 indicators and assessment methodology to identify the sustainability targets for building construction. It reviewed 56 literature material—12 official websites, 21 technical and managerial books, two conference papers, 21 journal papers—for identifying the connection of the targets to the SDGs. The documents were selected considering the relationship with the UN-SDGs (or suggested by the UN as an organization addressing the SDGs, or identified by the organization as contributing to the SDGs).	Summary	It was analyzed different models and aspects of management to build up a framework that addresses both the organizational structure (strategic layer) and processes management (tactical layer). It was considered a business model perspective and management process familiar to the construction industry, such as PMBOK.

The appendices B.14—The 100 SDI and D.2—SDMBOK introduces the whole data and references utilized by this research.

Although the documents analyzed were valuable sources of information, this research analyzed the materials critically and cautiously. The data was analyzed and introduced with the meaning and its contribution to the investigated issues (Bowen, 2009).

The meta-analysis used by this study allowed assessing the completeness of the materials and consolidating the information according to sustainable development—economic, environmental, and social perspectives—and management process in the two layers of management—strategic and tactical.

This research focused on a qualitative analysis, and used the idea of meta-analysis to consolidate the various analysed documents, consolidating information from several particular knowledge areas from diverse literature, however without statistical analysis, bringing the study to a narrative research review.

5.2. Findings

This research contributes to the field with the 100 SDI—a consolidated list with 99 sustainability targets for the building construction industry and their contribution to the UN-SDGs—and the SDMBOK—a manual with the taxonomy of the framework to implement sustainable development into the organization and templates for assisting the implementation of the first layer of the framework, the SOP.

Table 5.2 illustrates the summary report of the research methodology process and results.

Table 5.2. Summary report of this research

Contri- bution	Introduction	Method (Narrative Research Review - Meta-Analysis)				Results
		Literature Search Procedures	Study Inclusion and Exclusion Criteria	Study Characteristics and Effect Sizes	Data-Analytic Strategy	
The 100 SDI—The 100 Sustainable Develop- ment Indices for the Building Construction Industry	The 100 SDI is a consolidated list of sustainable development targets for the construction industry, also introducing the connection of the targets to the SDGs, assisting the building construction industry to identify the impact and contribution of the field to the sustainable development. The meta-analysis process identified the documents related to sustainable targets addressing the three aspects of sustainability—economic, social, environmental—focusing on the building construction industry. This research used the	Document Analysis-Systemic Literature Review: this part of the research searched for organizations that address some of the sustainability perspectives-economic, social, environmental-through targets and indicators. It was also considered organizations suggested by the United Nations or that presented a rationale for the contribution to SDGs.	This research focused on the literature that addresses sustainability issues in the building construction industry and business perspective. It also identified documents with international acceptance and familiar to the construction industry in North America.	This research used the Excel program to assist in organizing and consolidating the data. The research—see the table in appendix meta-analysis—The 100 SDI—collected the sustainability targets and sustainability indicators as well as the assessment methodology of each analyzed document. The data was separated into four categories-economic, social, environmental, and governance-and 15 subcategories-air emission, biodiversity, business growth, economic growth, energy, environment, human rights, innovation, local impact, management, resource consumption, social development, soil, waste, and water. Once organized, it was analyzed according to each	The objective/strategy of this part of this research was to consider all the indicators from the chosen literature so that it could be evaluated and compared to other literature. The indicators analysis was essential to identify the similarity of the targets, once the latter was used with different expressions. To make sure that the consolidation considered all the targets and categorized accordingly, the individual indicators and assessment methodologies were essential in the analysis phase. It was much	A consolidated list of sustainable development targets addressing the three aspects of sustainability—economic, social, environmental—focusing on the building construction industry to assist the organization to identify their contribution to sustainable development.

Contribution	Introduction	Method (Narrative Research Review - Meta-Analysis)				Results
		Literature Search Procedures	Study Inclusion and Exclusion Criteria	Study Characteristics and Effect Sizes	Data-Analytic Strategy	
	mapping process, utilizing the literature review to determine the relationship between the targets and the SDGs. More details can be found in earlier topics of this thesis.			indicator to identify the overlapping or repetition of targets. The research identified a common description of targets to organize the more than 1000 indicators and reduced the list to 99 targets. Once the reduced and consolidated list was identified, technical documents relating to each of the targets were researched to identify and explain the effect to the SDGs, using the concept of the mapping process.	more time-consuming but necessary for the reliability of the list.	
SDMBOK— Sustainable Development Management Body of Knowledge for the Construction Industry	The SDMBOK framework addresses both the organizational structure and processes management, assisting an organization to implement SDM practices into its activities. The framework introduces the main knowledge areas at both strategic	Document Analysis-Systemic Literature Review: This part of the research searched for management knowledge areas addressing both the organizational level (strategic layer) and process management	This research focused on the literature that addresses the organizational level considering a business perspective (strategic management knowledge), and also the	This part of the study also organized and consolidated the data-see appendix Meta-Analysis – SDMBOK. The research collected the current practices for each knowledge area addressed by this study. The data was separated into seven management knowledge area-at the strategic layer: corporate sustainability strategy,	The objective/strategy of this part of the research was to consider the main knowledge areas at the strategic level and tactical level. This research analyzed the steps necessary to implement the SDI connecting all the steps until the operational	A sustainable development management body of knowledge framework addressing both the strategic and tactical levels. Templates for assisting the

Contribution	Introduction	Method (Narrative Research Review - Meta-Analysis)				Results
		Literature Search Procedures	Study Inclusion and Exclusion Criteria	Study Characteristics and Effect Sizes	Data-Analytic Strategy	
	and tactical levels, also a set of templates to help an organization to implement the sustainability organizational practices (SOP). The meta-analysis process identified the knowledge areas of sustainable development management and consolidated them. The analysis considered the current literature of the management process, focusing on the construction industry, and case studies for the first layer of the framework—SOP.	(tactical level). Case Studies- Interview: to identify current practices at the organizational level (strategic layer), this research executed interviews with managers and CEOs of construction companies.	management process focusing on the project and construction management knowledge. This research also examined literature addressing sustainability management to define the taxonomy of the framework. For the case studies, the questions for the interview considered the taxonomy identified by the meta-analysis to question the managers and CEO of the construction companies participating in this research.	corporate sustainability objectives, corporate sustainability structure, corporate sustainability policies; and at the tactical level: sustainability operations management, sustainability indicators and assessment management, and sustainability reporting management. Once the practices identified in each of those knowledge areas were identified and organized, they were elaborated in a manual document to structure the taxonomy-SDMBOK-and developed templates to assist the implementation in the strategic layer-SOP. The case studies considered only the strategic level, interviewing professionals at the making decision process such as project managers, sustainability coordinators, CEO.	activity. The objective is not to present technical knowledge but to present the process to identify and manage them. The framework can use the SDI list but is flexible enough to consider the corporate particularities and preferences. Therefore, the strategy was to analyze the business model and management process from an organizational perspective (generalized knowledge), not as a specialized knowledge area, facilitating the implementation of the sustainability knowledge area.	organizations to implement the strategic level into their daily activities, providing objectivity and understanding for managing their sustainable impact.

5.3. Validation Process—Method Evaluation Model (MEM)

The two parts of the validation process of this research is presented as follows:

1. The methodological pragmatism of the findings (Actual efficacy/Performance)—using the systematic literature review and meta-analysis process to develop and validate the two artifacts introduced by this research—the 100 SDI and SDMBOK. The data analysis executed by this research (see appendices B.14—The 100 SDI and D.2—SDMBOK) comparing with the final documents—the 100 SDI and SDMBOK—demonstrates the efficiency and effectiveness of the results.

Figure 5-1 illustrates the pragmatic analysis of the findings.

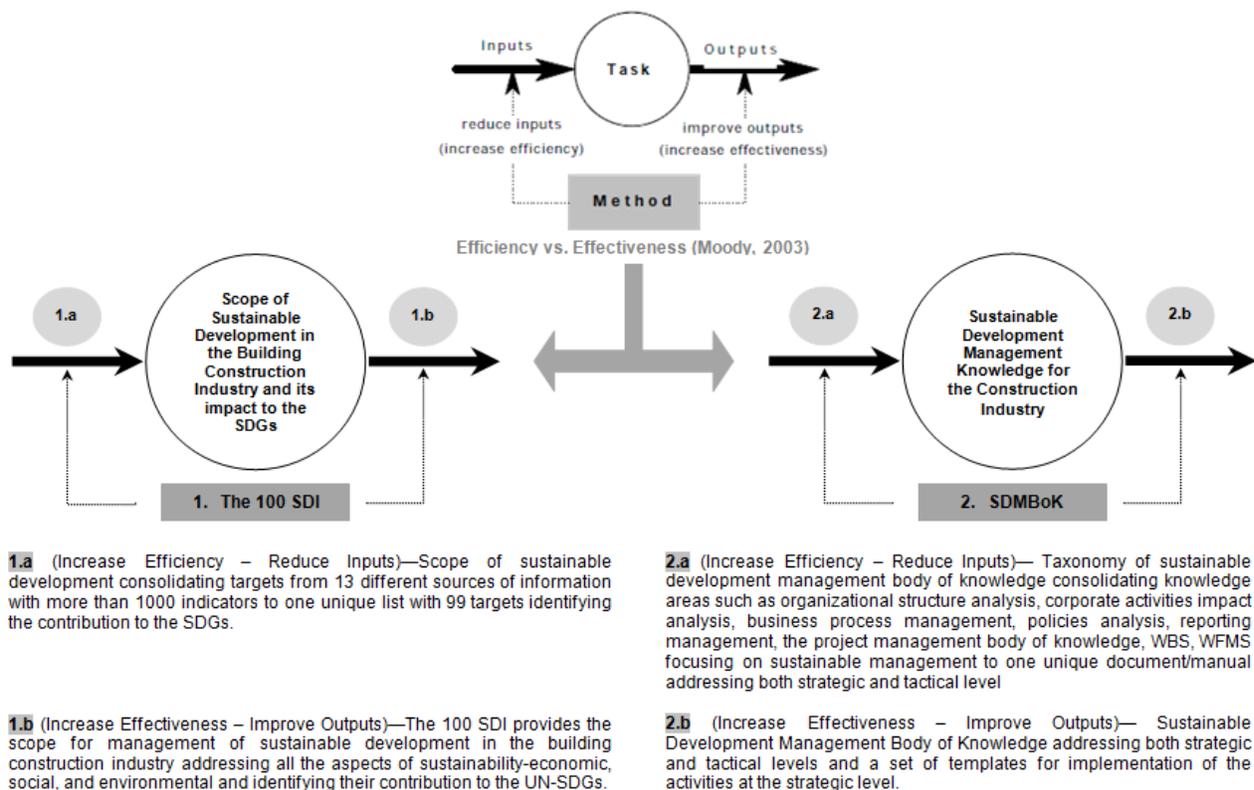


Figure 5-1. A graphic representation of the methodological pragmatism validation, illustrating the efficiency and effectiveness of this research results

2. The technology acceptance of the findings (perceived efficacy/adoption/practice)—as suggested by the MEM, the method of validation in this part is based on perceptions of the ease of use and

usefulness of the artifacts (Moody, 2003), presented by this research through specialist validation of the 100 SDI and SDMBOK.

An essential characteristic of this method of validation, according to Moody (2003), is that human perception—the subjective reality—is more important than objective reality. Although the actual efficacy (objective reality) partly influences the perceptions of ease of use and usefulness, factors such as prior knowledge and experience with particular methods also will affect the perceptions of effectiveness (subjective reality).

The final documents were introduced to specialists, with additional explanations of their objectives, to acquire the acceptance of the artifacts introduced by this research. The specialists were also asked to report their perceptions of the 100 SDI and SDMBOK.

Seventeen questions were made to the specialist to validate the artifacts. The questions are divided into four categories based on the variables identified in previous studies and mentioned by Moody (2003). Words were changed to adapt to this study. Below are the questions answered by the specialists participating in this research:

- Perception of the Documentation Efficiency

- Q.1 - Do you perceive value in the 100SDI/SDMBOK to the construction industry?

- Q.2 - Do you believe the 100SDI/SDMBOK is consistent and address the main issues of sustainability management in the construction industry?

- Perceived Ease of Use

- Q.3 - Did you find the procedure of the 100SDI/SDMBOK easy to follow?

- Q.4 - Did you find it would be easy to apply the 100SDI/SDMBOK in an organization?

- Q.5 - Did you find the 100SDI/SDMBOK easy to learn/understand?

- Q.6 - Did you find the information/instructions of the 100SDI/SDMBOK clear and easy to understand?

- Q.7 - Overall, did you find the 100SDI/SDMBOK easy to use?

- Perceived Usefulness

- Q.8 - Do you believe that the 100SDI/SDMBOK would reduce the effort required to understand and implement sustainable development management in the construction industry?

Q.9 - Do you believe that using the 100SDI/SDMBOK would make it easier for users to implement sustainable development in the construction industry?

Q.10 - Do you believe the 100SDI/SDMBOK would make it easier for the construction industry to identify and manage sustainable development activities?

Q.11 - Do you believe that using the 100SDI/SDMBOK would make it easier to maintain sustainable development practices in the construction industry?

Q.12 - Overall, do you believe that the 100SDI/SDMBOK provides an effective solution to sustainable development management in the construction industry?

Q.13 - Overall, do you believe the 100SDI/SDMBOK is an improvement to the sustainable development management practices in the construction industry?

Q.14 - Do you believe that using the 100SDI/SDMBOK would make it easier to communicate the sustainability performance of an organization?

Q.15 - Overall, did you find the 100SDI/SDMBOK to be useful?

- Intention to Use

Q.16 - Would you use the 100SDI/SDMBOK to manage sustainable development in a construction organization?

Q.17 - Would you intend to use the 100SDI/SDMBOK in preference to the standards the current sustainability management literature offers?

Q.(Extra) - If necessary, please add a comment or your overall analysis of the 100SDI/SDMBOK.

The percentage in the validation was considered the positive answer for each question in each category. Table 5.3. introduces the profile of the specialists and the percentage of acceptance of the 100 SDI and SDMBOK. Individual reports can be found in appendices B.16—100 SDI and D.3—SDMBOK.

Table 5.3. Specialists report summary validation

Finding	Specialist (Bio/Field)	Perception of the Documentation Efficiency	Perceived Ease of Use	Perceived Usefulness	Intention to Use	Overall Acceptance
The 100 SDI	1 - A 40 years veteran	100%	100%	88%	100%	97%

Finding	Specialist (Bio/Field)	Perception of the Documentation Efficiency	Perceived Ease of Use	Perceived Usefulness	Intention to Use	Overall Acceptance
	property investor and development business. See bio in appendix B.16					
	2 - A 19 years sustainability and environmental consulting. See bio in appendix B.16	100%	100%	75%	50%	81%
	3 - A leader in sustainability education See bio in appendix B.16*	100%	100%	100%	100%	100%
	4 - A Principal at an architect organization. See bio in appendix B.16	100%	100%	94%	75%	92%
The SDI Acceptance Summary	-	100%	100%	89%	81%	93%
SDMBOK	1 - A president of sustainability consulting See bio in appendix D.3	75%	80%	100%	75%	83%
	2 - A CFO and Financial Consultant.	100%	100%	100%	100%	100%

Finding	Specialist (Bio/Field)	Perception of the Documentation Efficiency	Perceived Ease of Use	Perceived Usefulness	Intention to Use	Overall Acceptance
	See bio in appendix D.3					
	3 – A professional of quality Management. See bio in appendix D.3	100%	100%	100%	0%	75%
	4 – An assistant professor in Engineering Management. See bio in appendix D.3	100%	90%	94%	100%	96%
	5 – An associate professor in Engineering Management See bio in appendix D.3	100%	80%	75%	100%	89%
	A professor in Engineering Management See bio in appendix D.3	100%	100%	100%	75%	94%
The SDMBOK Acceptance Summary	-	96%	92%	95%	75%	90%

5.4. Validation Results Discussion

The questionnaire to identify the acceptance of the deliverable documents has 17 questions plus additional comments: two questions to identify the perception of the documentation efficiency, five questions to identify perceived ease of use, eight questions to identify the perceived usefulness, two questions to identify the intention to use and one open question for additional comments.

The questions did not ask for numerical scores from the reviewers. However, in order to aggregate the overall responses, the reviewer’s responses were converted into a numerical “acceptance percentage” score based on the criteria in Table 5.4. The total acceptance percentage of the documents considered the average percentage of all the questions and all the validations. Although this method of quantifying the qualitative responses is subjective and imprecise, it is believed to be adequate for the task of providing a very high-level summary of the level of agreement reported by the reviewers, particularly for comparing the relative level of acceptance among the elements.

Table 5.4. Criteria to calculate the percentage of the validation process

Considered Percentage	Criterion
100%	Agreed with the question without any concern or opposite comments
50%	Agreed with the question with additional comments or concern
0%	Disagree completely with the question or did not feel able to answer it

Considering that we invited professionals with different positions and expertise (CFO, consultant, project manager, sustainability expert, academic professionals) in the construction industry field, the average acceptance of both documents—the 100 SDI (93%) and the SDMBOK (90%)—was 92%, which it was high. This demonstrated the broadness of acceptance and clarity of the documents. The documents did not receive any responses that fully disagreed with any evaluated criteria.

As this research did not have a large number of evaluations from the same expertise, a broad acceptance is acceptable, considering the purpose of the study to address a comprehensive management process of sustainability; however, it can be considered statistically limited in specialization analysis.

Below are the key words or expressions collected from the validation reports, which can be read in complete in appendices B.16 (The 100 SDI individual reports) and D.3 (The SDMBOK individual reports).

1. The 100 SDI validation key comments

- “I perceive value in the 100 SDI to members of the construction industry that value sustainability”
- “I cannot think of anything to add”
- “The organizations can filter the items that are most important or applicable to them”
- “Lots of searchable information in one place”

- “Assist in implementing SD because it outlines actions that users can implement to contribute towards the SDGs”
- “Overall I believe that the 100 SDI is more of an education, research, and planning tool”
- “It clearly shows organizations how their actions can contribute to the SDGs”
- “The 100 SDI would be useful to organizations wanting to implement or improve their sustainability management practices”
- “In my roles I do not think I would personally use the 100 SDI, but I can see that it could be helpful to our Sustainability Practice Leader and/or our Corporate Sustainability Director”
- “The 100 SDI is a comprehensive document that I hope the construction industry will be interested in using”
- “My background relates is in interpreting sustainability within engineering practice in general. As such, I am impressed with the breadth of sustainability issues captured by the 100 SDI”
- “The 100 SDI is a useful example of how to interpret and apply sustainability indicators within an industrial sector”
- “To date, the construction industry has not been able to improve its impact on climate change, bio-diversity loss, and other sustainability issues. Therefore the creation of the 100 SDI is a much needed intervention aimed at prompting needed change. It successfully links to the SDGs”
- “It is a fascinating notion. Setting a framework that organizations can easily step into, that aligns with global efforts, seems completely sensible. I do think that the pursuit of these goals is value-laden – they require commitment and, in many cases, a sense of moral obligation. Balancing this with the profit imperative capitalism provokes is the challenge.”
- “I think the themes capture the breadth of the issues in a general sense, however, to suit local conditions detailed tactics and responses must be formulated (based on the SDI)”

- “The 100 SDI makes themes more clear and easier to place in context. Given the order given to the material, I would expect it to be easy to align the values and initiatives of an organization to the 100 SDI.”
- “The clear organization of the 100 SDI positions real issues in universal ways. Commonality across industries and nations is a benefit, and following it as a framework will bring focus more quickly, will reinforce the themes in a consistent way, and will save the effort of ‘reinventing the wheel’.”
- “I’m not certain it (the 100 SDI) is a solution, but it certainly can act as an important framework to shape effort and seek broad alignment of goals. In the end the issues we face are value-laden, and motivations vary.”
- “the 100 SDI can be a part of improved management practices”
- “This is an important potential outcome. The framework gives a common language, sets the issues with a global perspective, and in a way makes a common purpose. The issues are complex, and reducing complexity through a clear roadmap is a benefit.”
- “the organization would need to prioritize the themes that resonate with the issues that they face, and those they can influence. A key use would be to align the values of the organization with the themes to create a tailored response that is focused and impactful.”
- “I am not an expert on sustainability management, but I know that seeking internationally aligned frameworks instinctively is more efficient, and more likely to have widespread benefit.”
- “Overall it (the SDI) aims to bundle the goals into action areas”
- “In general, one impediment organizations have implementing the goals is determining which items are directly material to their business processes. As this framework illustrates, because the UNSDG’s reflect governmental priorities, and are organized that way, bundling from a business perspective may make the SDG’s more relevant for businesses.”
- “Its first utility is to aid construction firms in understanding what the UNSDGs are and what they call for. This is an academic understanding of common principals the other

participants in the supply chain reference and seek to advance. To implement sustainable development approaches requires a partnership be the architect, contractor, developer and if they are already identified, the end user. This answers the challenge of ‘what it is we are trying to achieve’, not the ‘how do we actually accomplish that?’ ”

- “Yes, each firm will need to 1) identify goals that speak to them, 2) determine what outcomes they want to achieve, 3) plans, 4) metrics and targets to measure success. 1 and 2 are the identify, 3 and 4 are the manage part.”
- “It might also provide a contractor with the framework for laying out the targets they are trying to achieve and form a foundational reference for the other stakeholders to articulate how they measure success.”
- “It’s (the SDI) a tool to build a roadmap. It isn’t a solution on a standalone basis, nor can it be, since this is a journey each firm and each project team need to come together around.”
- “I am not aware of any other tool to explain/translate the UN framework to the business outcomes people in the construction industry care about, so yes (I believe the 100 SDI is an improvement to the sustainable development management practices in the construction industry)”.
- “I enjoyed reviewing the mapping, and the layered approach, E, then G, then S, and how the individual SDG’s support execution.”
- “It would be useful for guiding the overall plan, articulating priorities and desired outcomes. These positives are important, but construction itself is heavy on logistics, personnel management, scheduling, budgeting – managing construction projects and organizations requires a lot of technical skills beyond knowledge of sustainability.”
- “Nice work, a great deal of thought and research went into development of this resource”.

2. The SDMBOK validation key comments

- “The value lies with higher levels of construction management (or any management for that matter) such as universities or large construction groups with specialist knowledge and skills to understand and implement the SDMBOK”

- “I think the smaller, less sophisticated forms might shy away, having other priorities.”
- “I find it hard to imagine that most contractors, subcontractors, consultants and trades and professionals (often smaller entities) would or could apply this – unless forced to do so.”
- “The SDMBOK is higher level than typically sustainability issues such as energy efficiency, low carbon emissions and does not get into the specifics. I wonder if construction is omitted in the scope, would this be a better description of the SDMBOK?”
- “Once I got through a few sections I could see a pattern that was followed, then I found it easier to understand. I have the sense of layers of detail and I can imagine an html version going from ToC to the full detail in 3-5 layers being helpful”
- “... it something to have as a reference, almost a recipe guide”
- “It is logically laid-out and has a structure that is consistent and can be learned and applied in an organization. When thinking of Envision or other frameworks, I would say the SDMBOK is no more difficult to apply”
- “...a reasonable level of effort is required”
- “The language is clear and concise which is helpful”
- “SDMBOK reduces the effort in the sense of helping to understand what is needed in one place. I see the construction industry as having levels of sophistication. At the highest levels SDMBOK might be useful to reduce the level of effort, however for smaller and/or less sophisticated firms, I think they might be better served with some examples or case studies they can try to copy. I do not see how SDMBOK is particularly focused on the construction industry”
- “There are many ways to implement sustainable management practices. SDMBOK is one useful means”
- “SDMBOK would level the playing field if everyone followed it. It organizes information and approaches that would then make it easier to communicate”
- “In a large, sophisticated organization that wanted to demonstrate a systematic approach and communicate performance, the SDMBOK would be a tool I would consider as a consultant. It would be for a large-scale project”

- “Not sure (if I would use the SDMBOK). I follow a number of ISO standards. They lack the detail of SDMBOK, but they are familiar to me and perhaps to some parts of industry”
- “I see SDMBOK applying to a broader industry group than just construction management”
- “I work at a broader level where I see SDMBOK as being applicable”
- “SDMBOK framework detailed herein provides a efficient and effective methodology to assist any organization to implement it through a body of knowledge approaching both the strategic and tactical levels”
- “I have received in detail the current documentation in the Construction Extension to the PMBOK Guide and the Project Management Body of Knowledge – 6th Edition. I believe the SDMBOK is a significant improvement over existing BoK guides due to their efficient and effective methodology that assists an organization to implement this framework through a body of knowledge approaching both the strategic and tactical levels”
- “It (the SDMBOK) clearly articulate and links objectives to outcomes. In particular, I noted that Figure 11-SDMBOK Roadmap (Output-Input) provides clarity in detailing the connection of each feature of the framework and links the output of one subset to the input of another one. Excellent!”
- “Yes (I would use the SDMBOK). We are currently in the feasibility phase of a \$300 million data centre and greenhouse in Abbotsford, BC. We will be selecting the construction organization in the next year to complete this significant project. We have already discussed that one of the key criteria we will use to evaluate the bidders if the framework they have in place at both the strategic and tactical levels to achieve their sustainable development goals.”
- “I believe SDMBOK is a significant improvement in terms of efficiency and effectiveness as compared to the Construction Extension to the PMBOK Guide and the Project Management Body of Knowledge – 6th Edition’
- “In light of the serious issues arising from climate change and the critical need for the construction industry to contribute to the UN Sustainable Development Goals, we are facing an existential issue. I am of the view that SDMBOK is a very significant, positive and practical contribution to achieve sustainable development goals in Canada and worldwide”

- The implementation of the SDMBOK would be easy, “but also it will depend on whether the organization has a real and strong interest in sustainability.”
- “The manager needs to know how to use the tools and which ones are necessary for the target purpose, besides getting all the required information. Then, I did not find it easy to apply, but it is applicable and can get good results.”
- “It provides and describes the processes, it facilitates the understanding and implementing”
- “(SDMBOK) complement the literature”
- “I think it is necessary to describe the tools and techniques, for example, SBSC, we have a definition, but it is necessary to know how to apply it”

The SDI document had 93% overall acceptance among the validators. Its efficiency and efficacy were 100% accepted, and the perception of usefulness (89%) and the intention of use (81%) were also well accepted by the validators. The particularity of different areas could have affected the perception of usefulness and the intention of using it. As the initial objective of the 100 SDI is to create a consolidated list of the goals linking them to the SDGs and guide organizations to prioritize their sustainable goals according to their needs, the 100 SDI is demonstrated to achieve the main goal.

The SDMBOK document had 90% overall acceptance among the validators. Its efficiency and efficacy were 96% and 92% accepted respectively, and the perception of usefulness (95%) and the intention of use (75%) were also well accepted by the validators. The particularity of different areas could also have affected the perception of usefulness and the intention of using it. As the initial objective of the SDMBOK is to guide organizations to organize their sustainable goals according to their reality and assist organizations in implementing their goals in their daily activities, the SDMBOK is demonstrated to achieve the main goal.

Considering the main objectives of this research, The 100 SDI and the SDMBOK demonstrated to be an efficient and efficacious tools to assist the construction industry in identifying and implementing sustainable development practices into their business values and daily activities.

The validation process of considering the systemic literature review of proved previous models and research and the acceptance of different professionals, although presenting some limitations, as discussed previously, demonstrated valuable information based on a theoretical point of view and the practicality of the suggested models.

Further studies considering the implementation and analysis of a specific professional area would be beneficial for the use of Sustainable Development Management in the construction industry.

Chapter 6: Conclusion

The main objectives of this research were to identify the scope of SD in the building construction industry and to assist organizations to implement the SDM into their daily activities.

Although the two main objectives, the SD scope and the SDM taxonomy, are independent, they are connected. The former can assist the execution of the processes defined in the latter to analyze the sustainability targets that relate most closely to the building construction industry and identify which targets are aligned and addressed by the organization.

6.1. Summary of Contributions

The first main contribution of this research is the 100 SDI, as presented in the Appendix A. It introduces the scope of Sustainable Development Management with respect to the building construction industry; the complete table presents a set of 99 sustainable targets to assess the building construction industry's impact on sustainable development and introduces a mapping diagram for each of those targets illustrating and identifying the impact of them on achieving the United Nations Sustainable Development Goals (UN-SDGs).

The second main contribution is the SDMBOK, as presented in Appendix B—the Sustainable Development Management Body of Knowledge (SDMBOK). It introduces a framework with a taxonomy of the knowledge base for sustainable development management; the framework introduces tools and techniques, and templates to facilitate the implementation of the SDM into the organization's strategic and tactical management level.

The contribution of this research is the consolidation of the sustainability targets from various certifications and standards that partially address sustainable development content, presenting a consolidated list addressing the three pillars of sustainability, which determines sustainable development. Moreover, as the second objective, this research suggests an artifact that serves to frame the implementation of sustainable development into a construction organization's strategic and tactical level.

Figure 6-1 illustrates the roadmap of sustainable development management implementation, illustrating the main phases of implementing the SDM and representing the two contributions of this study: the 100 SDI and the SDMBOK.

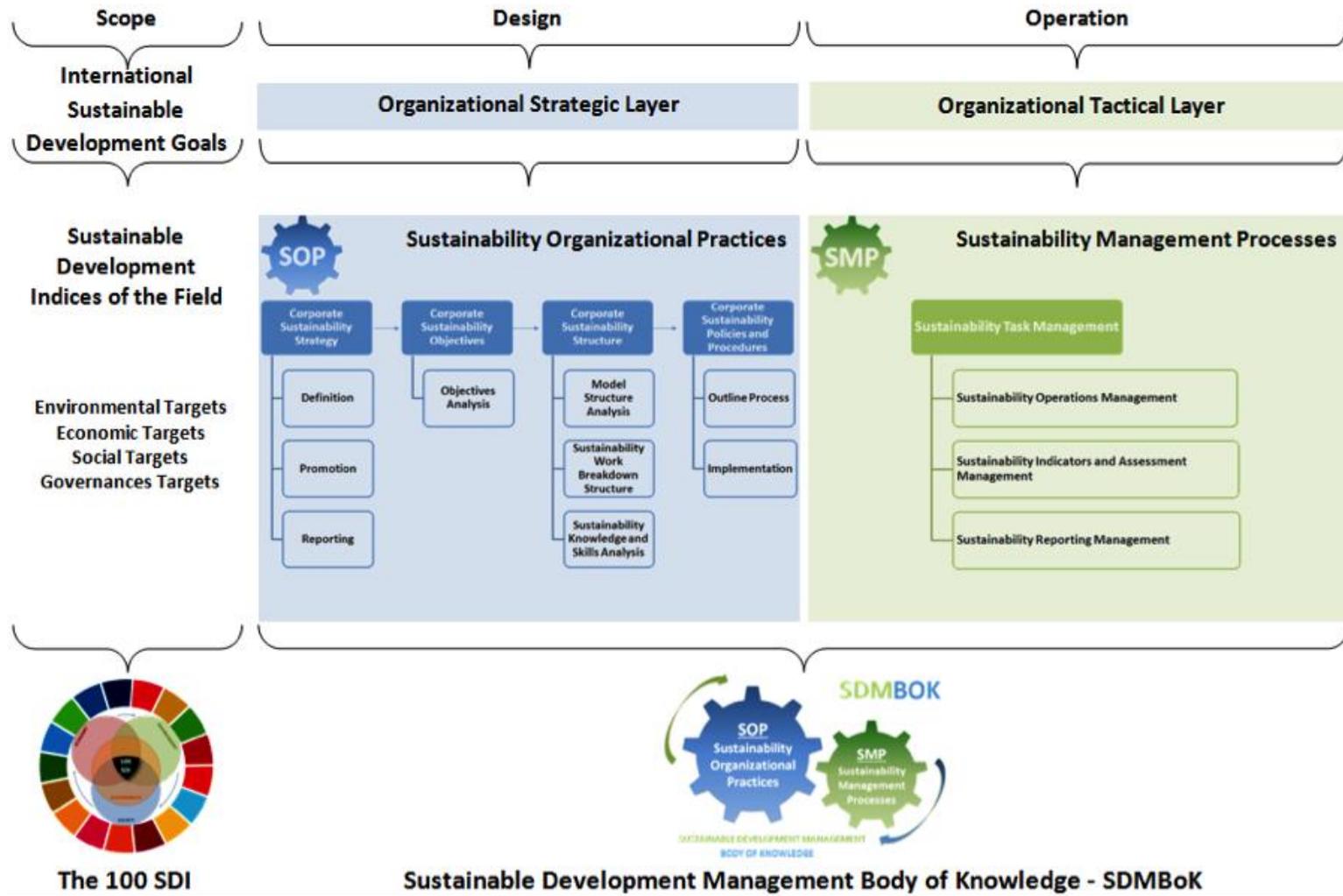


Figure 6-1. Roadmap of sustainable development management implementation, illustrating the main phases of implementing the SDM and the two main contributions of this study

6.2. Limitations of the work

Although we have abundant information regarding sustainability, and its term has favourable meanings as significant research funding and government and industry initiatives, many still consider it vague. The current literature review did not address the need to consolidate all the information to identify the broad approach of sustainable development, which requires addressing the three pillars of sustainability-social, economic, and environmental. Therefore, identifying the material utilized to define sustainable development's scope was the initial challenge of this research. Hence, this research decided to focus on the building construction industry's content and consider the international agreement on sustainable development goals, the UN-SDGs. The consolidated information of the 100 SDI, then, is limited to the building construction industry.

The sustainability scope is essential when the organization analyzes its sustainability strategy without being completely subjective or summarized into an individual's values. That is the independent part of the research, yet an essential tool for the second part of this research.

Equally challenging is identifying the primary body knowledge for implementing sustainable development management, the second main objective of this research. The topic has been exhaustively addressed in several areas, at different levels, for various fields. Even though most business organizations share a common management process, identifying the main knowledge areas to assist in implementing sustainable development goals was the initial challenge for this part of this study. With new types and volumes of management and administrative tasks required to pursue SD and the complex management processes, the combine essential knowledge areas for implementing specifically the SDM was a gap identified in the current literature. There is a lack of a clear framework for implementing SD at both the strategic and tactical levels. Therefore, this research focuses on the strategic level to help an organization identify and structure itself to implement sustainability goals into its daily activities. The level of detail required to implement each target makes unreasonable research considering that each organization has a unique structure and reality. Hence, the tactical level is being present in the essential knowledge areas without analyzing the current practices.

6.3. Potential Future Studies from this Research

The study introduced by this research would help future works determine specific tactical management processes considering each sustainability target identified in the strategic plan of an organization. The SDMBOK lies with higher levels of management processes used by those involved in an organization

planning and strategy. However, the framework introduces a consistent and well-defined flow of information to identify and be used at the tactical level. Several small studies can be directed by this research, focusing on aspects of sustainability.

Moreover, identifying the required governmental policies to either encourage or force sustainable development management practices is also a suggested further study. The researcher believes that to change the cultural management process needs to have an incentive from the government.

Therefore, a combination of sustainable development practices at the business level and an incentive from the government through policies is essential to make the culture of sustainable development more acceptable and practical.

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Appendix A: The 100 Sustainable Development Indices (SDI)

This appendix contains the complete list of the 100 SDI.

The 100 Sustainable Development Indices (The 100 SDI) for Building Construction Industry



@ Suzana C N L Espindola

Introduction

To address the objective of identifying the scope of sustainable development in the building construction industry and its impact on achieving the United Nations Sustainable Development Goals (UN-SDGs), detailed analysis and mapping diagrams are presented to identify the interrelationships between the 100 SDI and the UN-SDGs.

The 100 SDI is a master set of sustainability targets based on current standards and certifications. The 100 SDI introduces the sustainability targets for each area of sustainable development (social, economic and environment) and the SDG impacted by each target.

Purpose and Audience

The 100 SDI is a set of sustainability targets for the building construction industry, identifying their contribution to the SDGs. It helps an organization identify the focus of sustainable development in the building construction industry and information to elaborate a specific and clear plan to manage and report its contribution towards the SDGs. It helps the organization manage its sustainable development and report its contribution to the 2030 Agenda for Sustainable Development of the United Nations.

The 100 SDI can benefit the following stakeholders:

- Construction managers and project managers—assisting in identifying the sustainability targets to be managed in the site-building operations;
- Sustainability managers and coordinators—assisting in determining the sustainability targets to achieve in the building projects activities;
- Contractors—assisting in managing and reporting its sustainability impact, identifying the focus of sustainable development targets;
- Architects, designers, and engineers—assisting in identifying the main areas of sustainable development practices in the building construction in the design phase;
- Chief Executive Officers—according to IISD (2019), only 21% of chief executive officers believe business is playing a critical role in contributing to the SDGs, but 71% believe that business can play a crucial role in increasing commitment and action. The 100 SDI can assist the strategic part of the business in identifying the main topic areas to focus on in implementing sustainable development into the building construction industry;
- Construction consultants—according to the Association of Consulting Engineering Companies (2014), the consulting engineering industry has an essential role in developing more sustainable

solutions, working alongside the clients on setting challenging design objectives that focus on sustainable solutions. They state that there is the opportunity to participate in the sustainable development implementation and have an ethical responsibility to understand and communicate to clients the consequences of the projects that are being delivered. The 100 SDI can help the industry identify the main sustainable development targets for new solutions, assessment management, and report.

- Government—governments cannot be responsible alone for sustainable development. Still, they do have an essential role in delivering a sustainable future by providing informed decision-making mechanisms and developing and maintaining strategies and policies that will help sustainable practices implementation. The 100 SDI can help a government identify the sustainability impact of the building construction industry and manage the effect through policies and assessment of sustainability targets for this industry.

The 100 Sustainable Development Indices (The 100 SDI) for Building Construction Industry

The 100 SDI is divided into four categories and 15 subcategories, as illustrated in Figure X, introducing the sustainability target, its description and the impacted SDG with the mapping illustrating and explaining the relationship between the SDI and the SDG.

Category	Subcategory	100 SDI
Economic	Business growth	4
	Economy growth	5
Environmental	Air Emission	10
	Biodiversity	4
	Energy	5
	Local Impact	8
	Resource Consumption	5
	Soil	4
	Water	7
Governances	Environment	2
	Innovation	2
	Management	9
	Social Development	7
Social	Human Rights	10
	Social Development	17
Contribution to the 100 SDI		99

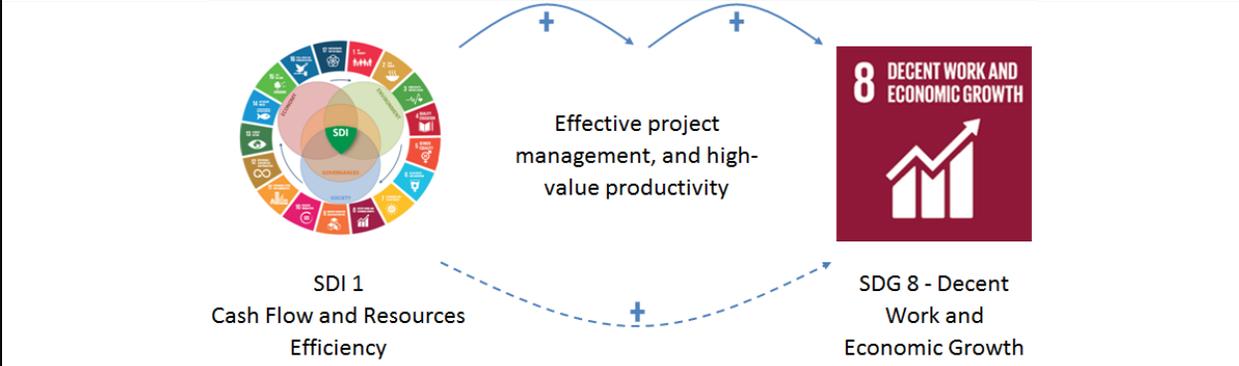
Figure 2 The 100 SDI categories and subcategories with the numbers of sustainability targets for each of the subcategory.

Table A-1 introduces the complete list of the 100 SDI.

Table A-1. The 100 SDI

SDI 1	Category:	Economic
	Subcategory:	Business growth
	Sustainability Target:	Cash Flow and Resources Efficiency
	Description:	Provide efficient cost management and cash flow during the project.

Impacted SDG: **SDG 8**



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, achieving higher economic productivity levels through diversification, technological upgrading and innovation, and focus on high-value added and labour-intensive sectors (United Nations, 2015). The need for external financing causes an increase in monetary costs and result in high project costs. The external financing need is a result of higher cash flow fluctuations. Cash flow includes a complete record of all cash expenditure, cash insufficiency, loans and borrowings, cost of money, and all the cash coming in the project due to project execution. Therefore, reliable project cash flow is essential for effective project management and high-value productivity (Mohagheghi, Mousav, & Vahdani, 2017). Hence, provide efficient cost management and cash flow during the project contributes to the economic growth of the industry and the sector, consequently contributing to the SDG 8

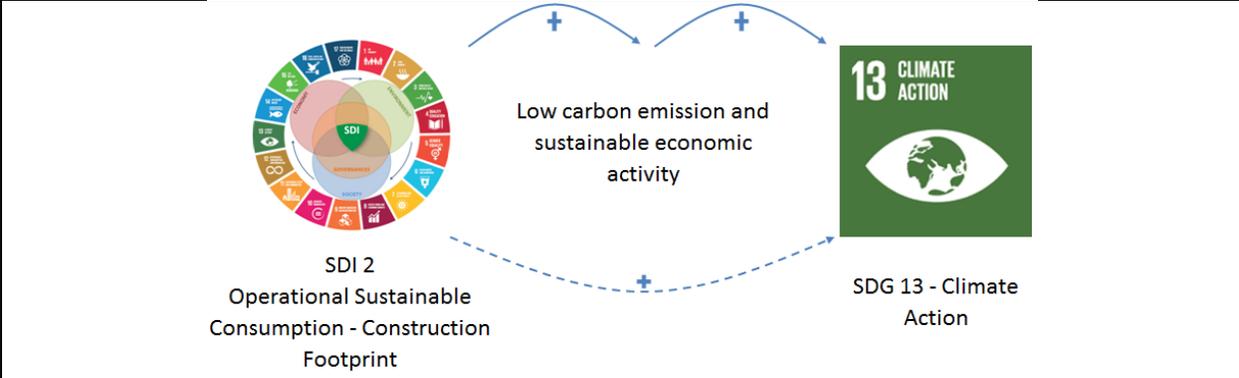
SDI 2	Category:	Economic
	Subcategory:	Business growth
	Sustainability Target:	Operational Sustainable Consumption - Construction Footprint
	Description:	Implement an operational sustainable consumption plan during construction, examining the carbon footprint of construction activities carefully and minimizing the energy consumption during the construction phase.

Impacted SDG: **SDG 12**



SDG 12 aims to ensure sustainable consumption and production patterns achieving the sustainable management and efficient use of natural resources and significantly reducing pollution release to air, water and soil to minimize their adverse impacts on human health and the environment (United Nations, 2015). BC government’s carbon tax provides a signal across the economy to reduce emissions while encouraging sustainable economic activity and investment in low-carbon innovation and support the transition to a lower-carbon future. On April 1, 2019, B.C.'s carbon tax rate rose and will increase each year per tonne in 2021. New revenues generated from increasing the carbon tax will provide carbon tax relief, protect affordability, maintain industry competitiveness and encourage new green initiatives. The government also offers several carbon tax programs for businesses and local governments. There are increasing opportunities for companies and organizations to participate in the low carbon economy (British Columbia Government, 2019). Therefore, implement an operational sustainable consumption plan during construction has benefits and directly contributes to SDG 12.

Impacted SDG: SDG 13

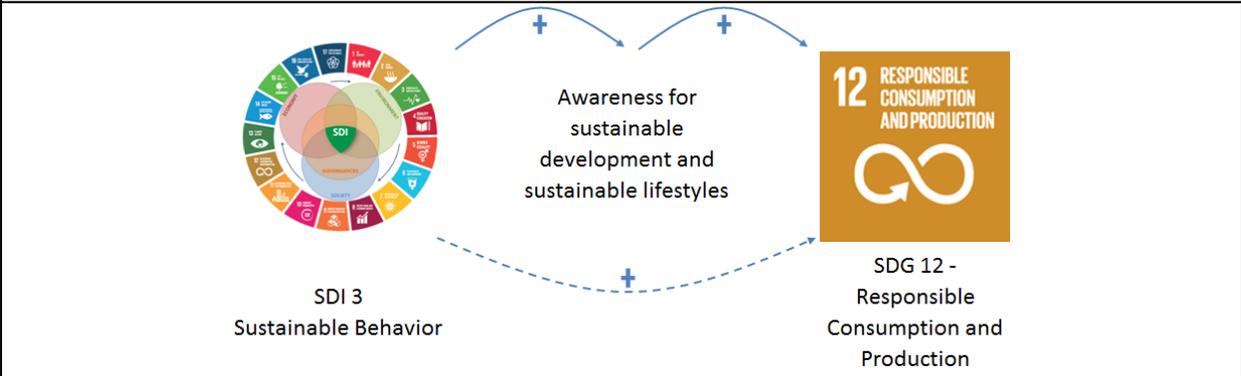


SDG 13 aims to take urgent action to combat climate change and its impacts integrating climate change measures into national policies, strategies and planning (United Nations, 2015). Carbon footprint refers to the greenhouse gases (GHGs) emission produced due to human activities. “Carbon footprint” assessment has gained importance in recent years and has been used as a benchmark to quantify GHG emissions in the context of climate change (Muthu, 2016). Therefore, implement an operational sustainable consumption plan during construction can directly contribute to SDG 13.

SDI 3	Category:	Economic
	Subcategory:	Business growth
	Sustainability Target:	Sustainable Behavior

	Description:	Implement a sustainable behaviour program, incentivizing sustainable thinking and operational cost reduction.
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Impacted SDG:	SDG 12
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SDG 12 aims to ensure sustainable consumption and production patterns ensuring that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature (United Nations, 2015). Education as a body of knowledge shows indispensable and necessary tools to contribute to understanding and change individuals' attitudes and values regarding energy consumption (A.Dias, R.Mattos, & A.P.Balestieri, 2004) other behaviours. Therefore, the education and knowledge of sustainable behaviour contribute directly and positively to SDG 12.

SDI 4	Category:	Economic
	Subcategory:	Business growth
	Sustainability Target:	Sustainable investment - Integrating ESG (Environmental, Social Governance)
	Description:	Integrate ESG (Environmental Social Governance) criteria into the organization's investment strategies, investing in sustainable programs.
Impacted SDG:		SDG 3



SDG 3 aims to ensure healthy lives and promote well-being for all, at all ages, contributing to the end of knowing diseases, prevention and treatment of substance abuse, health care (United Nations, 2015). In the construction industry, CSR is becoming a growing agenda in recent years, mainly for two paradoxical reasons: the construction activities are very aggressive and unsustainable regarding the extraction, processing and transportation of raw materials, excessive resources and energy affecting the physical environment and ecosystem in the forms of greenhouse gas emissions, dust, waste, carbon emission, and general air pollution; the construction activities are also generally labour intensive with high exposure to accidents, thereby making construction a less healthy and safe undertaking for construction workers (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, implementing CSR into the construction industry strategies contribute to SDG 3.

Impacted SDG: SDG 4



SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, ensuring that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy (United Nations, 2015). CSR encompasses stakeholder, social, economic, voluntariness and environmental dimensions. The implementation of CSR in the built environment leads to more sustainable products. CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, implementing CSR into the construction industry strategies contribute to SDG 4.

Impacted SDG: SDG 8



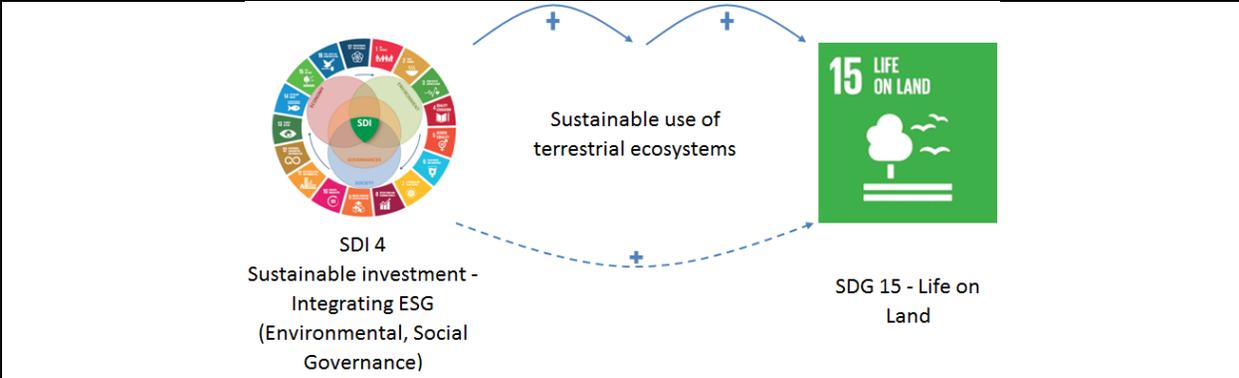
SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (United Nations, 2015). CSR encompasses stakeholder, social, economic, voluntariness and environmental dimensions. The implementation of CSR in the built environment leads to more sustainable products. CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, implementing CSR into the construction industry strategies contribute to SDG 8.

Impacted SDG: SDG 10



SDG 10 aims to reduce inequality within and among countries progressively, achieving and sustaining income growth of the bottom 40 percent of the population at a rate higher than the national average and facilitate orderly, safe, regular and responsible migration and mobility of people (United Nations, 2015). CSR encompasses stakeholder, social, economic, voluntariness and environmental dimensions. The implementation of CSR in the built environment leads to more sustainable products. CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, implementing CSR into the construction industry strategies contribute to SDG 10.

Impacted SDG: SDG 15



SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems (United Nations, 2015). CSR encompasses stakeholder, social, economic, voluntariness and environmental dimensions. CSR's ecological aspect focuses on the impact of the business activity on both living and non-living natural systems in the environment, including ecosystems, land, air and water. (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, implementing CSR into the construction industry strategies contribute to SDG 15.

Impacted SDG: SDG 17



SDG 17 aims to strengthen the means of implementation and revitalize the global partnership for sustainable development, increasing domestic resource mobilization, including through international support to developing countries, to improve local capacity for tax and other revenue collection (United Nations, 2015). CSR encompasses stakeholder, social, economic, voluntariness and environmental dimensions. CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Even though the CSR focuses on both direct and indirect of the immediate community and stakeholders, CSR implementation can go further and contribute to SDG 17.

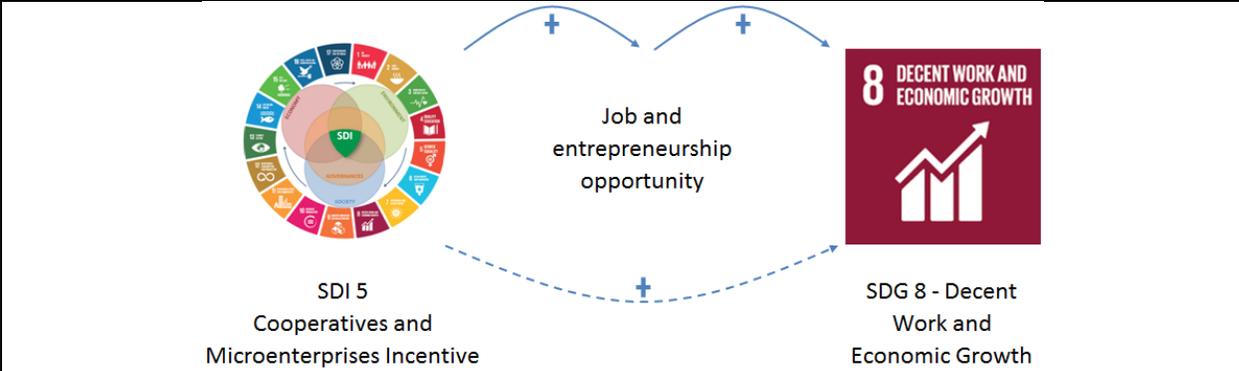
SDI 5	Category:	Economic
	Subcategory:	Economy growth
	Sustainability Target:	Cooperatives and Microenterprises Incentive

Description: Incentivize cooperatives and microenterprises*
 (*According to the University of California, cooperatives are formed by individuals who coordinate to achieve vertical integration in their business activities. This organization contributes to the local economic growth.)

Impacted SDG: SDG 1

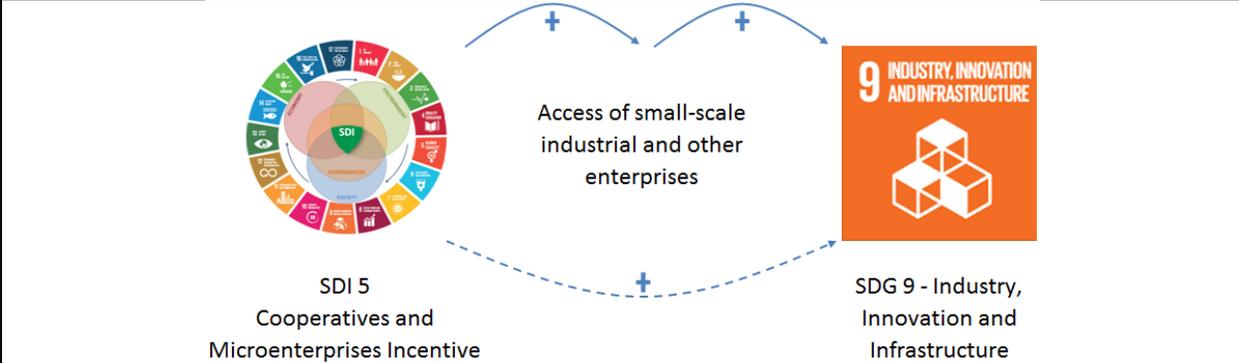


Impacted SDG: SDG 8



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, promoting development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services (United Nations, 2015). Microenterprise refers to small businesses owned and operated by poor people or groups of poor people with the support of sponsoring organizations. Microenterprises may be owned or operated by individuals, and often their family members are also involved. Otherwise, they may be held and operated cooperatively by groups of people. Microenterprise and microfinance are promoted as comprising an essential anti-poverty strategy (Midgley, 2008). Therefore, cooperatives and microenterprises incentives can contribute to decent job creation, entrepreneurship and directly to SDG 8.

Impacted SDG: SDG 9

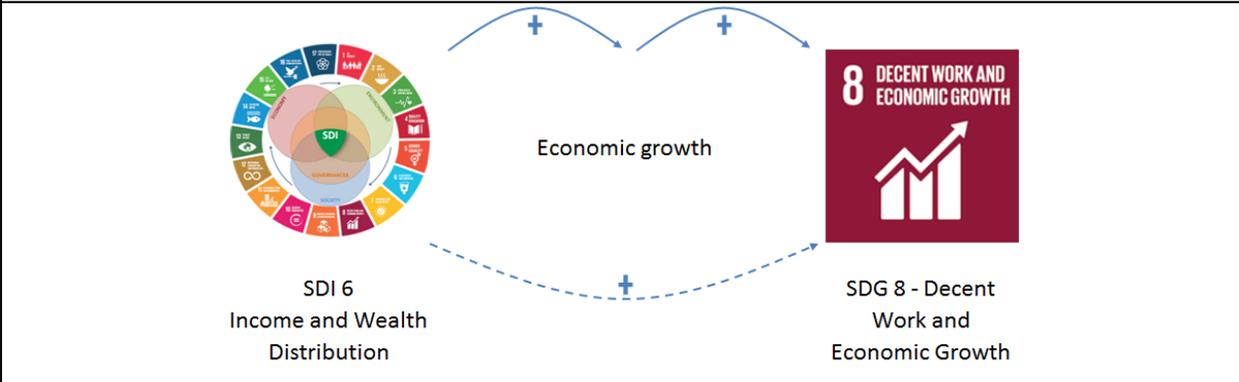


SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization, foster innovation, increase access to small-scale industrial and other enterprises, financial services, including affordable credit, and their integration into value chains and markets (United Nations, 2015). Microenterprise refers to small businesses owned and operated by poor people or groups of poor people with the support of sponsoring organizations. Microenterprises may be owned or operated by individuals, and often their family members are also involved. Otherwise, they may be held and operated cooperatively by groups of people. Microenterprise and microfinance are promoted as comprising an essential anti-poverty strategy (Midgley, 2008). Therefore, incentivizing cooperatives and microenterprises can contribute directly to SDG 9.

SDI 6	Category:	Economic
	Subcategory:	Economy growth
	Sustainability Target:	Income and Wealth Distribution

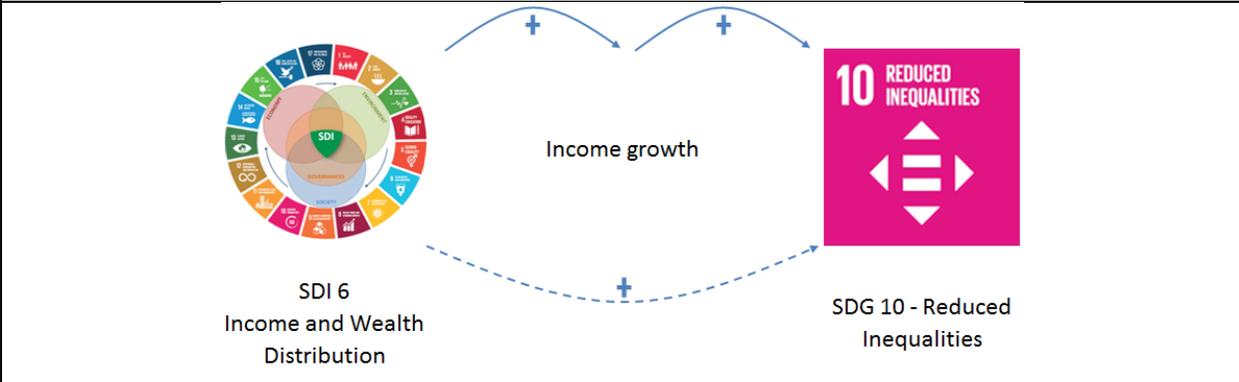
	Description:	Implement a financial benefit plan for the construction team according to the project's profitability - distribute Income and wealth.
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Impacted SDG:	SDG 8
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SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all achieving higher levels of economic productivity through diversification, technological upgrading and innovation, including a focus on high-value added and labour-intensive sectors (United Nations, 2015). Developmental economists have increasingly turned their attention to equity as an alternative analytic tool for economic development. There are more indicators, such as nonmonetary distribution, that can contribute to economic growth. However, the monetary distribution is one indicator to capture economic relationships reflecting relative buying power in the marketplace (Gimenez, Greenberg, Markusen, Mayer, & Newton, 1978). Therefore, income distribution contributes to economic growth and reduces inequalities, contributing to SDG 8

Impacted SDG:	SDG 10
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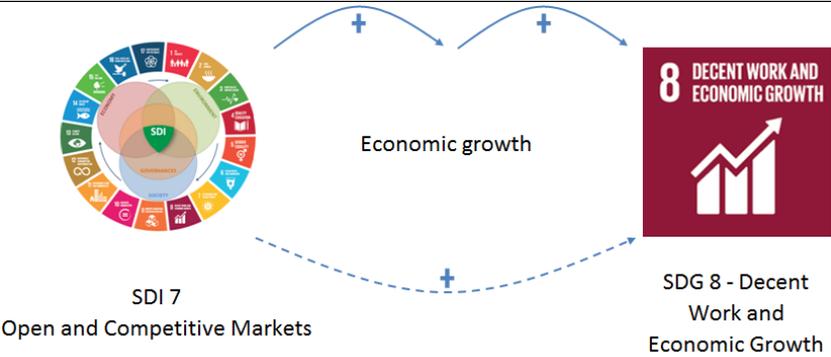


SDG 10 aims to reduce inequality within and among countries progressively, achieving and sustaining income growth of the bottom 40 percent of the population at a rate higher than the national average (United Nations, 2015). Developmental economists have increasingly turned their attention to equity as an alternative analytic tool for economic development. There are more indicators, such as nonmonetary distribution, that can contribute to economic growth. However, the monetary distribution is one indicator to capture economic relationships reflecting relative buying power in the marketplace (Gimenez, Greenberg, Markusen, Mayer, & Newton, 1978). Therefore, income distribution contributes to economic growth and reduces inequalities, contributing to SDG 10.

SDI 7	Category:	Economic
	Subcategory:	Economy growth

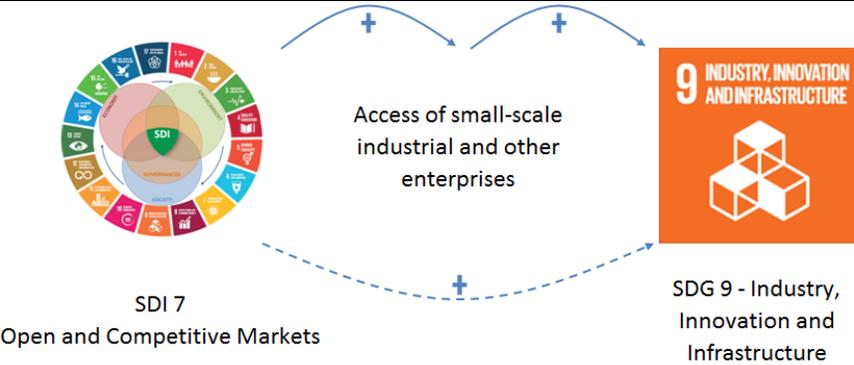
	Sustainability Target: Open and Competitive Markets
	Description: Promote social responsibility throughout the entire supply chain by maintaining open and competitive markets.

Impacted SDG: SDG 8



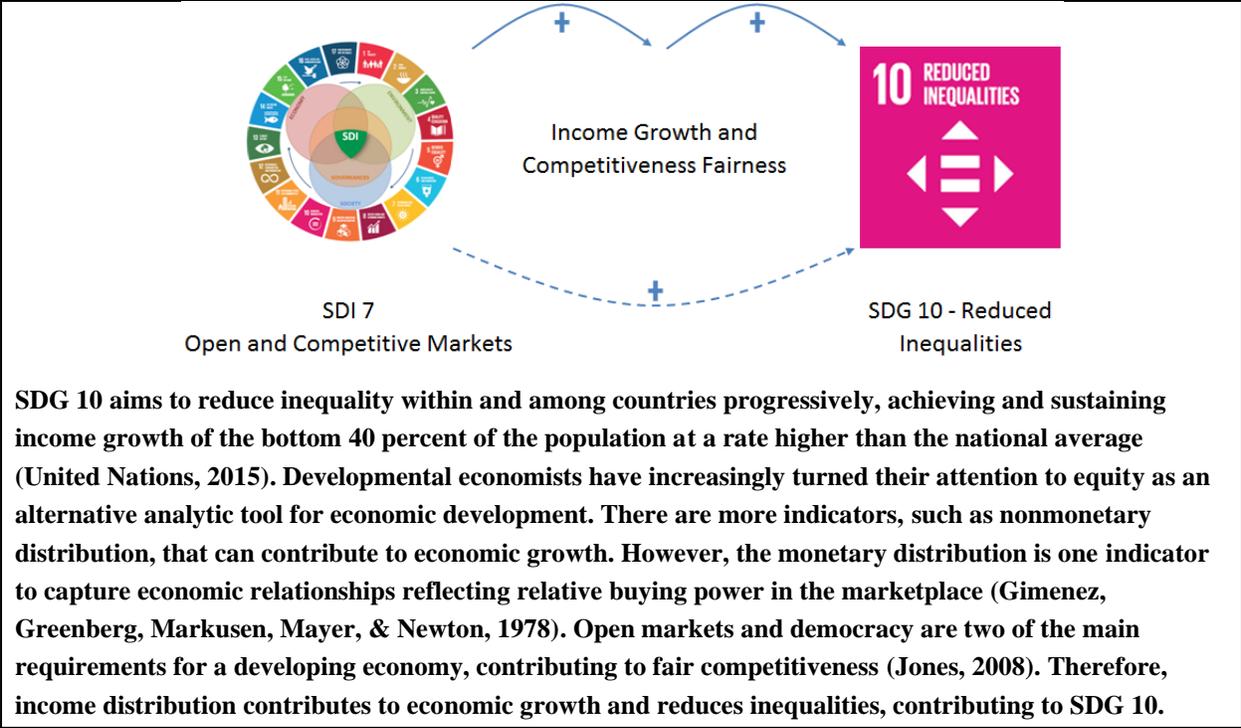
SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, promoting development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services (United Nations, 2015). Open markets and democracy are two of the main requirements for a developing economy (Jones, 2008). Therefore, open and competitive markets contribute directly to SDG 8.

Impacted SDG: SDG 9



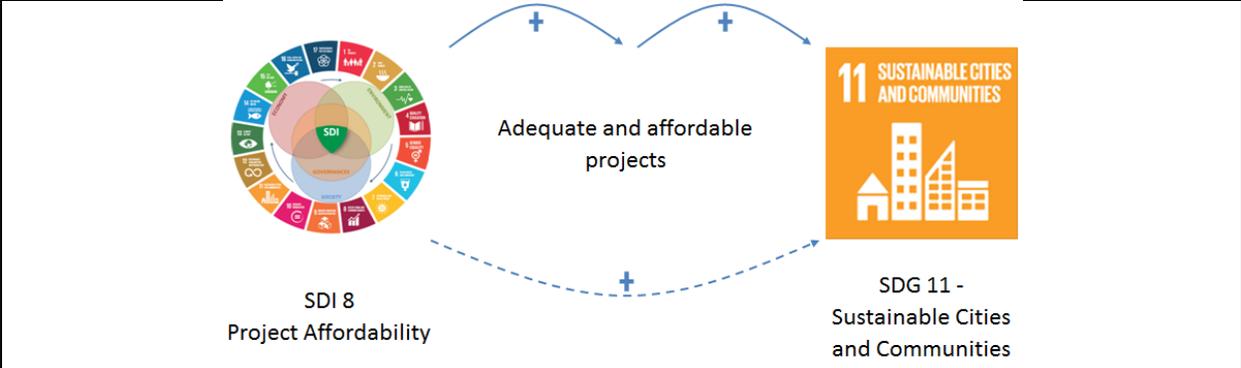
SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization, foster innovation, increase access to small-scale industrial and other enterprises, financial services, including affordable credit, and their integration into value chains and markets (United Nations, 2015). Open markets and democracy are two of the main requirements for a developing economy, contributing to fair competitiveness (Jones, 2008). Therefore, open and competitive markets contribute directly to SDG 9.

Impacted SDG: SDG 10



SDI 8	Category:	Economic
	Subcategory:	Economy growth
	Sustainability Target:	Project Affordability
	Description:	Provide affordable projects, extending a project’s useful life by designing a completed project that is more durable, flexible, and resilient.

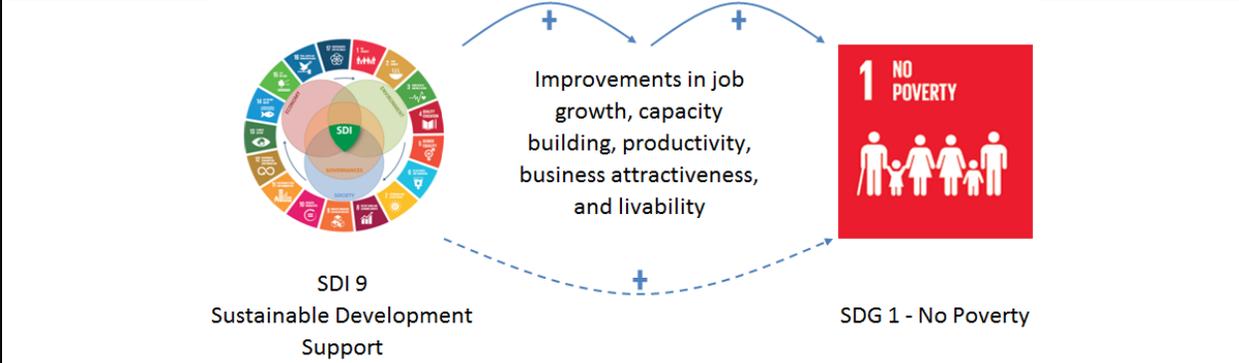
Impacted SDG: SDG 11



SDG 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable, ensuring access for all to adequate and affordable housing (United Nations, 2015). Affordable housing definitions vary, but it must be affordable and meet minimum human dignity and flourishing standards. Integrating green building enables stakeholders to address the environmental component as an integral part of affordable housing development (Huston & Baines, 2019). Therefore, developing project affordability contributes directly to SDG 11.

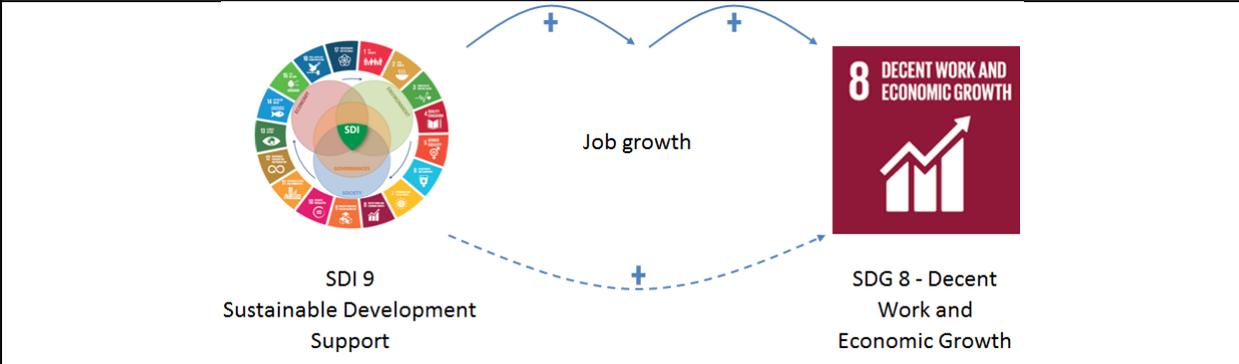
SDI 9	Category:	Economic
	Subcategory:	Economy growth
	Sustainability Target:	Sustainable Development Support
	Description:	Support and stimulate sustainable growth and development, including improvements in job growth, capacity building, productivity, business attractiveness, and livability.

Impacted SDG: **SDG 1**

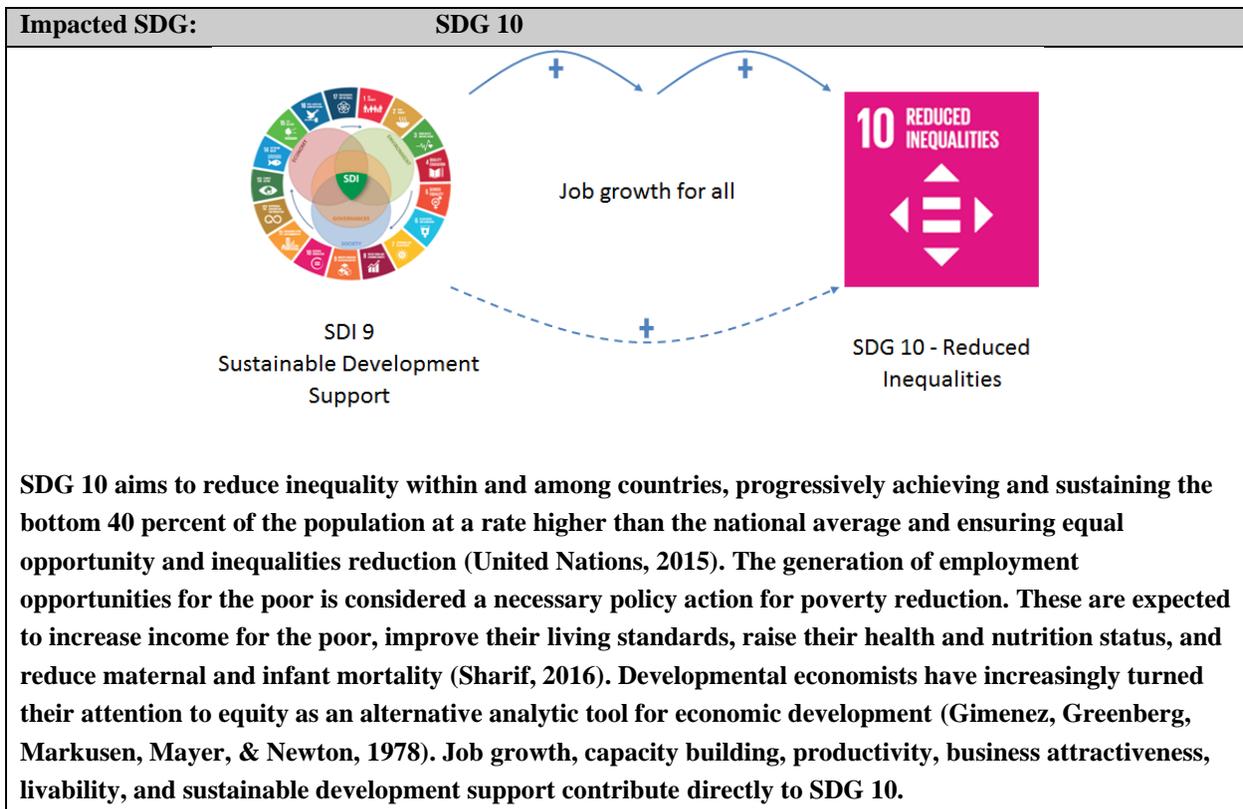


SDG 1 aims to end poverty in all its forms and everywhere. It seeks to ensure that all men and women, particularly the poor and the vulnerable, have equal rights to economic resources. It also aims to provide access to essential services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance (United Nations, 2015). The generation of employment opportunities for the poor is considered a necessary policy action for poverty reduction. These are expected to increase income for the poor, improve their living standards, raise their health and nutrition status and reduce maternal and infant mortality (Sharif, 2016). Therefore, sustainable development support contributes directly to SDG 1.

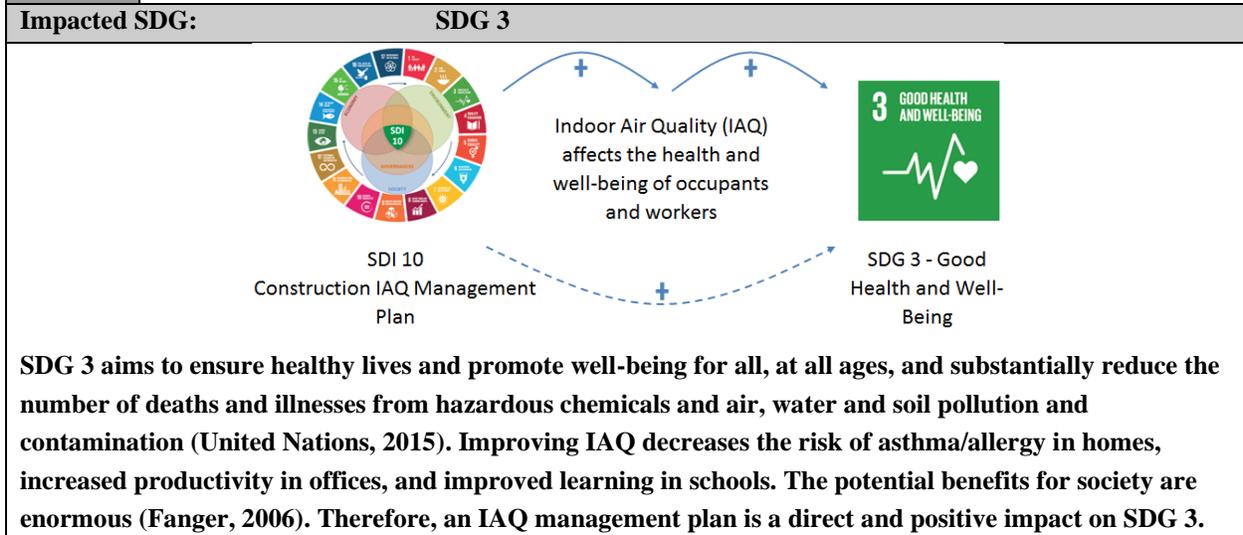
Impacted SDG: **SDG 8**



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, achieving higher levels of economic productivity through diversification, technological upgrading and innovation, including a focus on high-value added and labour-intensive sectors (United Nations, 2015). The generation of employment opportunities for the poor is considered a necessary policy action for poverty reduction. These are expected to increase income for the poor, improve their living standards, raise their health and nutrition status and reduce maternal and infant mortality (Sharif, 2016). Job growth, capacity building, productivity, business attractiveness, livability, and sustainable development support contribute directly to SDG 8.



SDI 10	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	Construction IAQ Management Plan
	Description:	Implement a construction IAQ management plan, promoting the comfort and well-being of construction workers.



SDI 11	Category:	Environmental
	Subcategory:	Air Emission

	Sustainability Target:	Environmental Tobacco Smoke Control
	Description:	Implement environmental tobacco smoke control, preventing or minimizing exposure of building occupants, indoor surfaces, and ventilation air distribution systems to environmental tobacco smoke.

Impacted SDG: **SDG 3**

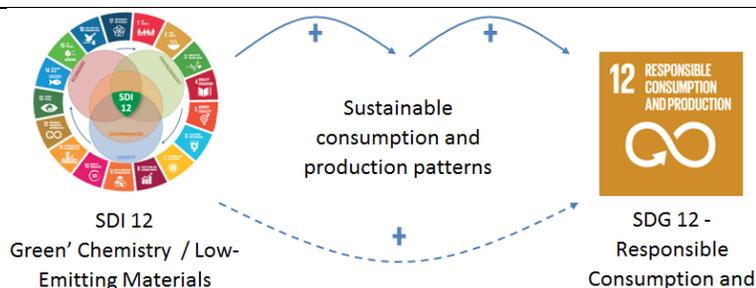
SDG 3 aims to ensure healthy lives and promote well-being for all, at all ages, and substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination (United Nations, 2015). Disease risks due to inhalation of tobacco smoke are not limited to smokers, and exposure to environmental tobacco smoke can cause several adverse health outcomes such as respiratory and cardiovascular problems (National Cancer Institute, 1999). Therefore, Environmental Tobacco Smoke Control is a direct and positive impact on SDG 3.

SDI 12	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	Green' Chemistry/Low-Emitting Materials
	Description:	Use low-emitting materials/green chemistry, reducing the use of materials with concentrations of chemical contaminants such as VOC (volatile organic compound).

Impacted SDG: **SDG 3**

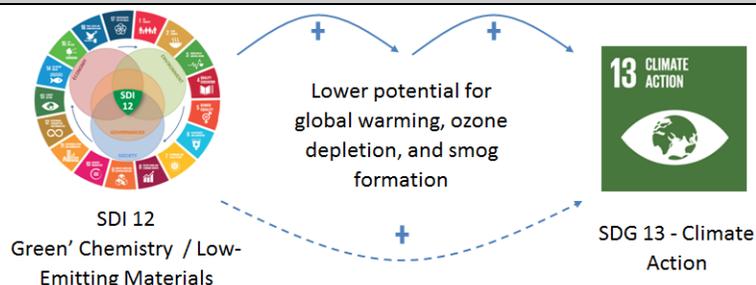
SDG 3 aims to ensure healthy lives and promote well-being for all, at all ages, and substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination (United Nations, 2015). According to EPA (EPA - United States Environmental Protection Agency, 2019), there are several benefits of green chemistry for human health such as cleaner air: less release of hazardous chemicals to the atmosphere leading to less damage to the lungs; cleaner water: less discharge of dangerous chemical wastes to water leading to cleaner drinking and recreational water; and less exposure to such toxic chemicals as endocrine disruptors. Therefore, this target has a direct and positive effect on SDG 3.

Impacted SDG: **SDG 12**



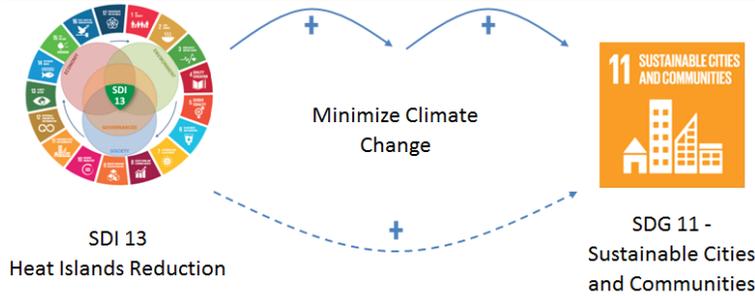
SDG 12 aims to ensure sustainable consumption and production patterns, achieving the environmental management of chemicals and all wastes throughout their life cycle, and significantly reduce their release into the air, water and soil to minimize their adverse impacts on human health and the environment (United Nations, 2015). According to EPA (EPA - United States Environmental Protection Agency, 2019), there are several benefits of green chemistry for human health such as cleaner air: less release of hazardous chemicals to the atmosphere leading to less damage to the lungs; cleaner water: less discharge of dangerous chemical wastes to water leading to cleaner drinking and recreational water; and less exposure to such toxic chemicals as endocrine disruptors. Therefore, this target has a direct and positive effect on SDG 12.

Impacted SDG: SDG 13



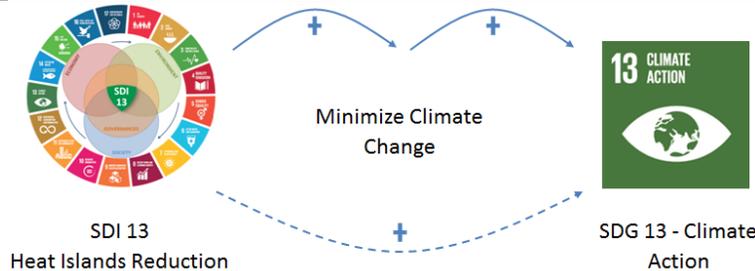
SDG 13 aims to take urgent action to combat climate change and its impacts, Integrating climate change measures into national policies, strategies and planning (United Nations, 2015). According to the EPA (EPA - United States Environmental Protection Agency, 2019), green chemistry has several benefits to the environment: the lower potential for global warming, ozone depletion, smog formation, and less chemical disruption of ecosystems. Therefore, this target has a direct and positive effect on SDG 13.

SDI 13	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	Heat Islands Reduction
	Description:	Reduce heat islands in the landscape and exterior design, minimizing surfaces with a low solar reflectance index to reduce localized heat accumulation and manage microclimates.
Impacted SDG:		SDG 11



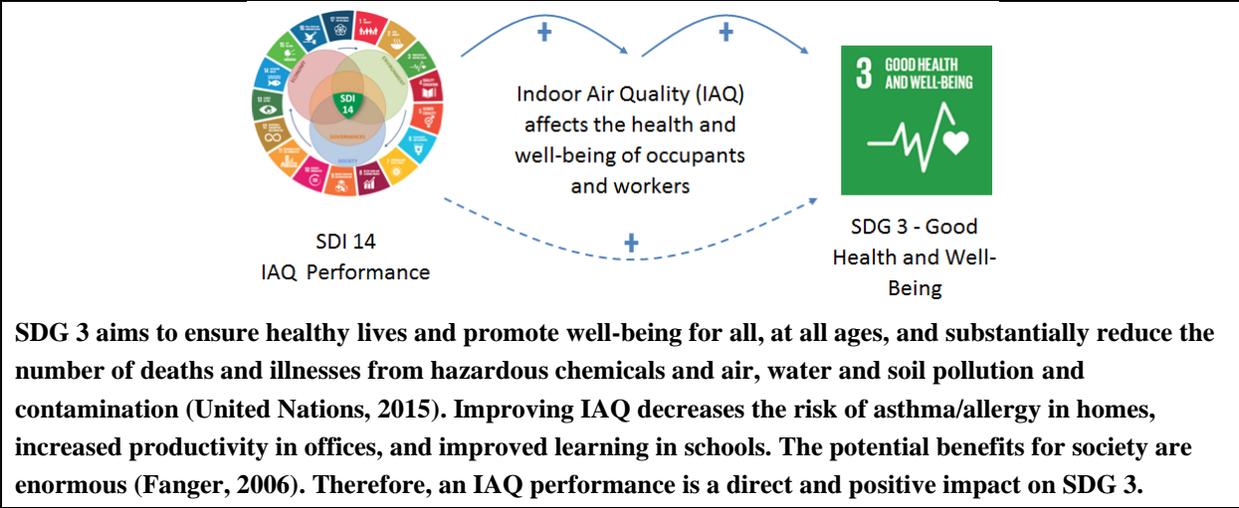
SDG 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable by implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change (United Nations, 2015). According to the EPA (EPA - United States Environmental Protection Agency, 2019), Climate Change and the heat island effect interact in two crucial ways. A warming climate will increase temperatures in heat island areas, and cooling strategies to reduce heat islands can help communities adapt to climate change impacts and reduce the greenhouse gas emissions that cause climate change. Therefore, this target has a direct and positive effect on SDG 11.

Impacted SDG: SDG 13



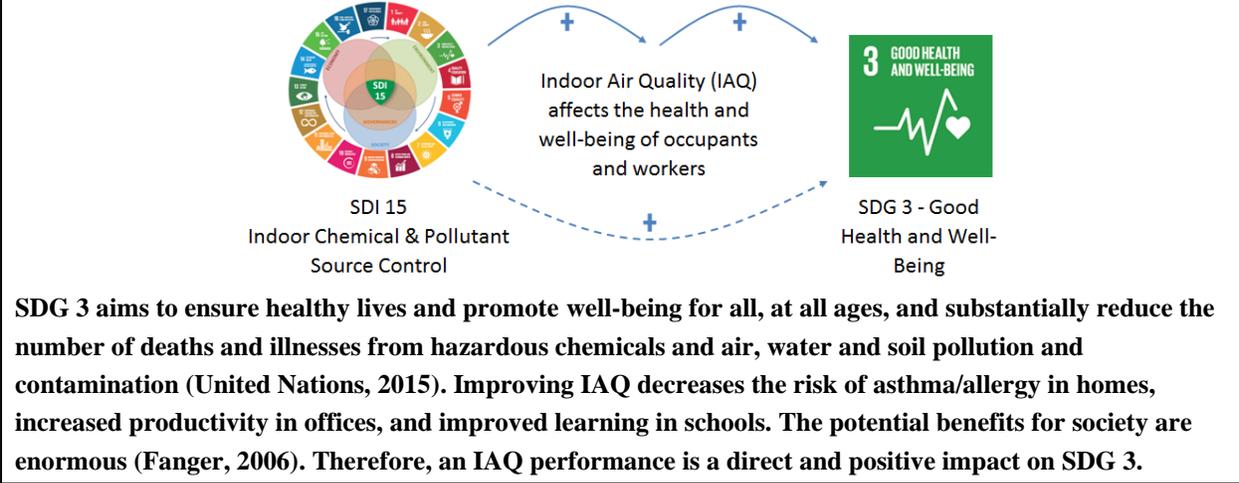
SDG 13 aims to take urgent action to combat climate change and its impacts improving education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning (United Nations, 2015). According to EPA (EPA - United States Environmental Protection Agency, 2019), Climate Change and the heat island effect interact in two crucial ways. A warming climate will increase temperatures in heat island areas. Therefore, cooling strategies to reduce heat islands can help communities adapt to climate change impacts and lower greenhouse gas emissions that cause climate change. Therefore, this target has a direct and positive effect on SDG 13.

SDI 14	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	IAQ Performance
	Description:	Increase indoor air quality (IAQ) performance.
Impacted SDG:		SDG 3

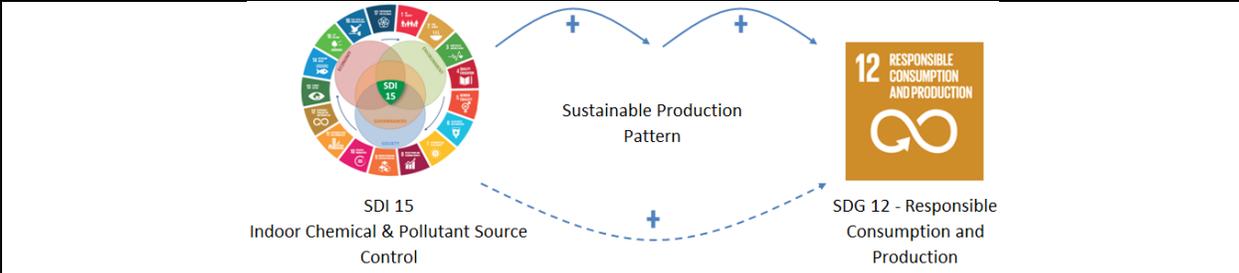


SDI 15	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	Indoor Chemical & Pollutant Source Control
	Description:	Implement emissions control management to transport materials, products, waste, employees, and passengers (trucks, trains, ships, airplanes, buses, cars).

Impacted SDG: SDG 3

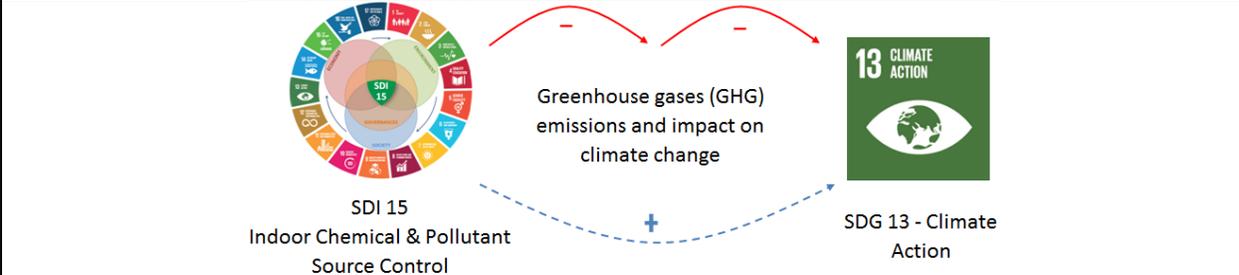


Impacted SDG: SDG 12



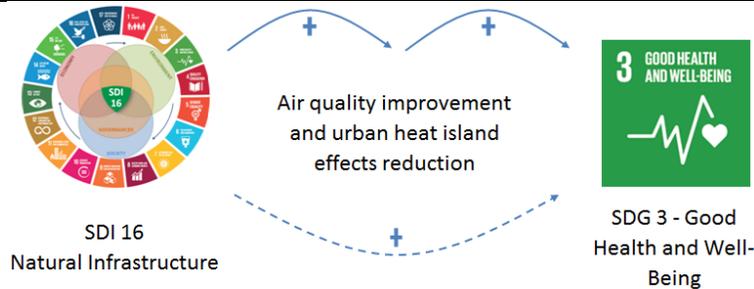
SDG 12 aims to ensure sustainable consumption and production patterns achieving the environmentally sound management of chemicals and reducing their release to air, water and soil to minimize their adverse impacts on human health and the environment (United Nations, 2015). According to EPA (EPA - United States Environmental Protection Agency, 2019), the transportation sector is one of the most significant contributors to greenhouse gas (GHG) emissions. Cars, trucks, commercial aircraft, and railroads, among other sources, all contribute to transportation end-use sector emissions. Therefore, this target has a direct and positive effect on SDG 12.

Impacted SDG: SDG 13



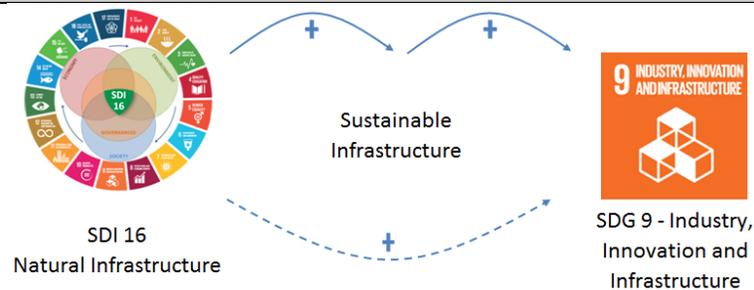
SDG 13 aims to take urgent action to combat climate change and its impacts integrating climate change measures into national policies, strategies and planning (United Nations, 2015). According to EPA (EPA - United States Environmental Protection Agency, 2019), the transportation sector is one of the most significant contributors to greenhouse gas (GHG) emissions. Cars, trucks, commercial aircraft, and railroads, among other sources, all contribute to transportation end-use sector emissions. Therefore, this target has a direct and positive effect on SDG 13.

SDI 16	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	Natural Infrastructure
	Description:	Invest in natural infrastructure, improving air quality, protecting humans from harmful substances, and preventing environmental emergencies or mitigating their impacts.
Impacted SDG:		SDG 3



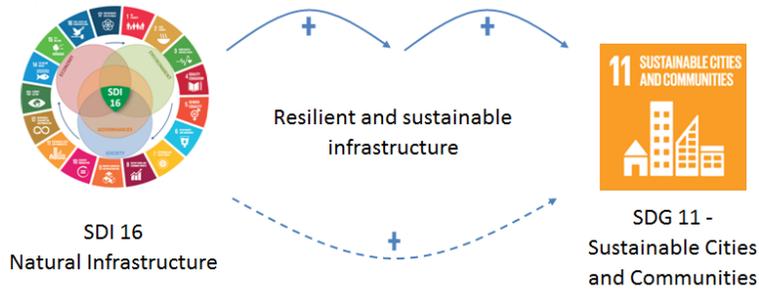
SDG 3 aims to ensure healthy lives and promote well-being for all, at all ages, and substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination (United Nations, 2015). Green infrastructure can help communities manage stormwater, and vegetated systems like green roofs and tree barriers can also improve air quality and reduce urban heat island effects. Additionally, natural features such as urban forests and vegetative walls planted near roads, parking lots, and city centers help reduce vehicle emissions and improve local air quality. Green infrastructure can help reduce particulate pollution and ground-level ozone and provide public health benefits (EPA - United States Environmental Protection Agency, 2017). Therefore, using natural infrastructure impacts directly and positively on SDG 3.

Impacted SDG: **SDG 9**



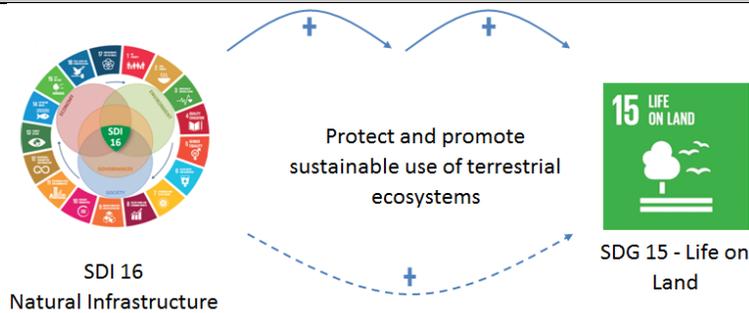
The SDG 9 - 9.1 aims to develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, focusing on affordable and equitable access for all (United Nations, 2015). Green infrastructure can help communities manage stormwater, and vegetated systems like green roofs and tree barriers can also improve air quality and reduce urban heat island effects. Additionally, natural features such as urban forests and vegetative walls planted near roads, parking lots, and city centers help reduce vehicle emissions and improve local air quality. Green infrastructure can help reduce particulate pollution and ground-level ozone and provide public health benefits (EPA - United States Environmental Protection Agency, 2017). Therefore, using natural infrastructure impacts directly and positively on SDG 9.

Impacted SDG: **SDG 11**



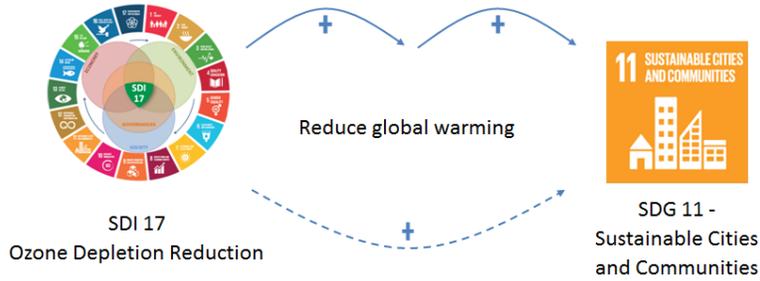
SDG 11 aims to make cities and human settlements inclusive, safe, resilient, and sustainable and strengthen efforts to protect and safeguard the world’s cultural and natural heritage (United Nations, 2015). Green infrastructure can help communities manage stormwater, and vegetated systems like green roofs and tree barriers can also improve air quality and reduce urban heat island effects. Additionally, natural features such as urban forests and vegetative walls planted near roads, parking lots, and city centers help reduce vehicle emissions and improve local air quality. Green infrastructure can help reduce particulate pollution and ground-level ozone and provide public health benefits (EPA - United States Environmental Protection Agency, 2017). Therefore, using natural infrastructure impacts directly and positively on SDG 11.

Impacted SDG: SDG 15



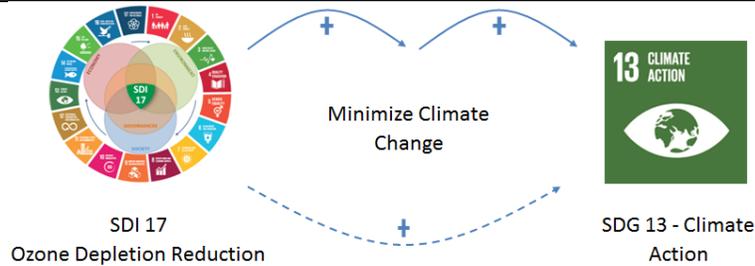
SDG 15 aims to take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity, protect, restore and promote sustainable use of terrestrial ecosystems and reverse land degradation (United Nations, 2015). Natural features such as urban forests and vegetative barriers planted near roads, parking lots, and city centers improve local air quality. Green infrastructure can assist in reducing particulate pollution and ground-level ozone and provide public health benefits. (EPA - United States Environmental Protection Agency, 2017). Therefore, using natural infrastructure impacts directly and positively on SDG 15.

SDI 17	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	Ozone Depletion Reduction
	Description:	Reduce greenhouse gas emissions and Ozone Depleting Substances (ODS), developing a comprehensive climate impact assessment and adaptation plan.
Impacted SDG:		SDG 11



SDG 11 aims to make cities and human settlements inclusive, safe, resilient, and sustainable, reducing cities' adverse per capita environmental impact (United Nations, 2015). Ozone-depleting substances (ODS) generally contain chlorine, fluorine, bromine, carbon, and hydrogen in varying proportions and are often described by the general term halocarbons. Chlorofluorocarbons (CFCs), carbon tetrachloride, and methyl chloroform are important human-produced ozone-depleting gases used in many applications such as refrigeration, air conditioning, foam blowing, cleaning of electronics components, and solvents (Government of Canada, 2013). Therefore, reducing the ozone-depleting substances impacts directly and positively on SDG 11, making the cities more sustainable and healthier.

Impacted SDG: SDG 13



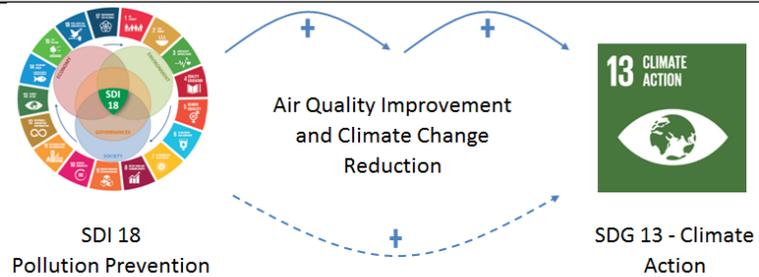
SDG 13 aims to take urgent action to combat climate change and its impacts, strengthening resilience and adaptive capacity to climate-related hazards (United Nations, 2015). Ozone-depleting substances (ODS) generally contain chlorine, fluorine, bromine, carbon, and hydrogen in varying proportions and are often described by the general term halocarbons. Chlorofluorocarbons (CFCs), carbon tetrachloride, and methyl chloroform are important human-produced ozone-depleting gases used in many applications, including refrigeration, air conditioning, foam blowing, cleaning of electronics components, and as solvents (Government of Canada, 2013). Therefore, reducing the ozone-depleting substances directly and positively contribute to SDG 13, making the cities more sustainable and healthier.

SDI 18	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	Pollution Prevention
	Description:	Prevent pollution, reducing the emission of six criteria pollutants: particulate matter (including dust), ground-level ozone, carbon monoxide, sulphur oxides, nitrogen oxides, lead, and noxious odours.
Impacted SDG:		SDG 3



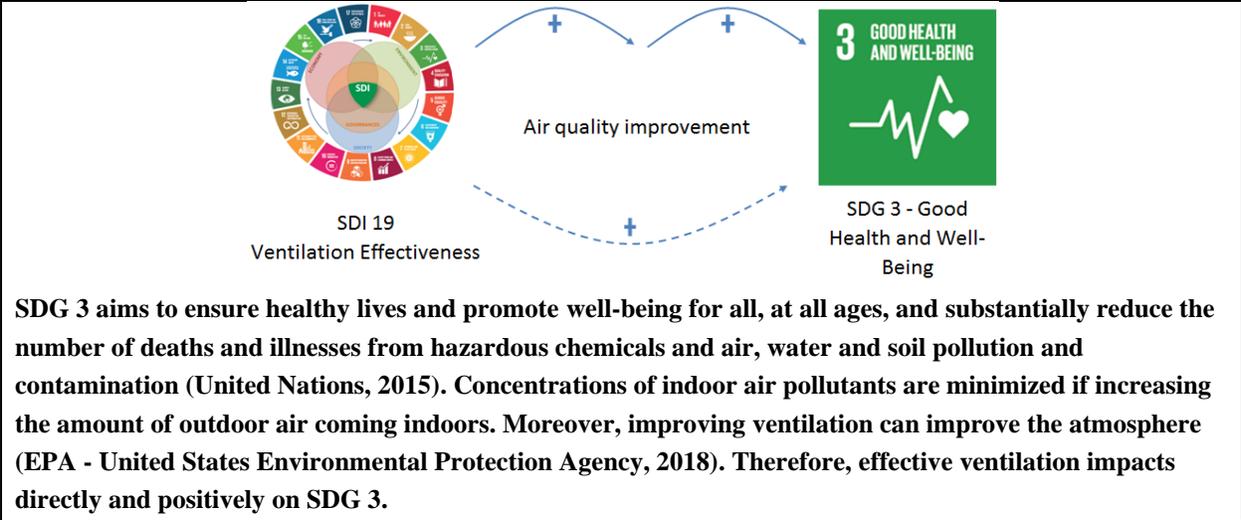
SDG 3 aims to ensure healthy lives and promote well-being for all, at all ages, and substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination (United Nations, 2015). The six common "criteria pollutants" are common and widespread pollutants that affect public health, the environment and damage properties. (EPA - United States Environmental Protection Agency, 2017). Therefore, using natural infrastructure impacts directly and positively on SDG 3.

Impacted SDG: SDG 13



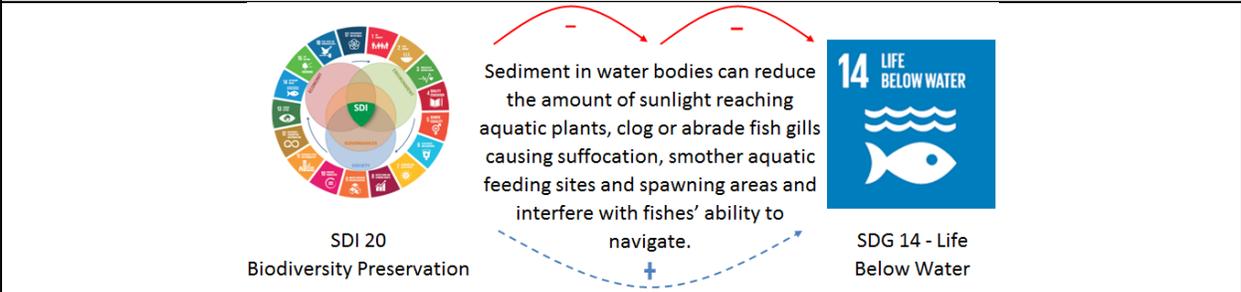
SDG 13 aims to take urgent action to combat climate change and its impacts, strengthening resilience and adaptive capacity to climate-related hazards (United Nations, 2015). The six common "criteria pollutants" are common and widespread pollutants that affect public health, the environment and damage properties. Ground-level ozone and particulate matter are the most prevalent air pollution types, for example (EPA - United States Environmental Protection Agency, 2017). Therefore, reducing the ozone-depleting substances directly and positively contribute to SDG 13, making the cities more sustainable and healthier.

SDI 19	Category:	Environmental
	Subcategory:	Air Emission
	Sustainability Target:	Ventilation Effectiveness
	Description:	Increase ventilation effectiveness, providing an effective delivery and mixing of fresh air to support building occupants' health, safety, and comfort.
Impacted SDG:		SDG 3



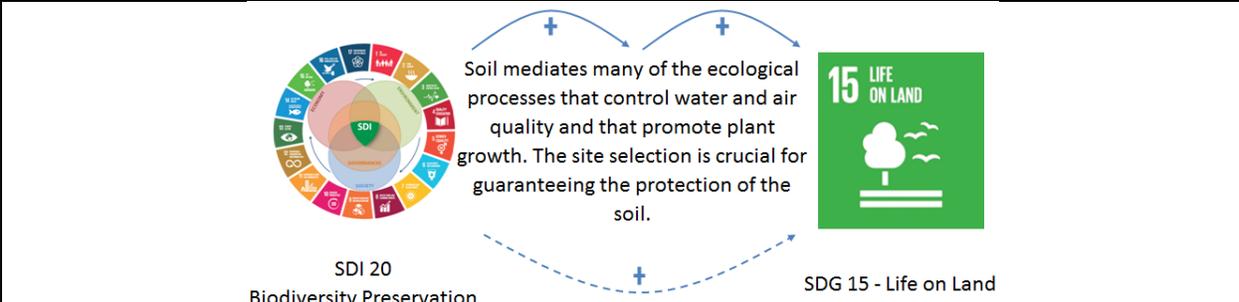
SDI 20	Category:	Environmental
	Subcategory:	Biodiversity
	Sustainability Target:	Biodiversity Preservation
	Description:	Preserve biodiversity, avoiding placing the project, the site compound, and temporary works on land with high ecological value or high-value species, preserving and restoring species and habitats.

Impacted SDG: SDG 14



SDG 14 aims to prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities (United Nations, 2015). Eroded particles of soil, or sediments, can easily be moved off construction and landscaping sites by flowing water and end up in natural water bodies. These sediments can cause damage to receiving water bodies. Sediment in water bodies can reduce the amount of sunlight reaching aquatic plants, clog or abrade fish gills causing suffocation, smother marine feeding sites, spawning areas and interfere with fishes' ability to navigate. Preventing and controlling erosion is essential to protecting natural streams, rivers and saltwater ecosystems (Capital Regional District - CRD, 2019). Therefore, the project location and biodiversity protection can directly and positively affect the life below water (SDG 14).

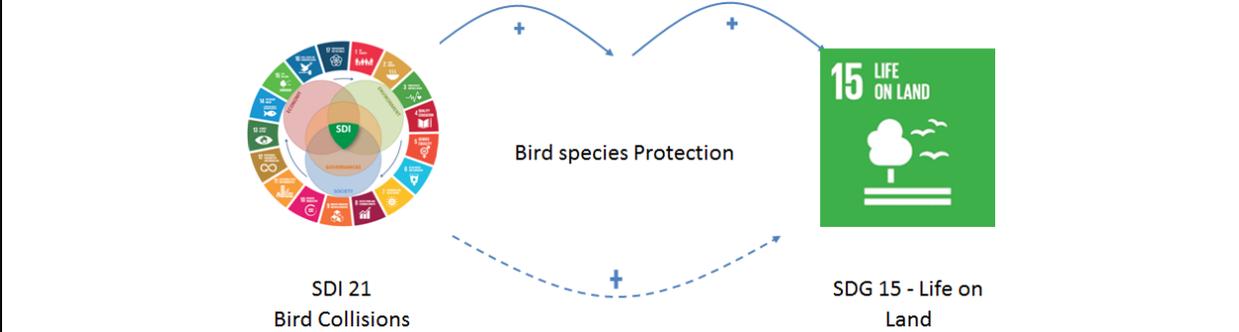
Impacted SDG: SDG 15



SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems, reverse land degradation and halt biodiversity loss (United Nations, 2015). Soil serves as a medium for plant growth; a sink for heat, water, and chemicals; a filter for water; and a biological medium for the breakdown of wastes. Soil interacts intimately with water, air, and plants and acts as a damper to fluctuations in the environment. Soil mediates many ecological processes that control water and air quality and promote plant growth (National Academy of Sciences, 1993). Therefore, the site's selection is essential for the ecosystem and biodiversity preservation, contributing to SDG 15.

SDI 21	Category:	Environmental
	Subcategory:	Biodiversity
	Sustainability Target:	Bird Collisions
	Description:	Implement bird collision management.

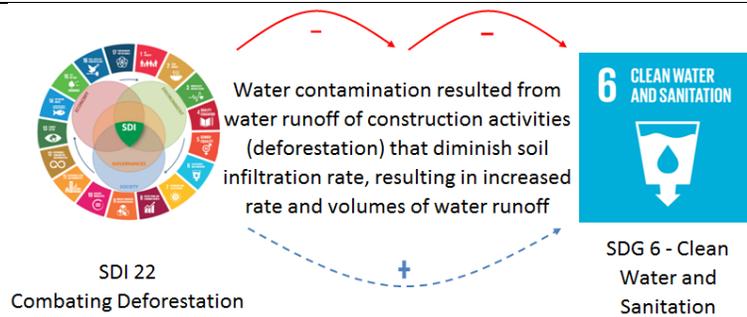
Impacted SDG: SDG 15



SDG 15 aims to protect, restore, and promote sustainable use of terrestrial ecosystems, reverse land degradation and halt biodiversity loss, and take urgent and significant action to reduce natural habitats' degradation and stop biodiversity loss (United Nations, 2015). According to The State of Canada's Birds (Canadian Wildlife Service, Environment and Climate Change Canada, 2012), habitat loss due to human settlement, industry, and forestry has caused a 35% decline in a representative sample of bird species in Canada's Pacific Coast region since 1970 (City of Vancouver, 2015). Therefore, bird collision management has a direct and positive impact on SDG 15.

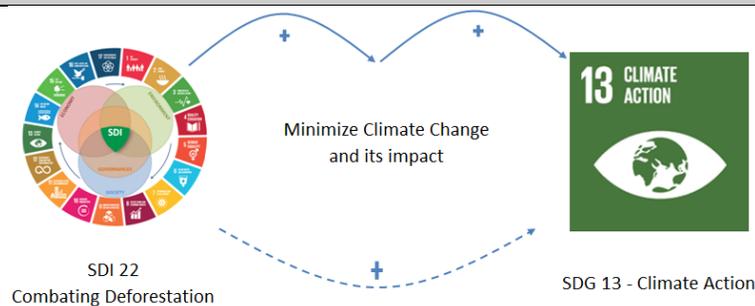
SDI 22	Category:	Environmental
	Subcategory:	Biodiversity
	Sustainability Target:	Combating Deforestation
	Description:	Combat deforestation, protecting, buffering, enhancing, and restoring areas designated as wetlands, shorelines, and water-bodies.

Impacted SDG: SDG 6



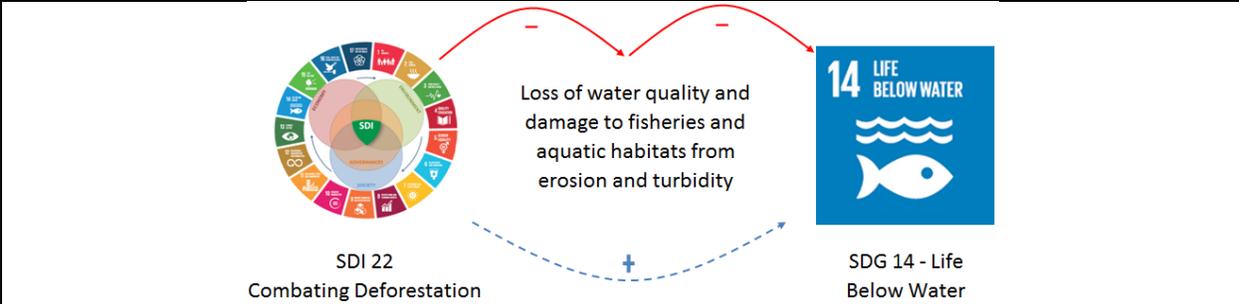
SDG 6 aims to protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes (United Nations, 2015). Development can remove surface depressions that store rainfall. Construction activities can compact the soil and diminish its infiltration rate, resulting in an increased rate and volumes of stormwater runoff from the development site (New Jersey Department of Environmental Protection, 2004). Therefore, Combating Deforestation has a direct and positive impact on SDG 6.

Impacted SDG: SDG 13



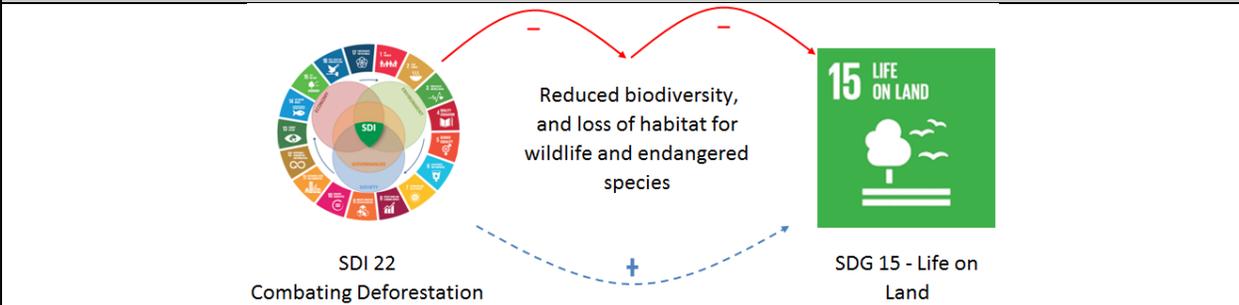
SDG 13 aims to take urgent action to combat climate change and its impacts, strengthening resilience and adaptive capacity to climate-related hazards (United Nations, 2015). The major environmental problems associated with deforestation include loss of water quality, including water used for drinking, commercial, agricultural and recreational purposes; damage to fisheries and aquatic habitats from erosion and turbidity; increased flooding during wet periods; erosion of topsoil and nutrients loss; climate change, such as decreased local rainfall and desertification; and reduced biodiversity, and loss of habitat for wildlife and endangered species (EPA - United States Environmental Protection Agency, 1995). Therefore, Combating Deforestation has a direct and positive impact on SDG 13.

Impacted SDG: SDG 14



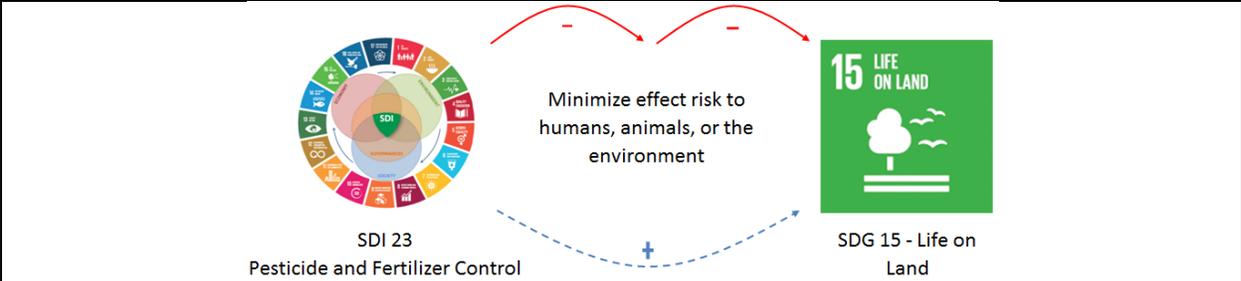
SDG 14 aims to protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes (United Nations, 2015). The major environmental problems associated with deforestation include loss of water quality, including water used for drinking, commercial, agricultural and recreational purposes; damage to fisheries and aquatic habitats from erosion and turbidity; increased flooding during wet periods; erosion of topsoil and nutrients loss; climate change, such as decreased local rainfall and desertification; and reduced biodiversity, and loss of habitat for wildlife and endangered species (EPA - United States Environmental Protection Agency, 1995). Therefore, Combating Deforestation has a direct and positive impact on SDG 14.

Impacted SDG: SDG 15



SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (United Nations, 2015). The major environmental problems associated with deforestation include loss of water quality, including water used for drinking, commercial, agricultural and recreational purposes; damage to fisheries and aquatic habitats from erosion and turbidity; increased flooding during wet periods; erosion of topsoil and nutrients loss; climate change, such as decreased local rainfall and desertification; and reduced biodiversity, and loss of habitat for wildlife and endangered species (EPA - United States Environmental Protection Agency, 1995). Therefore, Combating Deforestation has a direct and positive impact on SDG 15.

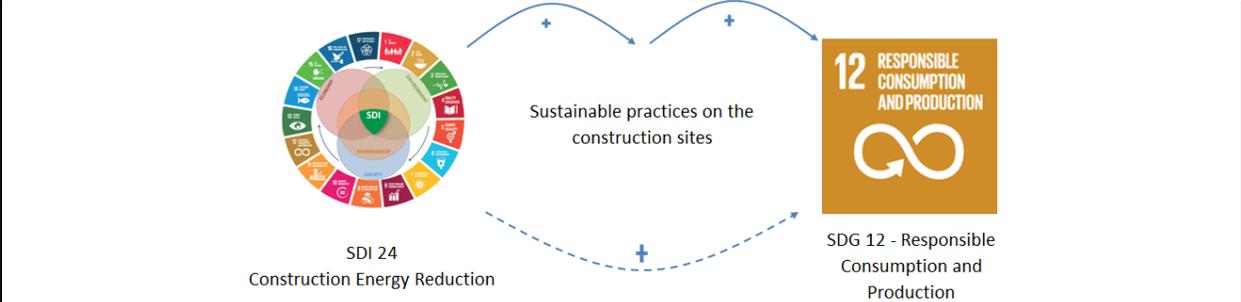
SDI 23	Category:	Environmental
	Subcategory:	Biodiversity
	Sustainability Target:	Pesticide and Fertilizer Control
	Description:	Reduce pesticide and fertilizer impacts.
Impacted SDG:		SDG 15



SDG 15 aims to take urgent and significant action to reduce natural habitats' degradation and halt biodiversity loss (United Nations, 2015). Pesticides with public health uses are intended to limit the potential for disease, but to be effective, they must be applied appropriately. By their nature, many pesticides may pose some risk to humans, animals, or the environment because they are designed to kill or otherwise adversely affect living organisms. Safely using pesticides depends on using the appropriate pesticide and using it correctly (EPA - United States Environmental Protection Agency, 2017). Therefore, the correct use of pesticides has a direct and positive impact on SDG 3 and SDG 15.

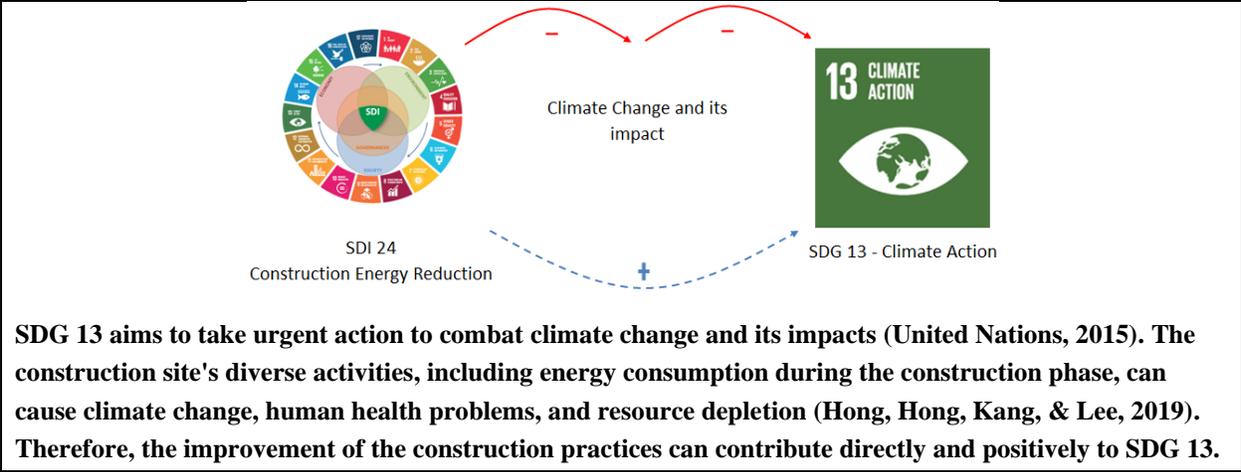
SDI 24	Category:	Environmental
	Subcategory:	Energy
	Sustainability Target:	Construction Energy Reduction
	Description:	Reduce construction energy consumption.

Impacted SDG: SDG 12



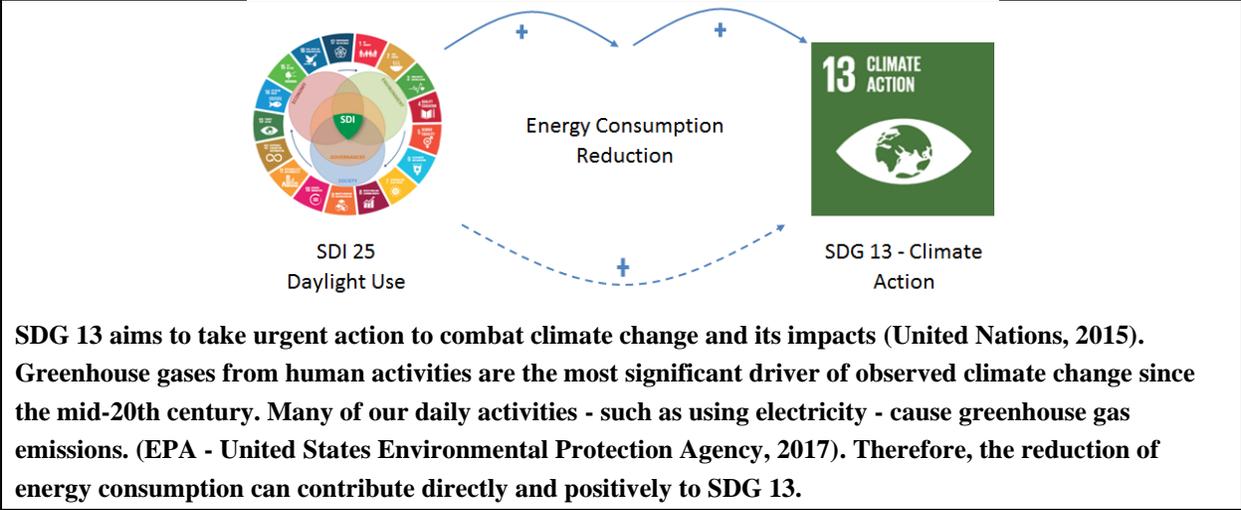
SDG 12 aims to ensure sustainable consumption and production patterns by implementing the 10-year framework of programmes on sustainable consumption and production (United Nations, 2015). The construction site's energy consumption depends on the construction sites' various characteristics and the methods undertaken. It requires an analysis of the process, selecting key factors and the sensor network, algorithms for monitoring, evaluating and minimizing energy consumption in the construction phase (Hong, Hong, Kang, & Lee, 2019). Therefore, the improvement of the construction practices can contribute directly and positively to SDG 12.

Impacted SDG: SDG 13



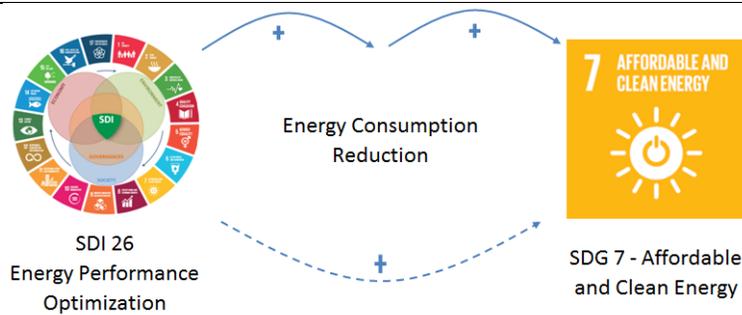
SDI 25	Category:	Environmental
	Subcategory:	Energy
	Sustainability Target:	Daylight Use
	Description:	Maximize the daylight usage and views, reduce energy consumption, and connect indoor spaces and the outdoors.

Impacted SDG: SDG 13



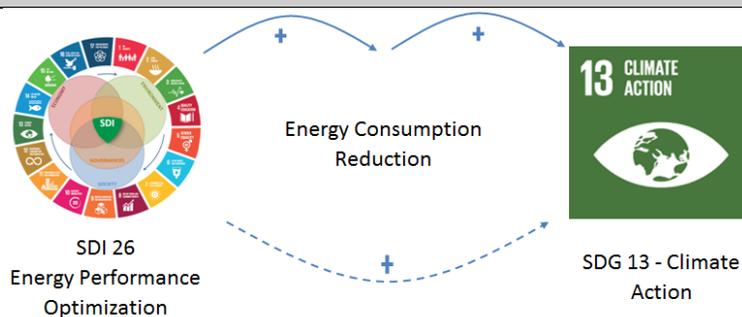
SDI 26	Category:	Environmental
	Subcategory:	Energy
	Sustainability Target:	Energy Performance Optimization
	Description:	Optimize energy performance, reducing overall operation and maintenance energy consumption throughout the project life.

Impacted SDG: SDG 7



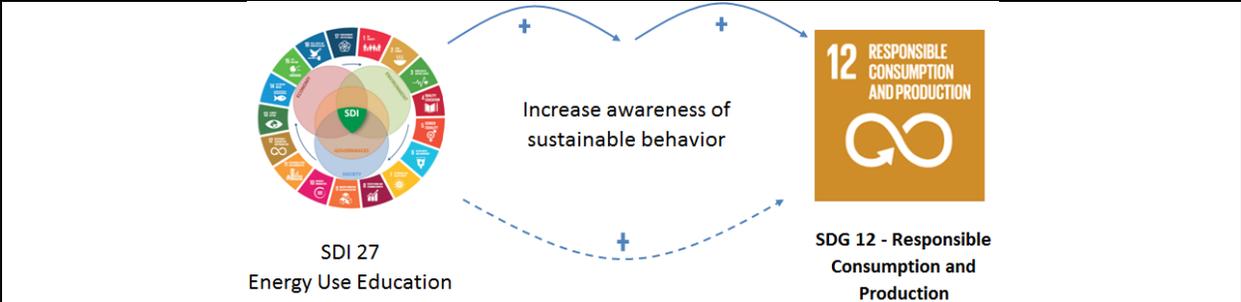
SDG 7 aims to ensure access to affordable, reliable, sustainable and modern energy, doubling the global energy efficiency rate (United Nations, 2015). Improving energy efficiency is one of the most constructive and cost-effective ways to address the challenges of high energy prices, energy security and independence, air pollution, and global climate change. (EPA - United States Environmental Protection Agency, 2019). Therefore, the reduction of energy consumption can contribute directly and positively to SDG 7.

Impacted SDG: SDG 13



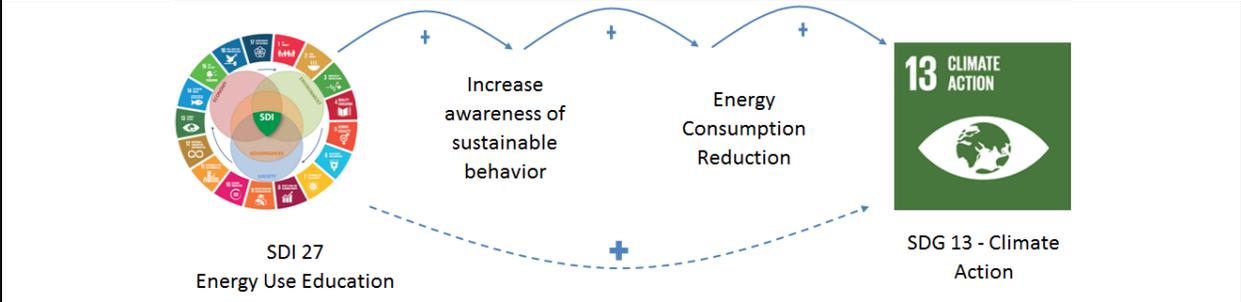
SDG 13 aims to take urgent action to combat climate change and its impacts (United Nations, 2015). Greenhouse gases from human activities are the most significant driver of observed climate change since the mid-20th century. Many of our daily activities - such as using electricity - cause greenhouse gas emissions (EPA - United States Environmental Protection Agency, 2017). Therefore, the reduction of energy consumption can contribute directly and positively to SDG 13.

SDI 27	Category:	Environmental
	Subcategory:	Energy
	Sustainability Target:	Energy Use Education
	Description:	Invest in energy use education programs (influencing consumer behaviour).
Impacted SDG:		SDG 12



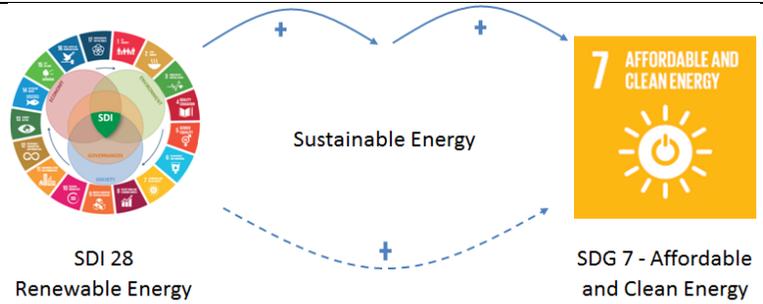
SDG 12 aims to ensure that people everywhere have relevant information and awareness for sustainable development and lifestyles in harmony with nature (United Nations, 2015). Education as a body of knowledge shows indispensable and necessary tools to contribute to awareness and change of individuals' attitudes and values regarding energy consumption (A.Dias, R.Mattos, & A.P.Balestieri, 2004). Therefore, the education and knowledge of energy consumption behaviour contribute directly and positively to SDG 12.

Impacted SDG: SDG 13



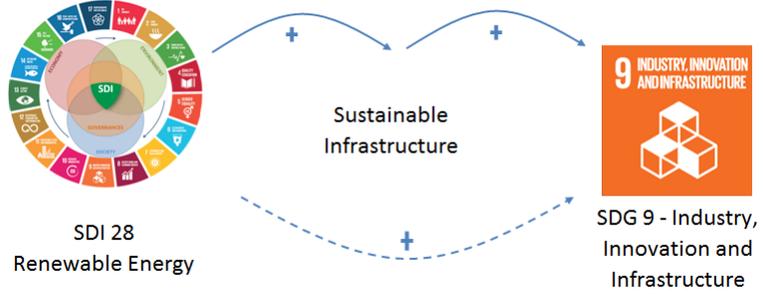
SDG 13 aims to take urgent action to combat climate change and its impacts (United Nations, 2015). Education as a body of knowledge shows indispensable and necessary tools to contribute to awareness and change of individuals' attitudes and values regarding energy consumption (A.Dias, R.Mattos, & A.P.Balestieri, 2004), impacting energy consumption reduction. Therefore, the education of energy consumption can contribute directly and positively to SDG 13.

SDI 28	Category:	Environmental
	Subcategory:	Energy
	Sustainability Target:	Renewable Energy
	Description:	Invest in renewable energy (green power).
Impacted SDG:		SDG 7



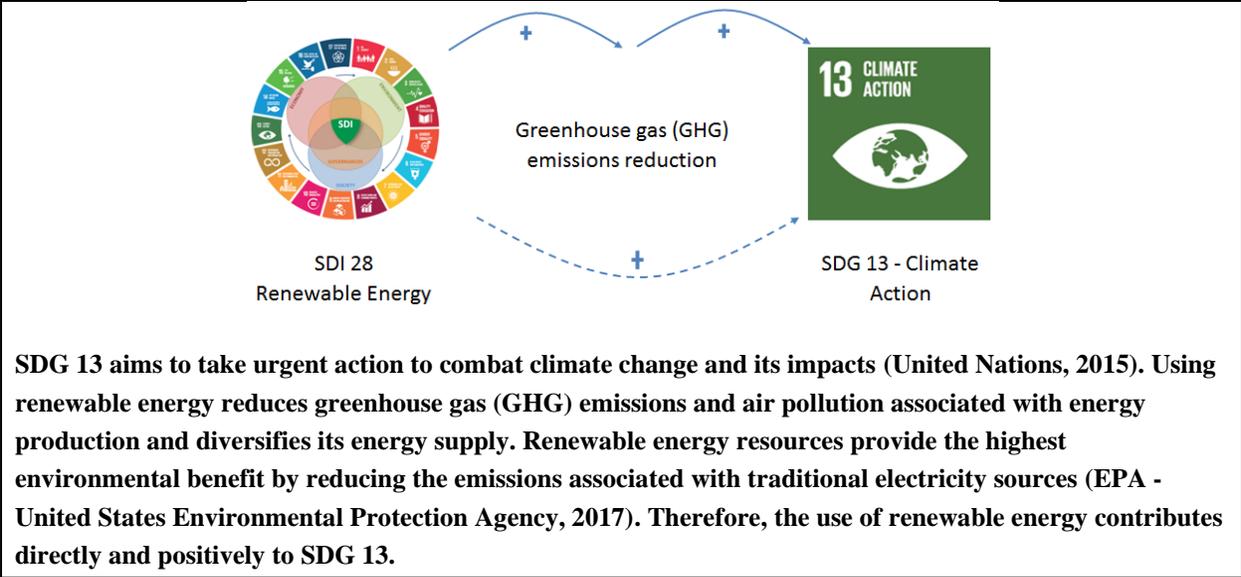
SDG 7 aims to ensure access to affordable, reliable, sustainable and modern energy for all, doubling the global rate of improvement in energy efficiency (United Nations, 2015). Using renewable energy reduces greenhouse gas (GHG) emissions and air pollution associated with energy production and diversifies its energy supply. Renewable energy resources provide the highest environmental benefit by reducing the emissions associated with traditional electricity sources (EPA - United States Environmental Protection Agency, 2017). Therefore, the use of renewable energy contributes directly and positively to SDG 7.

Impacted SDG: SDG 9



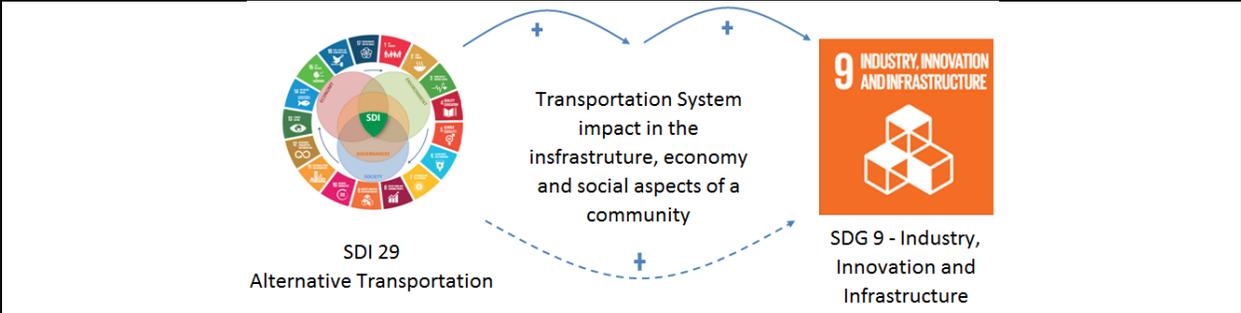
The SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. The objective is to upgrade infrastructure and retrofit industries, making them sustainable with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes; all countries take action according to their respective capabilities (United Nations, 2015). Renewable energy resources provide the highest environmental benefit by reducing the emissions associated with traditional electricity sources (EPA - United States Environmental Protection Agency, 2017). Therefore, using renewable energy impacts directly and positively on SDG 9.

Impacted SDG: SDG 13



SDI 29	Category:	Environmental
	Subcategory:	Local Impact
	Sustainability Target:	Alternative Transportation
	Description:	Offer alternative transportation options, providing public transportation access, bicycle storage, changing room, alternative fuel vehicles charge station, parking capacity, and carpooling, improving mobility, access, and community livability.

Impacted SDG: SDG 9



The SDG 9 - 9.1 aims to develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, focusing on affordable and equitable access for all (United Nations, 2015). An essential consideration for sustainable cities is a transport system that meets the needs for economic growth and, at the same time, care for the environment and people's quality of life. Sustainable urban transport is an attempt to contribute positively to communities and their built environments (Attard, Shiftan, Ison, & Shaw, 2015).

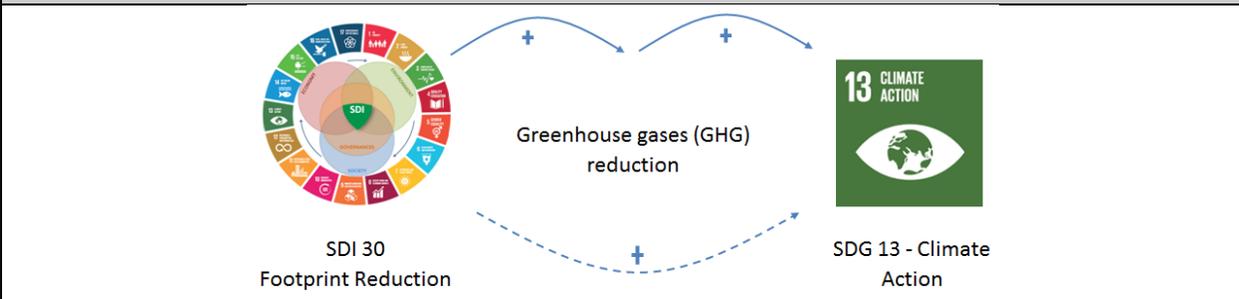
Impacted SDG: SDG 11



The urban transportation system provides passengers and freight movement in urbanized areas and includes different transportation modes and accessibility (Woldeamanuel, 2016). SDG 11:11.2 aims to achieve access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, special attention to the needs of those in vulnerable situations, women, children, and with disabilities and older persons (United Nations, 2015).

SDI 30	Category:	Environmental
	Subcategory:	Local Impact
	Sustainability Target:	Footprint Reduction
	Description:	To minimize the environmental harms associated with the project

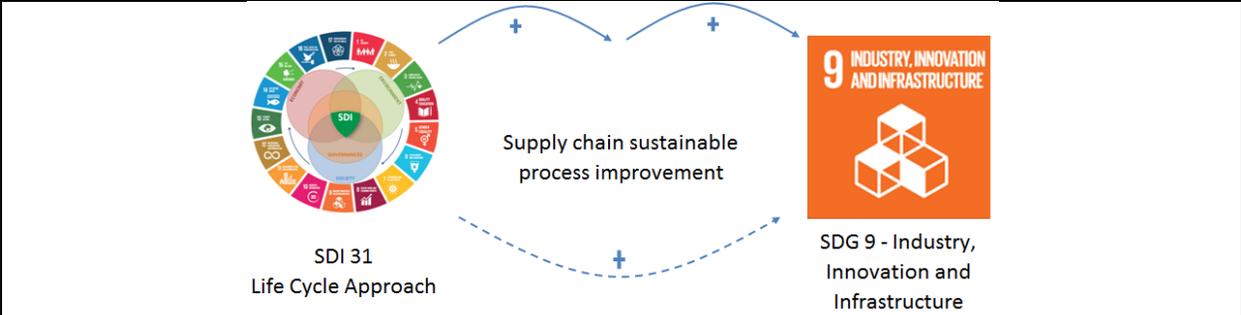
Impacted SDG: **SDG 13**



Greenhouse gases from human activities are the most significant driver of observed climate change since the mid-20th century. Many of our daily activities - such as using electricity, driving a car, or disposing of waste - cause greenhouse gas emissions. Together these emissions make up a carbon footprint that affects Climate Change (United States Environmental Protection Agency, 2017).

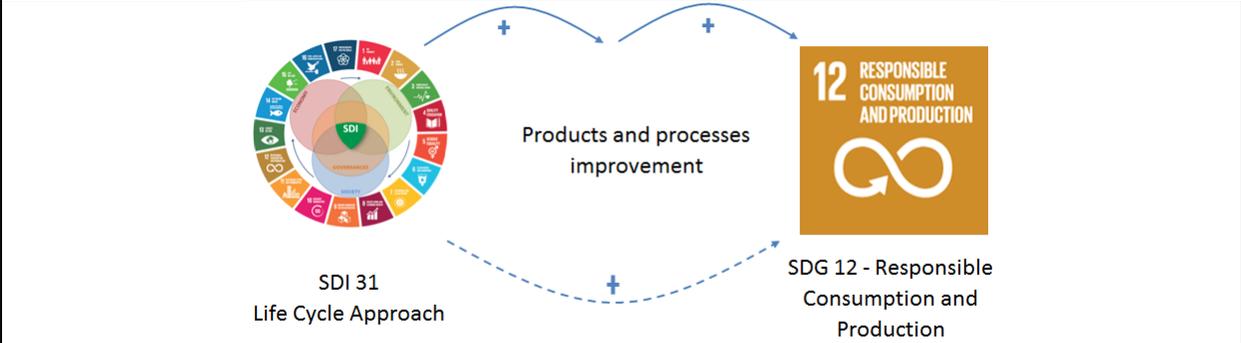
SDI 31	Category:	Environmental
	Subcategory:	Local Impact
	Sustainability Target:	Life Cycle Approach
	Description:	Implement life cycle approaches, obtaining materials and equipment from manufacturers and suppliers that implement sustainable practices.

Impacted SDG: **SDG 9**



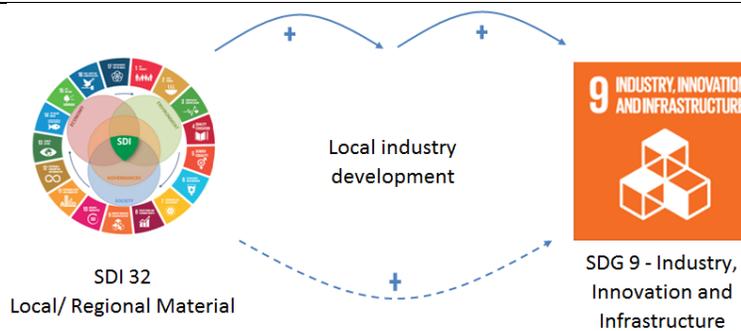
The buildings are becoming more efficient regarding energy efficiency due to regulations. Therefore, other construction phases such as choice of materials, construction, end-of-life and water gain more importance in the life cycle assessment (Buyle, Braet, & Audenaert, 2013). SDG 9 aims to promote inclusive and sustainable industrialization and foster innovation and upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes (United Nations, 2015).

Impacted SDG: SDG 12



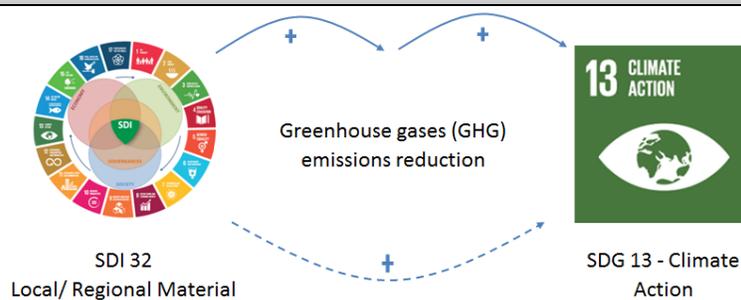
LCA is a tool to investigate a product or process's environmental burdens, considering the whole life cycle. The tool considers all aspects of the natural environment, human health and resource depletion (Buyle, Braet, & Audenaert, 2013). SDG 12 aims to ensure sustainable consumption and production patterns by achieving sustainable management and efficient use of natural resources, chemicals, and environmental waste management. Throughout life cycle analysis, significantly reduce emissions release to air, water and soil to minimize their adverse impacts on humans' health and the environment. The goal also aims to encourage companies to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015).

SDI 32	Category:	Environmental
	Subcategory:	Local Impact
	Sustainability Target:	Local/ Regional Material
	Description:	Use local/ regional materials to minimize transportation costs and greenhouse emissions and motivate local economic growth.
Impacted SDG:		SDG 9



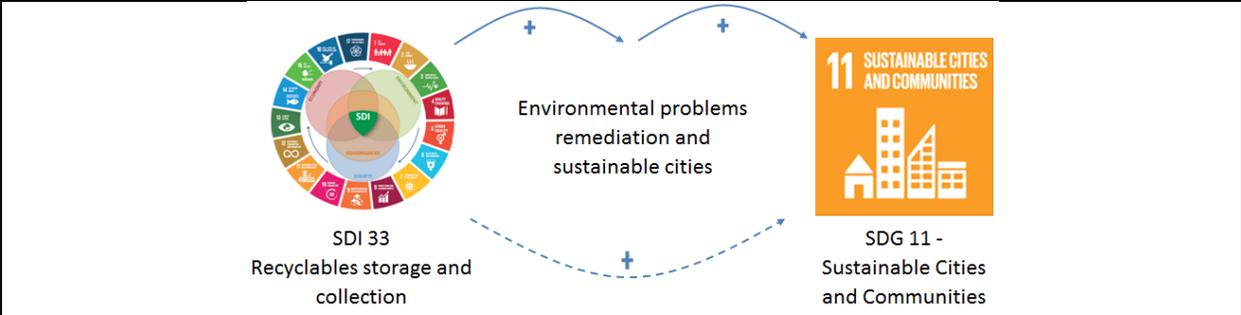
The SDG 9 aims to promote inclusive and sustainable industrialization, increase the access of small-scale industrial and other enterprises, and support local technology development, research and innovation (United Nations, 2015).

Impacted SDG: SDG 13



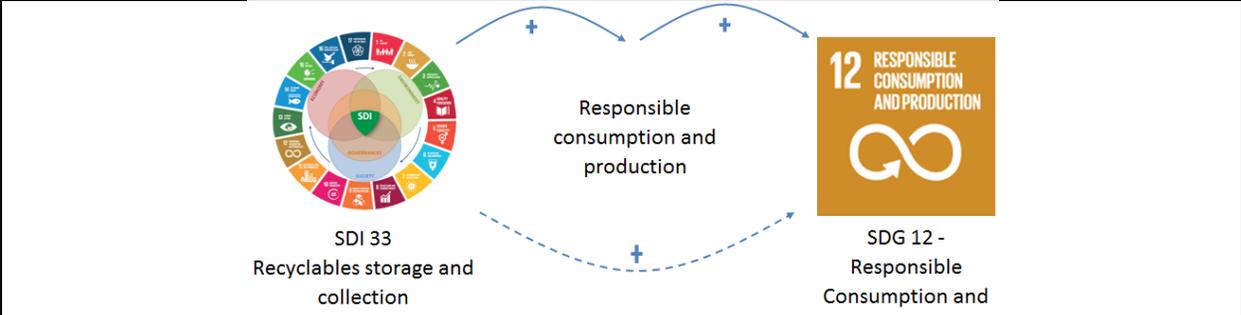
Greenhouse gases from human activities are the most significant driver of observed climate change since the mid-20th century. Many of our daily activities - such as using electricity, transportation, or disposing of waste - cause greenhouse gas emissions. Together these emissions make up a carbon footprint that affects Climate Change. The largest source of greenhouse gas emissions from human activities in the United States is from burning fossil fuels for electricity, heat, and transportation (United States Environmental Protection Agency, 2017).

SDI 33	Category:	Environmental
	Subcategory:	Local Impact
	Sustainability Target:	Recyclables storage and collection
	Description:	Create a storage and recyclables collection system, monitoring the correct use.
Impacted SDG:		SDG 11



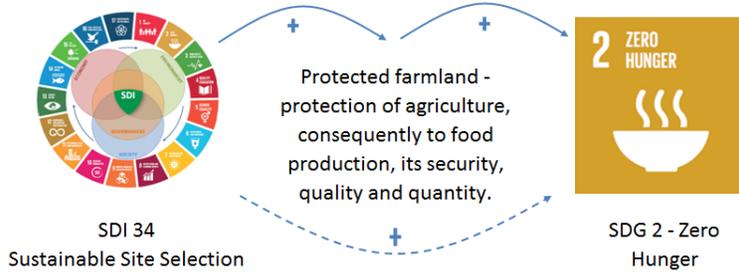
The smart cities have considerable potential in remediating environmental problems through facilitating waste management efforts that interconnected three elements: (1) the infrastructure for proper collection, (2) to prevent waste generation, and (3) proper upstream waste separation (Esmailian, et al., 2018).

Impacted SDG: **SDG 12**



The smart cities have considerable potential in remediating environmental problems through facilitating waste management efforts that interconnected three elements: (1) infrastructure for proper collection, (2) to prevent waste generation, and (3) proper upstream waste separation (Esmailian, et al., 2018). The SDG 12 aims substantially reduce waste generation through prevention, reduction, recycling and reuse. The chemical and environmental waste management, throughout their life cycle, reduce their release to air, water and soil to minimize their adverse impacts on human health and the environment (United Nations, 2015).

SDI 34	Category:	Environmental
	Subcategory:	Local Impact
	Sustainability Target:	Sustainable Site Selection
	Description:	Select suitable sites, protecting soils designated as important or protected farmland and improving user accessibility, safety, and wayfinding of the site and surrounding areas.
Impacted SDG:		SDG 2



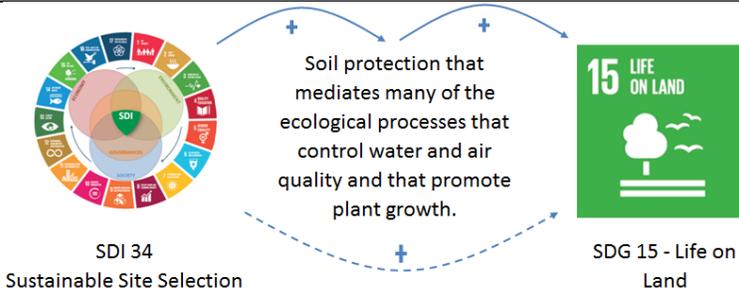
The demographic shifts have a significant impact on society, the economy, and the environment. There are many reasons to improve the awareness and protection of agricultural areas, such as food production, security, quality, and quantity (Provincial Agricultural Land Commission BC, 2014).

Impacted SDG: SDG 11



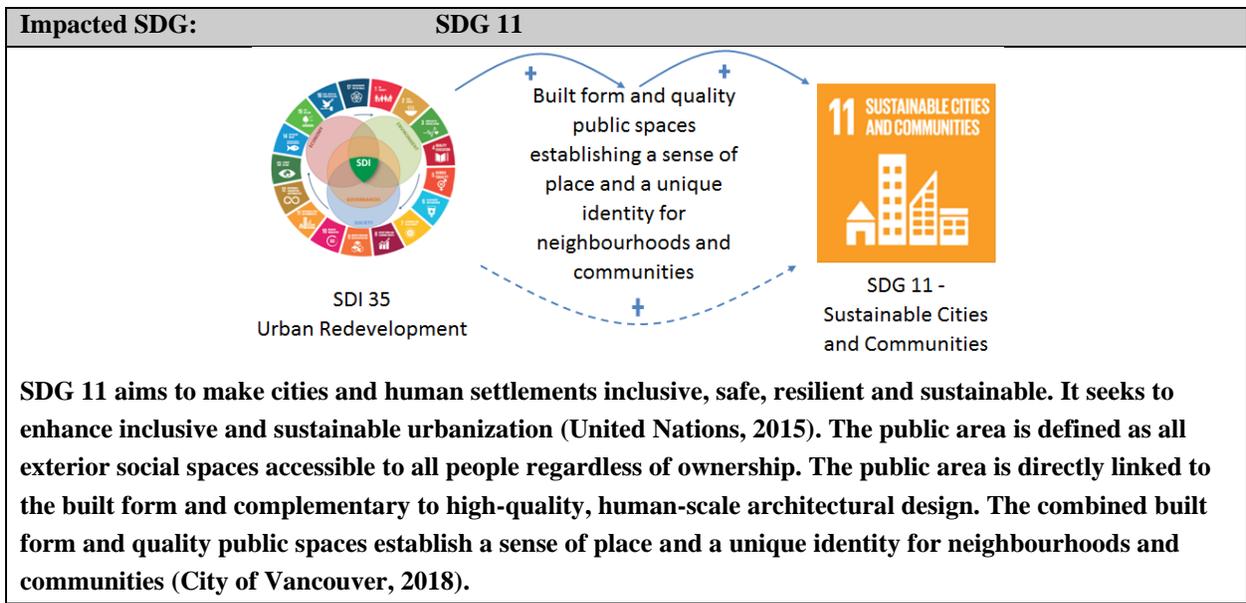
The SDG 11 (Sustainable Cities and Communities) claims to make cities and human settlements inclusive, safe, resilient and sustainable (United Nations, 2015).

Impacted SDG: SDG 15

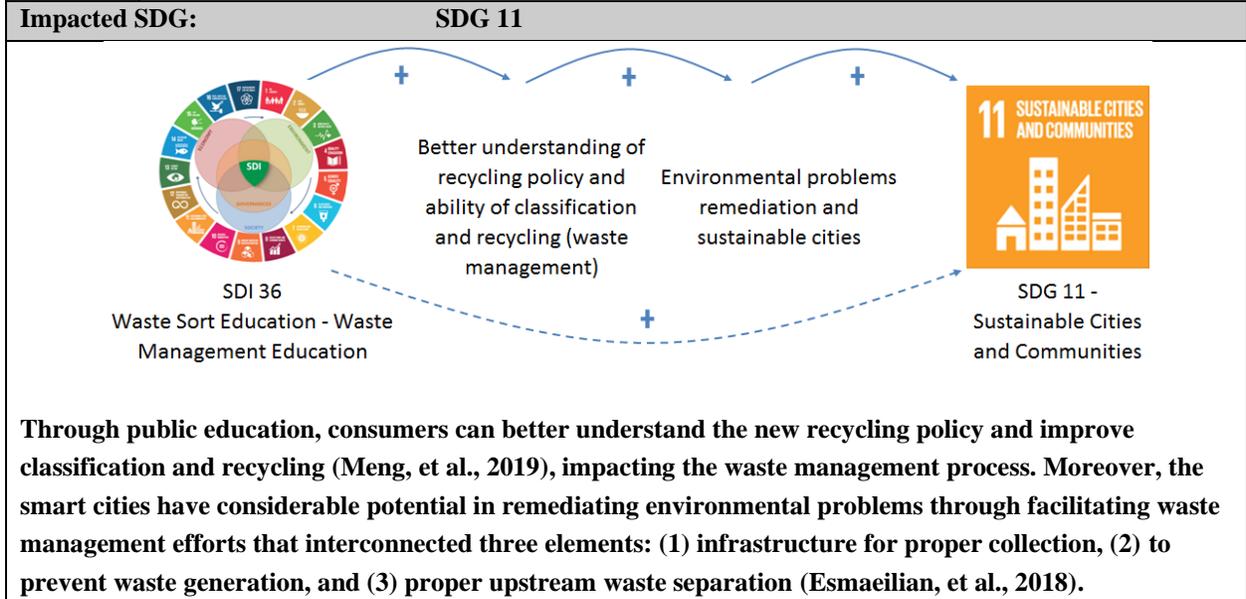


Soil serves as a medium for plant growth; a sink for heat, water, and chemicals; a filter for water; and a biological medium for the breakdown of wastes. Soil interacts intimately with water, air, and plants and acts as a damper to fluctuations in the environment. Soil mediates many ecological processes that control water and air quality and promote plant growth (National Academy of Sciences, 1993). Therefore, the selection of the site is significant for the ecosystem.

SDI 35	Category:	Environmental
	Subcategory:	Local Impact
	Sustainability Target:	Urban Redevelopment
	Description:	Redevelop urban areas, improving public spaces such as parks, plazas, recreational facilities, or wildlife refuges to enhance community livability.



SDI 36	Category:	Environmental
	Subcategory:	Local Impact
	Sustainability Target:	Waste Sort Education - Waste Management Education
	Description:	Implement a recycling program at the administrative level of the organization.

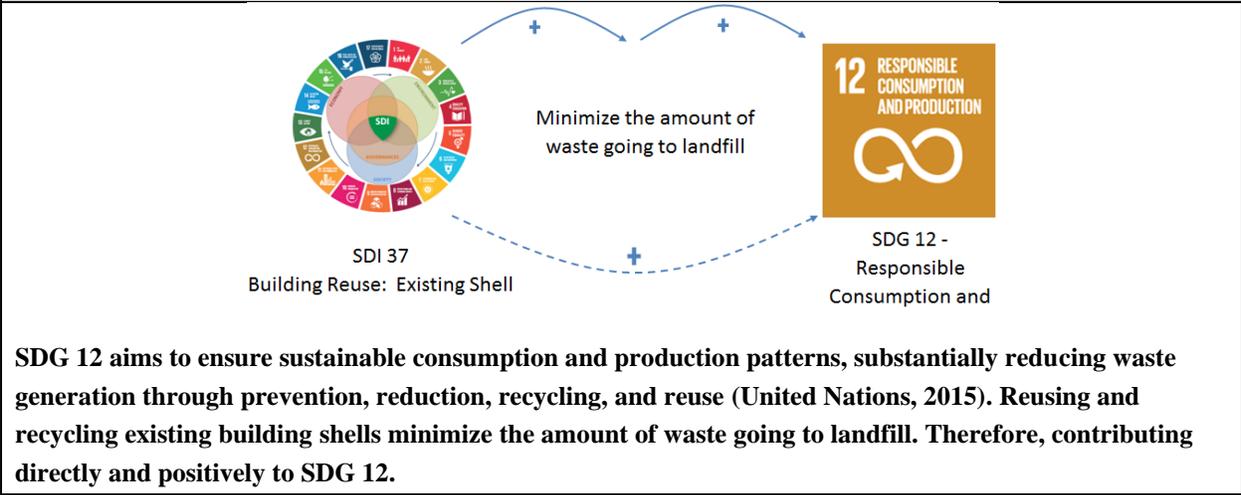


Impacted SDG: SDG 12



SDI 37	Category:	Environmental
	Subcategory:	Resource Consumption
	Sustainability Target:	Building Reuse: Existing Shell
	Description:	Reuse existing building shells, minimizing waste from former construction.

Impacted SDG: **SDG 12**



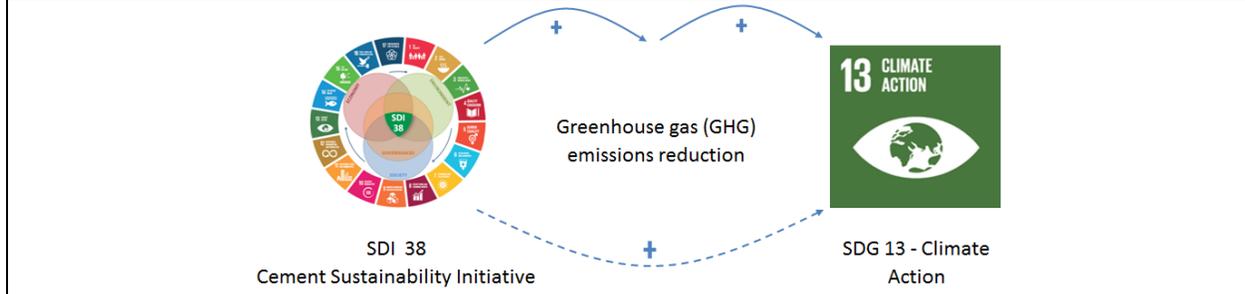
SDI 38	Category:	Environmental
	Subcategory:	Resource Consumption
	Sustainability Target:	Cement Sustainability Initiative
	Description:	Use sustainable cement technologies.

Impacted SDG: SDG 9



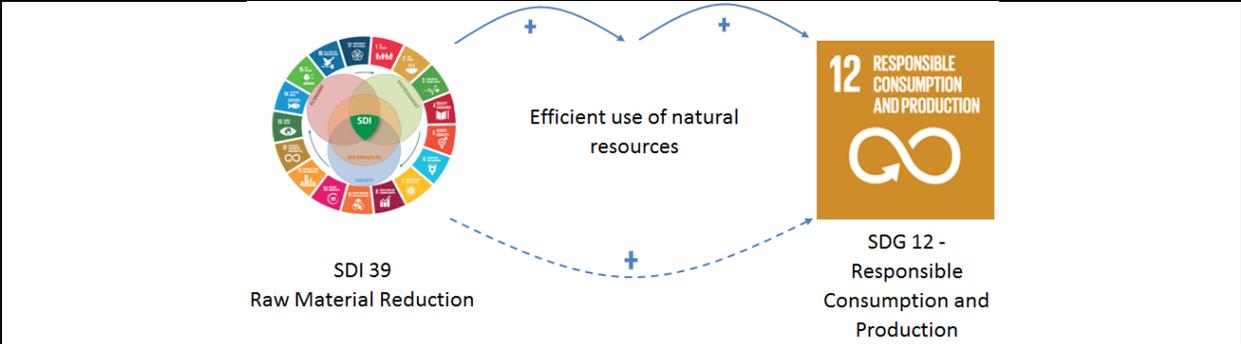
SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation, upgrading infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes (United Nations, 2015). The cement industry is ranking the second highly carbon-intensive in terms of value at stake from carbon costs. In recent years, the cement industry has been active in promoting a sectoral approach to reducing CO2 emissions, helping the industry become more sustainable (Cook & Ponsard, 2011). Therefore, contributing directly and positively to SDG 9.

Impacted SDG: SDG 13



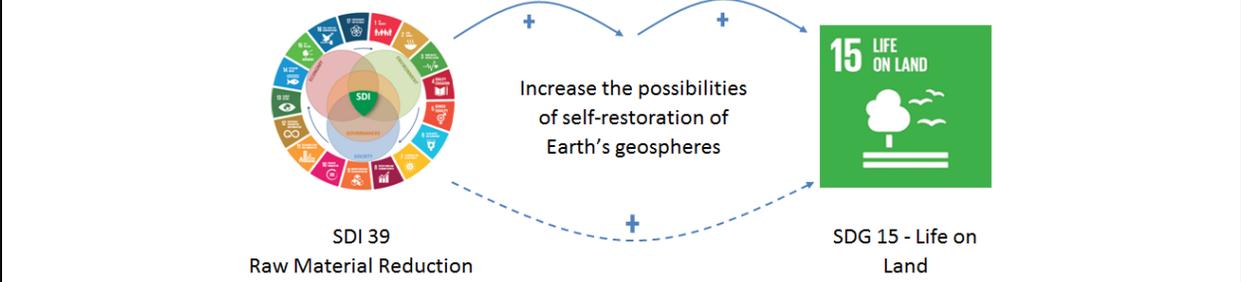
SDG 13 aims to take urgent action to combat climate change and its impacts on integrating climate change measures into national policies, strategies, and planning (United Nations, 2015). The cement industry is ranking the second highly carbon-intensive in terms of value at stake from carbon costs. In recent years, the cement industry has been active in promoting a sectoral approach to reducing CO2 emissions (Cook & Ponsard, 2011). Therefore, contributing directly and positively to SDG 13.

SDI 39	Category:	Environmental
	Subcategory:	Resource Consumption
	Sustainability Target:	Raw Material Reduction
	Description:	Reduce raw material usage, identifying and pursuing opportunities to use unwanted by-products or discarded materials and resources from nearby operations, and use products that meet at least one of the responsible extractions
Impacted SDG:		SDG 12



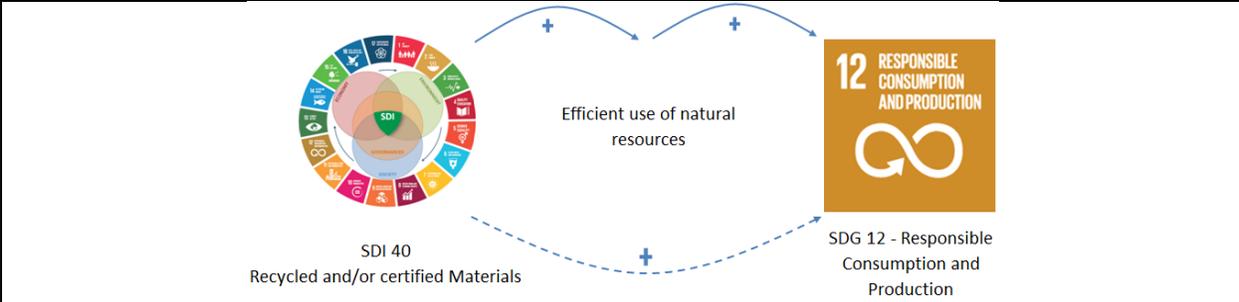
SDG 12 aims to ensure sustainable consumption and production patterns implement programmes on sustainable consumption and production and achieve sustainable management and efficient use of natural resources (United Nations, 2015). Constantly growing human society requirements determine the emergence of more capable technical means and technologies to develop raw fields. However, an increase in the rates of expenditure and production of resources, which is inconsistent with the possibilities of self-restoration of Earth’s geospheres, leads to a violation of natural balance (Lavrusevich, Abene, & Lavrusevich, 2019). Therefore, reducing the consumption of raw materials contributes directly and positively to SDG 12.

Impacted SDG: SDG 15



SDG 15 aims to take urgent and significant action to reduce natural habitats' degradation and halt biodiversity loss (United Nations, 2015). The increase in the rates of expenditure and production of resources, which is inconsistent with the possibilities of self-restoration of Earth’s geospheres, leads to a violation of natural balance (Lavrusevich, Abene, & Lavrusevich, 2019). Therefore, reducing the consumption of raw materials contributes directly and positively to SDG 15.

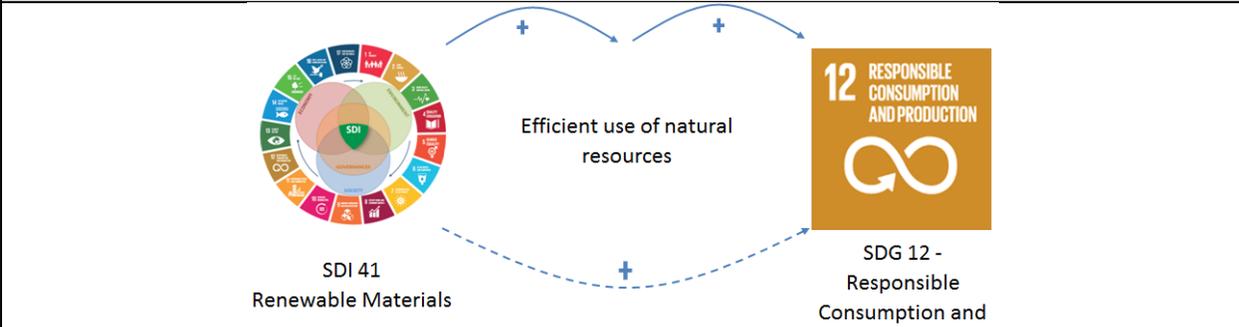
SDI 40	Category:	Environmental
	Subcategory:	Resource Consumption
	Sustainability Target:	Recycled and certified Materials
	Description:	Use recycled materials or certified products that demonstrate impact reduction into the project.
Impacted SDG:		SDG 12



SDG 12 aims to ensure sustainable consumption and production patterns implementing programmes on sustainable consumption and production and achieving sustainable management and efficient use of natural resources (United Nations, 2015). Using and reusing materials more productively over their entire life cycles represents a change in how our society thinks about natural resources and environmental protection. By looking at a product's life cycle, we can find new opportunities to reduce environmental impacts, conserve resources and reduce costs (EPA - United States Environmental Protection Agency, 2019). Therefore, reducing the consumption of raw materials contributes directly and positively to SDG 12.

SDI 41	Category:	Environmental
	Subcategory:	Resource Consumption
	Sustainability Target:	Renewable Materials
	Description:	Use renewable materials in the project.

Impacted SDG: SDG 12

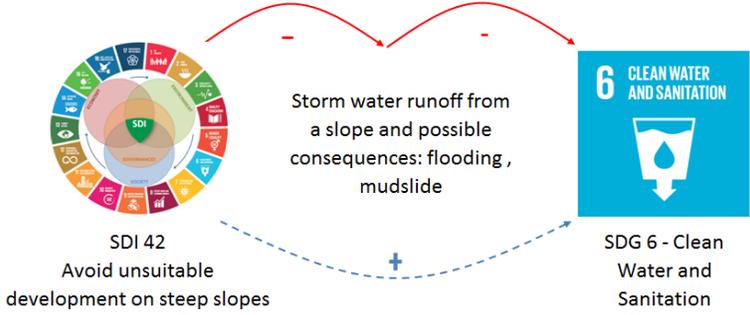


SDG 12 aims to ensure sustainable consumption and production patterns implementing programmes on sustainable consumption and production and achieving sustainable management and efficient use of natural resources (United Nations, 2015). Natural and renewable building and insulation materials can be made from biological sources such as hemp, flax, wood, straw, sheep's wool, etc. They can be combined with benign or low impact materials, such as lime and earth, into composites. Many building problems can be solved using these materials, opening the possibility of significant benefits in less pollution, less energy used, and better and healthier buildings (Woolley, 2013). Therefore, utilizing renewable materials contributes directly and positively to SDG 12.

SDI 42	Category:	Environmental
	Subcategory:	Soil
	Sustainability Target:	Avoid unsuitable development on steep slopes

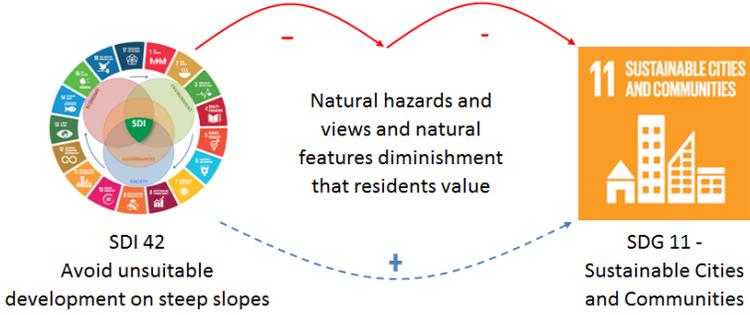
Description: To protect steep slopes and hillsides from inappropriate and unsuitable development, avoiding exposures and risks from erosion, landslides, and other natural hazards.

Impacted SDG: SDG 6



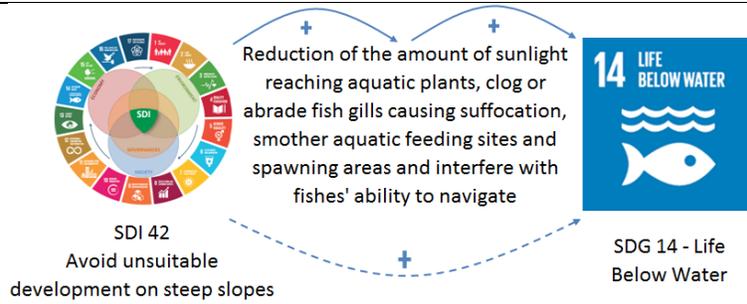
Development can remove surface depressions that store rainfall, and construction activities can compact the soil and diminish its infiltration rate, resulting in increased rate and volumes of stormwater runoff from the development site (New Jersey Department of Environmental Protection, 2004)

Impacted SDG: SDG 11



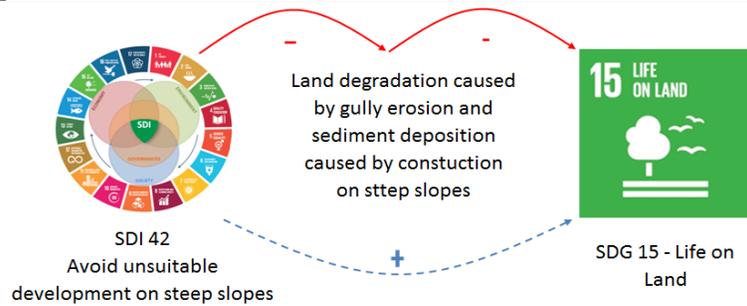
Steep slope areas are prone to natural hazards; they topographically constrain the design of developments and contain many natural features or aesthetic values that may need to be protected. Despite the constraints, they are attractive places to live. However, according to the City of Nanaimo, inadequate and excessive hillside development can diminish the very views and natural features residents value (City of Nanaimo, 2005).

Impacted SDG: SDG 14



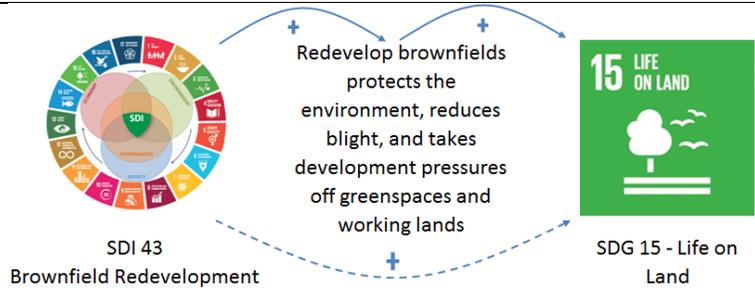
Eroded particles of soil, or sediments, can easily be moved off construction and landscaping sites by flowing water and end up in natural water bodies. These sediments can cause damage to receiving water bodies. Sediment in water bodies can reduce the amount of sunlight reaching aquatic plants, clog or abrade fish gills causing suffocation, smother aquatic feeding sites, spawning areas and interfere with fishes' ability to navigate. Preventing and controlling erosion is essential to the protection of natural streams, rivers and saltwater ecosystems (Capital Regional District - CRD, 2019)

Impacted SDG: SDG 15



Soil erosion, sediment transport, siltation, and deposition can cause diverse effects of on-site and off-site construction, such as land degradation caused by gully erosion and sediment deposition (Official Portal for Department of Irrigation and Drainage, 2017). Erosion control also includes physically changing the landscape, which can impact the valuable agricultural land (National Geographic Headquarters, 2019)

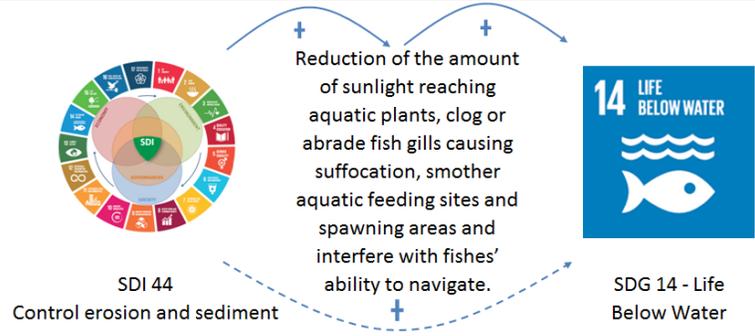
SDI 43	Category:	Environmental
	Subcategory:	Soil
	Sustainability Target:	Brownfield Redevelopment
	Description:	Redevelop brownfield sites, restoring soils disturbed during previous development and new construction to bring back ecological and hydrological functions.
Impacted SDG:		SDG 15



Cleaning up and reinvesting in "brownfield site"—redevelopment or reuse of a complicated land by the presence or potential presence of a hazardous substance, pollutant, or contaminant—protects the environment, reduces blight, and takes development pressures off greenspaces and working lands (United States Environmental Protection Agency, 2019).

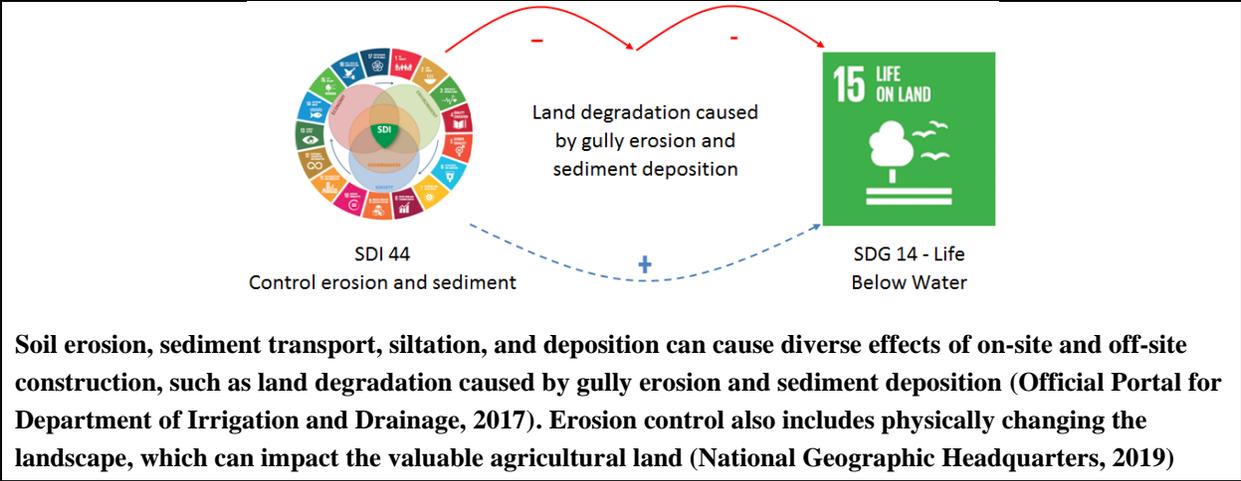
SDI 44	Category:	Environmental
	Subcategory:	Soil
	Sustainability Target:	Control erosion and sediment.
	Description:	To minimize the movement of soils and other excavated materials off-site to reduce transportation and environmental impacts.

Impacted SDG: SDG 14



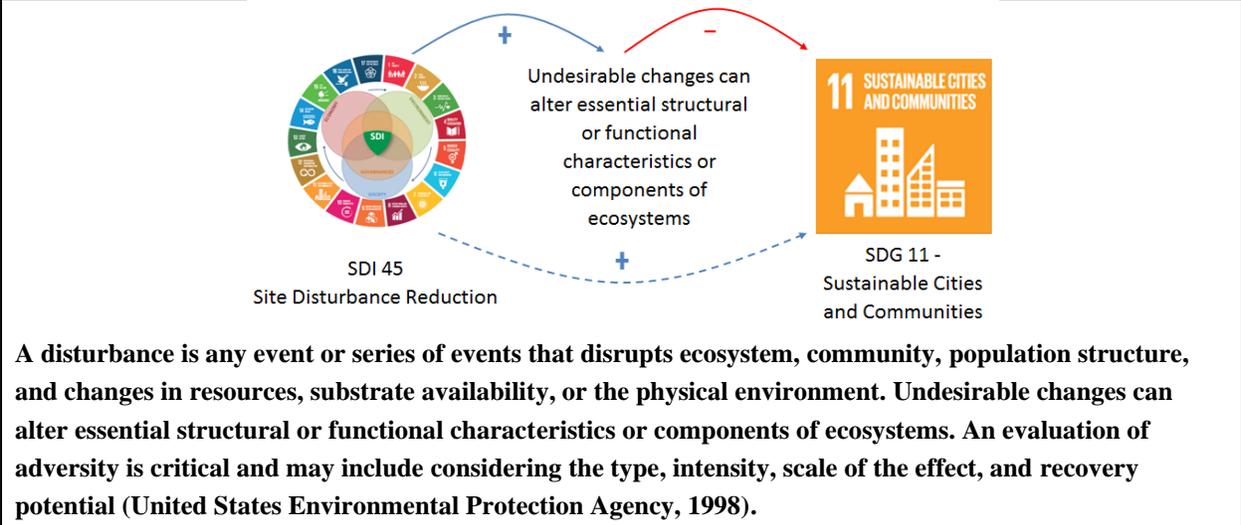
Eroded particles of soil, or sediments, can easily be moved off construction and landscaping sites by flowing water and end up in natural water bodies. These sediments can cause damage to receiving water bodies. Sediment in water bodies can reduce the amount of sunlight reaching aquatic plants, clog or abrade fish gills causing suffocation, smother aquatic feeding sites, spawning areas and interfere with fishes' ability to navigate. Preventing and controlling erosion is essential to protecting natural streams, rivers and saltwater ecosystems (Capital Regional District - CRD, 2019).

Impacted SDG: SDG 15

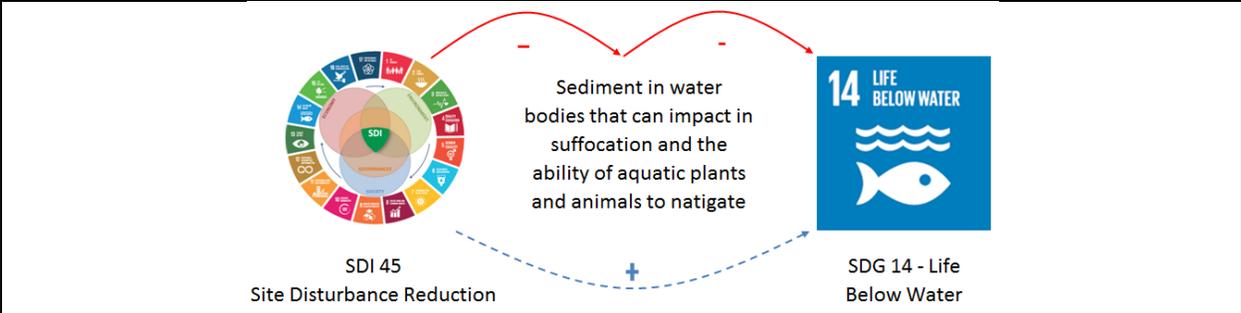


SDI 45	Category:	Environmental
	Subcategory:	Soil
	Sustainability Target:	Site Disturbance Reduction
	Description:	Reduce site disturbance, protect or restore open space, and avoid the development of adverse geologic formations; safeguard aquifers to reduce risks of natural hazards and preserve high-quality groundwater resources.

Impacted SDG: SDG 11

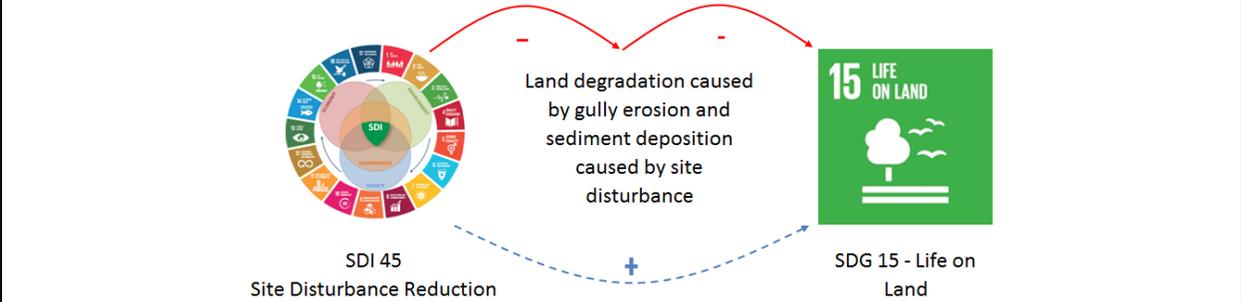


Impacted SDG: SDG 14



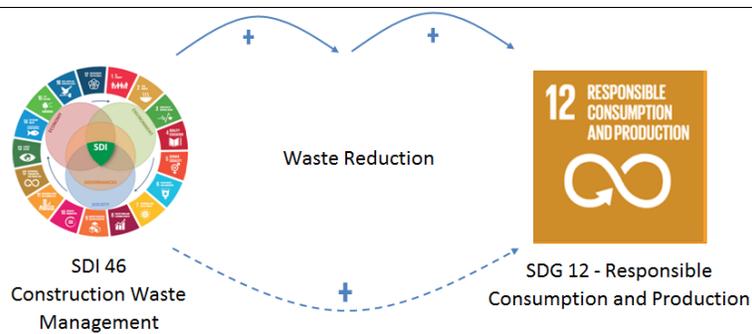
A disturbance is any event or series of events that disrupts ecosystem, community, population structure, and changes in resources, substrate availability, or the physical environment (United States Environmental Protection Agency, 1998). Eroded particles of soil, or sediments, can easily be moved off construction and landscaping sites by flowing water and end up in natural water bodies. These sediments can cause damage to receiving water bodies. Sediment in water bodies can reduce the amount of sunlight reaching aquatic plants, clog or abrade fish gills causing suffocation, smother aquatic feeding sites, spawning areas and interfere with fishes’ ability to navigate. Preventing and controlling erosion is essential to the protection of natural streams, rivers and saltwater ecosystems (Capital Regional District - CRD, 2019)

Impacted SDG: SDG 15



Site disturbance can cause soil erosion that can cause diverse effects of on-site and off-site construction, such as land degradation caused by gully erosion and sediment deposition (Official Portal for Department of Irrigation and Drainage, 2017). Erosion control also includes physically changing the landscape, which can impact the valuable agricultural land (National Geographic Headquarters, 2019)

SDI 46	Category:	Environmental
	Subcategory:	Waste
	Sustainability Target:	Construction Waste Management
	Description:	Implement construction waste management (hazardous wastes; recycled wastes; solid wastes; sewage-related issues; radioactive wastes).
Impacted SDG:		SDG 12



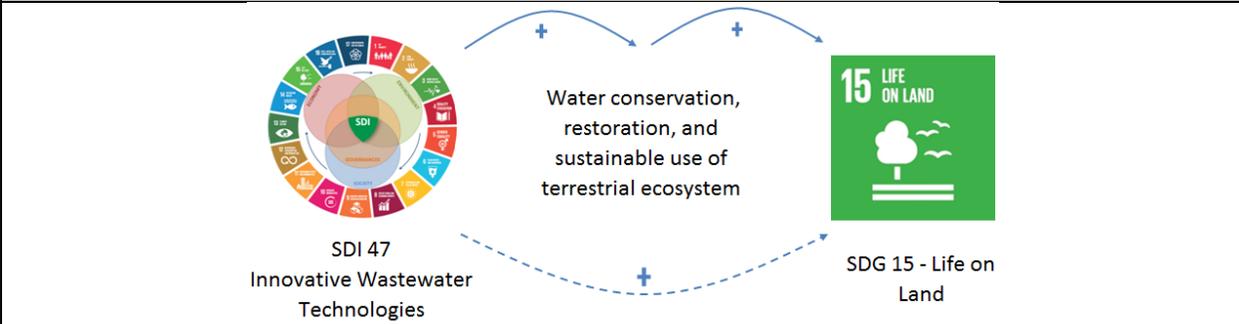
SDG 12 aims to ensure sustainable consumption and production patterns achieving the environmentally sound management of chemicals and all wastes throughout their life cycle and substantially reduce waste generation through prevention, reduction, recycling, and reuse (United Nations, 2015). The construction industry is one of the industries that generates and dumps heaps of waste to landfill. Waste leads to an unnecessary loss of natural resources, such as water and embodied energy. Natural resource depletion can only be avoided or reduced via sustainable consumption and strategic waste management based on resource recovery, waste avoidance, and efficient material use with less embodied energy (Li, 2015). Therefore, waste management in the construction industry contributes directly and positively to SDG 12.

SDI 47	Category:	Environmental
	Subcategory:	Water
	Sustainability Target:	Innovative Wastewater Technologies
	Description:	Invest in innovative wastewater technologies, reducing overall potable water consumption and encouraging greywater, recycled water, and stormwater to meet water needs.
Impacted SDG:		SDG 6



SDG 6 aims to ensure availability and sustainable water and sanitation management for all and substantially increase water-use efficiency across all sectors (United Nations, 2015). Wastewater Process is the treatment or processing of wastewater to produce quality water appropriate for another use, including recycling or reuse. Wastewater Recycling Treatment is the process of collecting and treating wastewater on-site for return and uses back into the same site; for example, collection and reclamation of graywater from an establishment for subsequent toilet flushing in that same establishment. Wastewater Reuse Reclamation is collecting and treating wastewater for the deliberate application of that treated wastewater for a beneficial purpose such as turf irrigation (Bahadori & Smith, 2016). Wastewater management is a practice that encourages water and wastewater treatment to be on a sustainable path. It needs investments to result in efficient infrastructure systems and a pace and level that allows the water and wastewater sectors to provide the desired service levels over the long term (Spellman, 2013). Therefore, wastewater management in the construction industry contributes directly and positively to SDG 6.

Impacted SDG: SDG 15

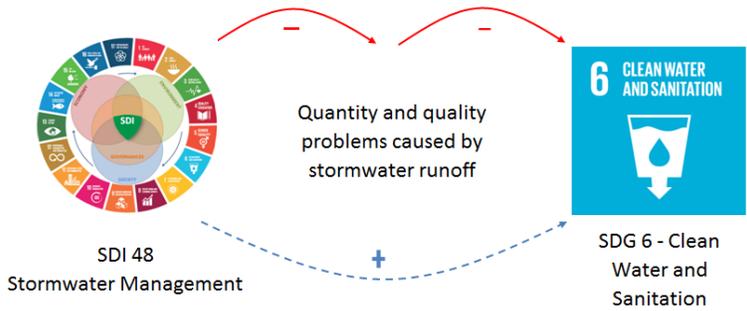


SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems, ensuring the conservation, restoration, and sustainable use of terrestrial and inland freshwater ecosystems and their services (United Nations, 2015). Wastewater management is a practice that encourages water and wastewater treatment to be on a sustainable path. It needs investments to result in efficient infrastructure systems and a pace and level that allows the water and wastewater sectors to provide the desired service levels over the long term (Spellman, 2013). Therefore, wastewater management in the construction industry contributes directly and positively to SDG 15, efficiently utilizing water resources.

SDI 48	Category:	Environmental
	Subcategory:	Water
	Sustainability Target:	Stormwater Management

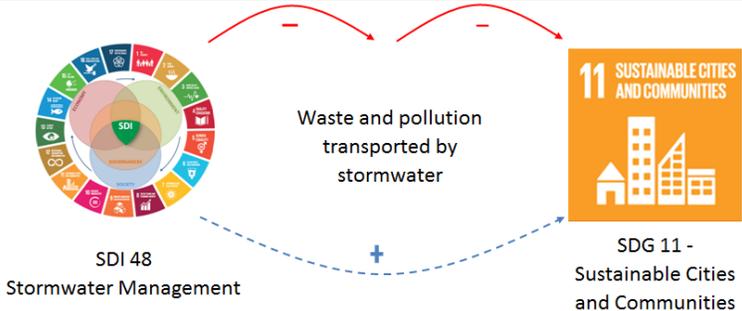
Description: Implement stormwater management, minimizing the impact of infrastructure on quantity and quality of stormwater runoff.

Impacted SDG: SDG 6



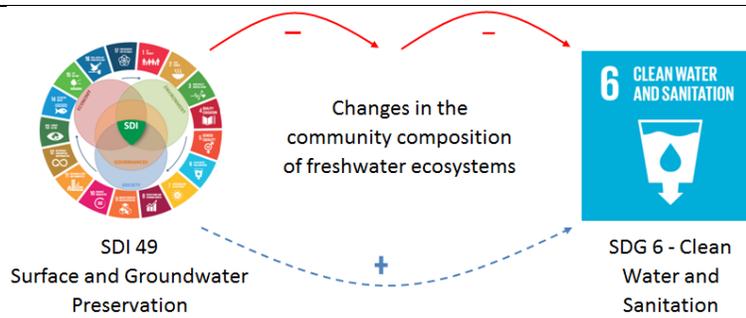
SDG 6 aims to ensure availability and sustainable water and sanitation management for all, implementing integrated water resources management at all levels (United Nations, 2015). Waste and pollution transported by stormwater pose quantity and quality problems, affecting public health and the environment's quality. The perception of stormwater changed considerably during the centuries, affecting sanitation infrastructures in urbanized regions (Barbosa, Fernandes, & David, 2012). Therefore, stormwater management in the construction industry contributes directly and positively to SDG 6.

Impacted SDG: SDG 11



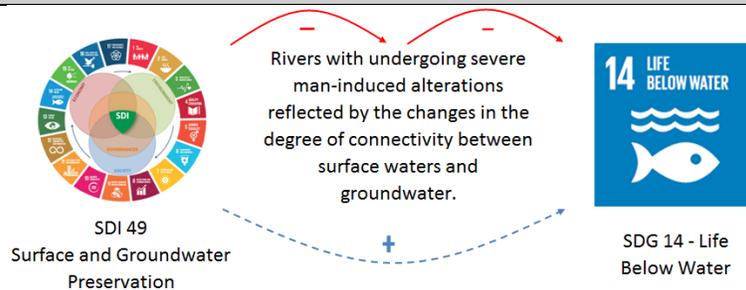
SDG 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable, reducing the adverse per capita environmental impact of cities, including paying particular attention to air quality and municipal and other waste management (United Nations, 2015). Waste and pollution transported by stormwater pose quantity and quality problems, affecting public health and the environment's quality. The perception of stormwater changed considerably during the centuries, affecting sanitation infrastructures in urbanized regions (Barbosa, Fernandes, & David, 2012). An evaluation of adversity is critical and may include considering the type, intensity, scale of the effect, and recovery potential (United States Environmental Protection Agency, 1998). Therefore, stormwater management in the construction industry contributes directly and positively to SDG 11.

SDI 49	Category:	Environmental
	Subcategory:	Water
	Sustainability Target:	Surface and Groundwater Preservation
	Description:	Prevent surface and groundwater contamination.
Impacted SDG:		SDG 6



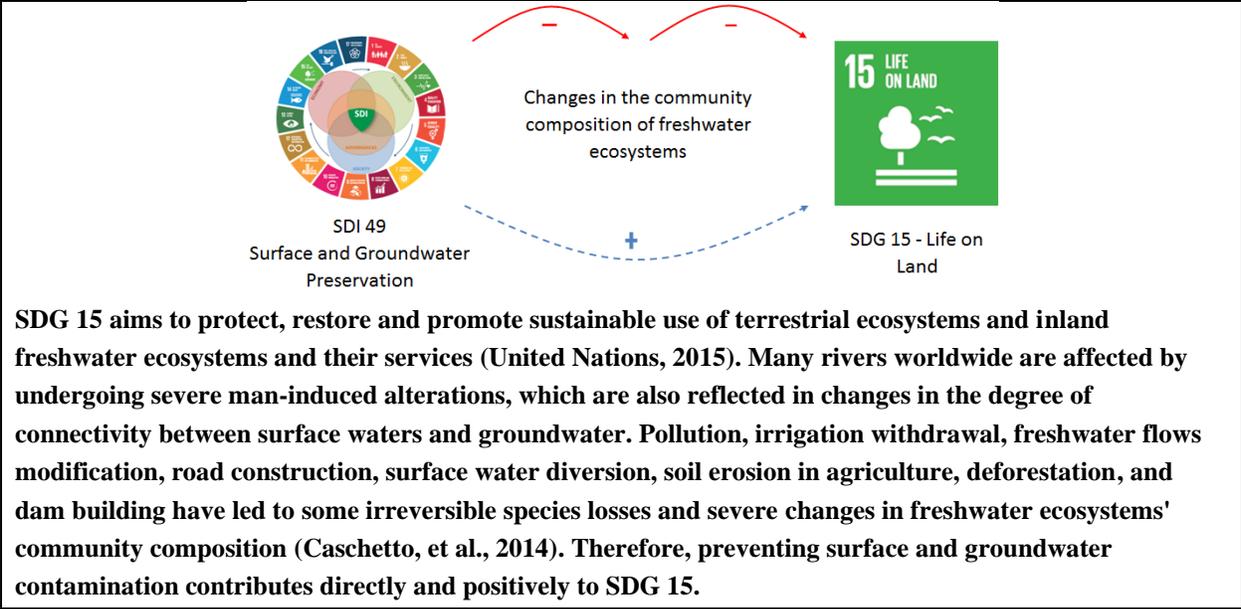
SDG 6 aims to ensure availability and sustainable water and sanitation management for all, protecting and restoring water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes (United Nations, 2015). Many rivers worldwide are affected by undergoing severe man-induced alterations, which are also reflected in changes in the degree of connectivity between surface waters and groundwater. Pollution, irrigation withdrawal, modification of freshwater flows, road construction, surface water diversion, soil erosion in agriculture, deforestation, and dam building have led to some irreversible species losses and severe changes in freshwater ecosystems' community composition (Caschetto, et al., 2014). Therefore, preventing surface and groundwater contamination contributes directly and positively to SDG 6

Impacted SDG: SDG 14



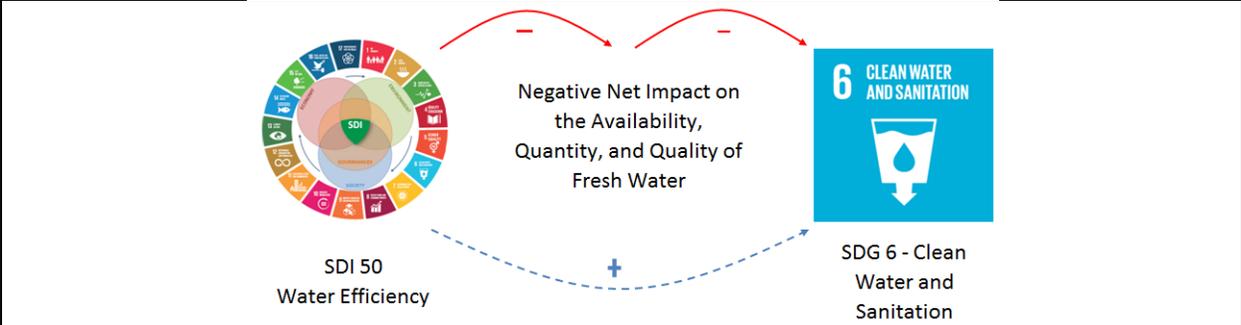
SDG 14 aims to conserve and sustainably use the oceans, seas and marine resources for sustainable development, preventing and significantly reducing marine pollution of all kinds, particularly from land-based activities (United Nations, 2015). Many rivers worldwide are affected by undergoing severe man-induced alterations, which are also reflected in changes in the degree of connectivity between surface waters and groundwater. Pollution, irrigation withdrawal, modification of freshwater flows, road construction, surface water diversion, soil erosion in agriculture, deforestation, and dam building have led to some irreversible species losses and severe changes in freshwater ecosystems' community composition (Caschetto, et al., 2014). Therefore, preventing surface and groundwater contamination contributes directly and positively to SDG 14.

Impacted SDG: SDG 15



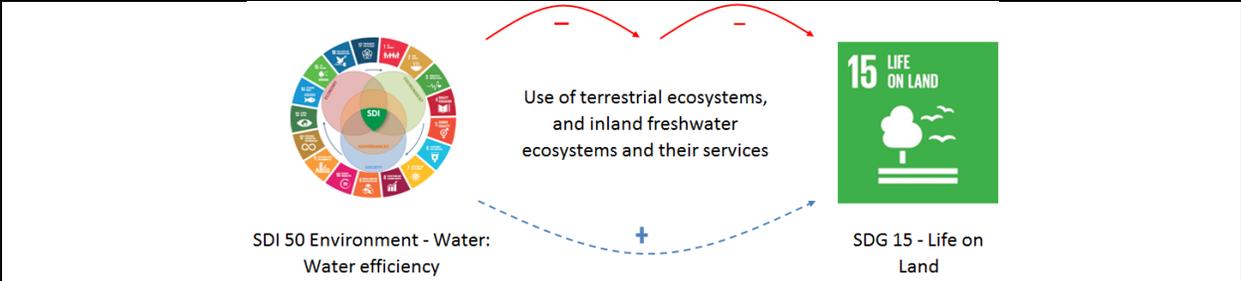
SDI 50	Category:	Environmental
	Subcategory:	Water
	Sustainability Target:	Water efficiency
	Description:	Improve water efficiency, reducing the negative net impact on the availability, quantity, and quality of freshwater.

Impacted SDG: SDG 6



SDG 6 aims to ensure availability and sustainable water and sanitation management, substantially increasing water-use efficiency across all sectors and ensuring sustainable withdrawals and freshwater supply to address water scarcity (United Nations, 2015). Terrestrial water fluxes are affected by direct human interventions, and humans directly change the dynamics of the water cycle through water withdrawals for industrial, agricultural, or domestic purposes. The impacts of water withdrawals and water consumption on the long-term global terrestrial water balance can be small. However, anthropogenic interventions' effects result in substantial changes in vegetation composition and distribution patterns (Haddeland, et al., 2014). Therefore, the efficient use of water contributes directly and positively to SDG 6.

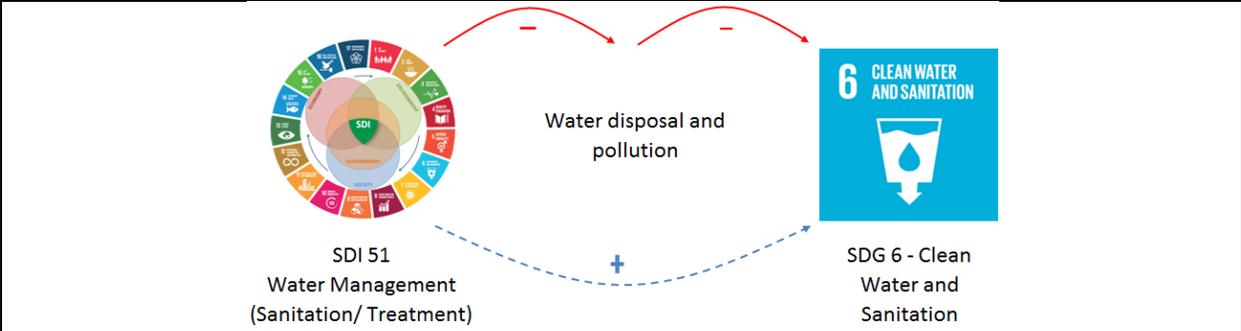
Impacted SDG: SDG 15



SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems and inland freshwater ecosystems and their services (United Nations, 2015). Terrestrial water fluxes are affected by direct human interventions, and humans directly change the dynamics of the water cycle through water withdrawals for industrial, agricultural, or domestic purposes. The impacts of water withdrawals and water consumption on the long-term global terrestrial water balance can be small. However, anthropogenic interventions' effects result in substantial changes in vegetation composition and distribution patterns (Haddeland, et al., 2014). Therefore, the efficient use of water contributes directly and positively to SDG 15.

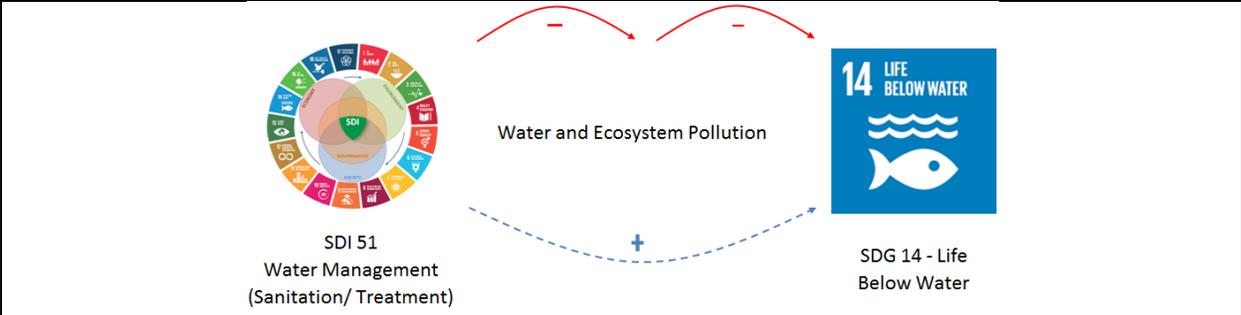
SDI 51	Category:	Environmental
	Subcategory:	Water
	Sustainability Target:	Water Management (Sanitation/ Treatment)
	Description:	Manage water treatment and disposal, preserving floodplain functions and pollution.

Impacted SDG: SDG 6



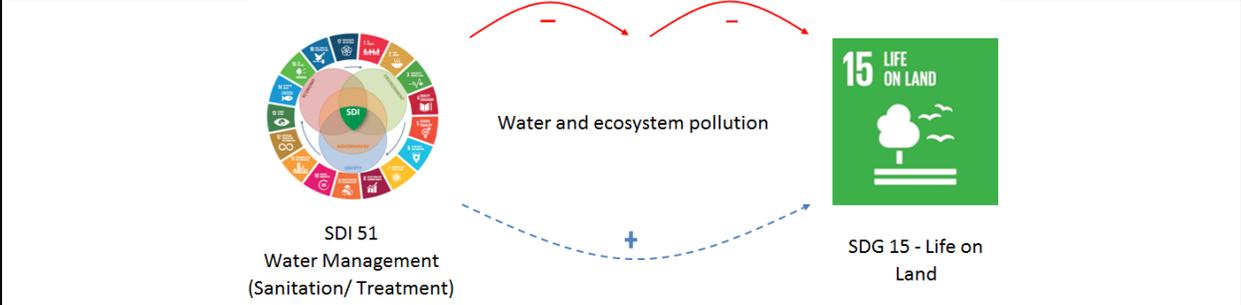
SDG 6 aims to ensure availability and sustainable water and sanitation management, improving water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing safe recycling reuse globally (United Nations, 2015). Pollution, irrigation withdrawal, freshwater flows modification, road construction, surface water diversion, soil erosion in agriculture, deforestation, and dam building have led to some irreversible species losses and severe changes in freshwater ecosystems' community composition (Caschetto, et al., 2014). Therefore, preventing surface and groundwater contamination contributes directly and positively to SDG 6.

Impacted SDG: SDG 14



SDG 14 aims to conserve and sustainably use the oceans, seas and marine resources for sustainable development, preventing and significantly reducing marine pollution of all kinds, particularly from land-based activities (United Nations, 2015). Many rivers worldwide are affected by undergoing severe man-induced alterations. Water pollution led to some irreversible species losses and severe changes in freshwater ecosystems’ community composition (Caschetto, et al., 2014). Therefore, water management from buildings contributes directly and positively to SDG 14.

Impacted SDG: SDG 15



SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems and inland freshwater ecosystems and their services (United Nations, 2015). Many rivers worldwide are affected by undergoing severe man-induced alterations. Water pollution led to some irreversible species losses and severe changes in the freshwater ecosystems’ community composition (Caschetto, et al., 2014). Therefore, the efficient use of water contributes directly and positively to SDG 15.

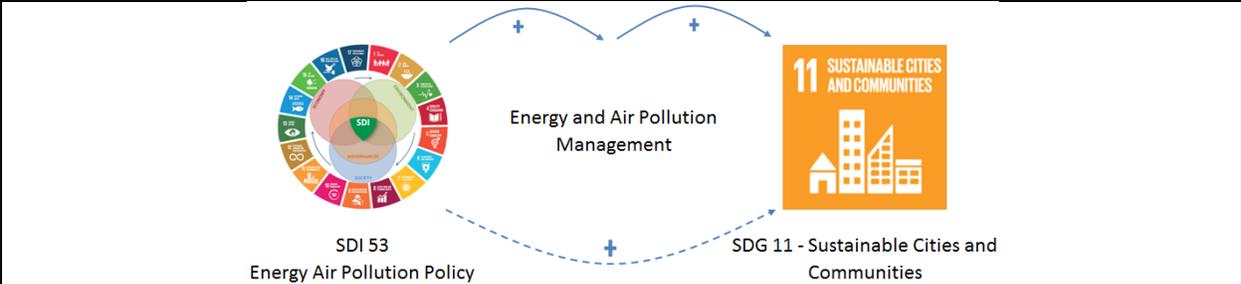
SDI 52	Category:	Environmental
	Subcategory:	Water
	Sustainability Target:	Water use education
	Description:	Invest in water use education programs (influencing consumer behaviour).
Impacted SDG:		SDG 6



SDG 6 aims to ensure availability and sustainable water and sanitation management, substantially increasing water-use efficiency across all sectors and ensuring sustainable withdrawals and freshwater supply to address water scarcity (United Nations, 2015). Education as a body of knowledge shows indispensable and necessary tools to contribute to awareness and change of individuals' attitudes and values regarding energy consumption (A.Dias, R.Mattos, & A.P.Balestieri, 2004). Therefore, the education and knowledge of water consumption behaviour contribute directly and positively to SDG 6.

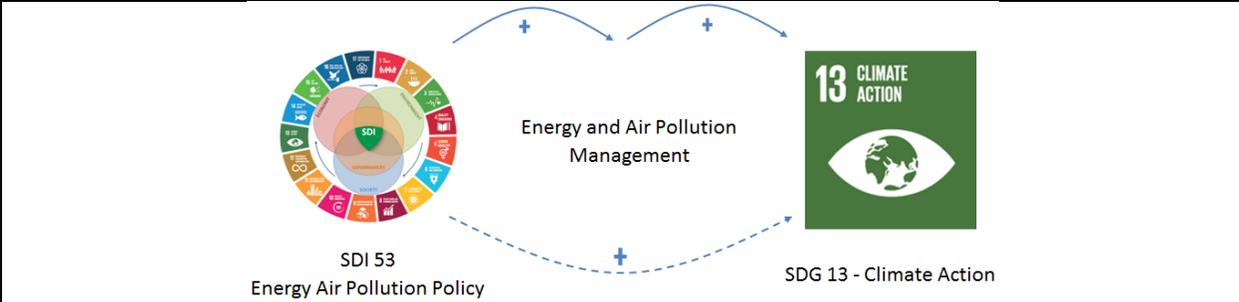
SDI 53	Category:	Governances
	Subcategory:	Environment
	Sustainability Target:	Energy Air Pollution Policy
	Description:	Implement an energy and air pollution policy, integrating energy, transport and environment.

Impacted SDG: SDG 11



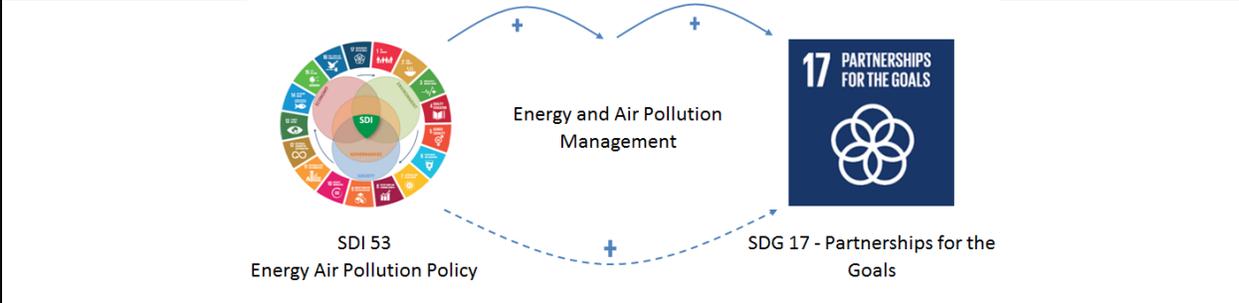
SDG 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable by substantially increasing the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change and resilience to disasters (United Nations, 2015). Construction activities have significant impacts, negative and positive, on sustainability's social, environmental and economic aspects. Adverse effects include: generating waste, greenhouse gas emission, noise and dust. The standard approaches to sustainability policy include online disclosure, a dedicated section on sustainability issues in the annual report and a stand-alone sustainability report (Zuo, Zillante, Wilson, Davidson, & Pullen, 2012). Therefore, analyze and manage the impacts of construction activities such as energy and air pollution directly and positively contribute to SDG 11.

Impacted SDG: SDG 13



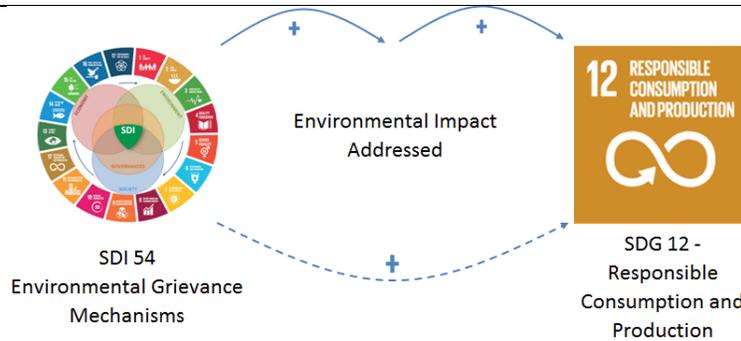
SDG 13 aims to take urgent action to combat climate change and its impacts by integrating climate change measures into national policies, strategies and planning (United Nations, 2015). The construction site's diverse activities, including energy consumption during the construction phase, can cause climate change, human health problems, and resource depletion (Hong, Hong, Kang, & Lee, 2019). Therefore, considering energy and air pollution policies into construction practices can positively contribute to SDG 13.

Impacted SDG: SDG 17



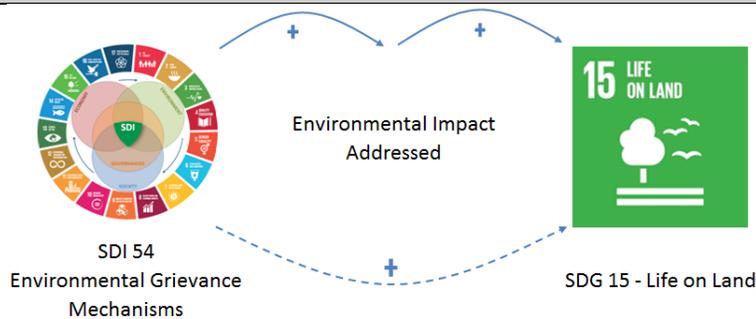
SDG 17 aims to strengthen the means of implementation and revitalize the global partnership for sustainable development by enhancing policy coherence for sustainable development (United Nations, 2015). To minimize the negative impacts of the construction process, recycle and reduce waste, increase resource efficiency and improve procurement processes are some of the measures of doing that. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and reductions in the number of yards skip removed, CO2 emissions and water consumption (Murray & Dainty, 2009). Therefore, considering energy and air pollution policies into the construction practices can contribute directly and positively to SDG 17

SDI 54	Category:	Governances
	Subcategory:	Environment
	Sustainability Target:	Environmental Grievance Mechanisms
	Description:	Implement effective environmental grievance mechanisms, filling, addressing, and resolving environmental impacts.
Impacted SDG:		SDG 12



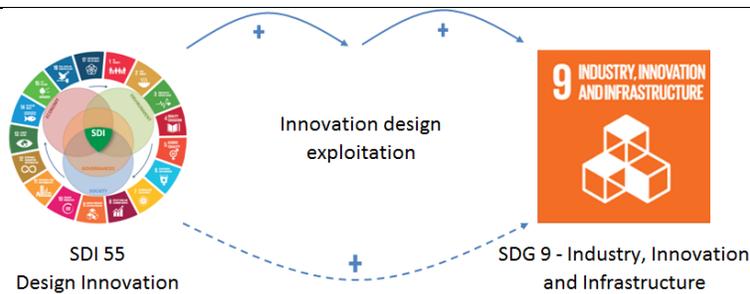
SDG 12 aims to ensure sustainable consumption and production patterns by achieving chemicals and waste environmental management throughout their life cycle and significantly reduce their release into the air, water, and soil to minimize their adverse impacts on human health and the environment (United Nations, 2015). The construction industry is one of the industries that generates and dumps heaps of waste to landfill. Waste leads to an unnecessary loss of natural resources, such as water and embodied energy. Natural resource depletion can only be avoided or reduced via sustainable consumption and strategic waste management based on resource recovery, waste avoidance, and efficient material use with less embodied energy (Li, 2015). Therefore, to identify and address environmental impact contributes directly and positively to SDG 12.

Impacted SDG: SDG 15



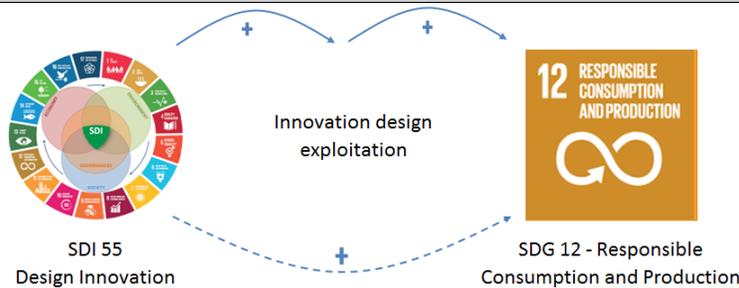
SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss by integrating ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts (United Nations, 2015). The construction industry is one of the industries that generates and dumps heaps of waste to landfill. Natural resource depletion can only be avoided or reduced via sustainable consumption and strategic waste management based on resource recovery, waste avoidance, and efficient material use with less embodied energy (Li, 2015). Therefore, to identify and address environmental impact contributes directly and positively to SDG 15.

SDI 55	Category:	Governances
	Subcategory:	Innovation
	Sustainability Target:	Design Innovation
	Description:	Exploit innovation in the design phase.
Impacted SDG:		SDG 9



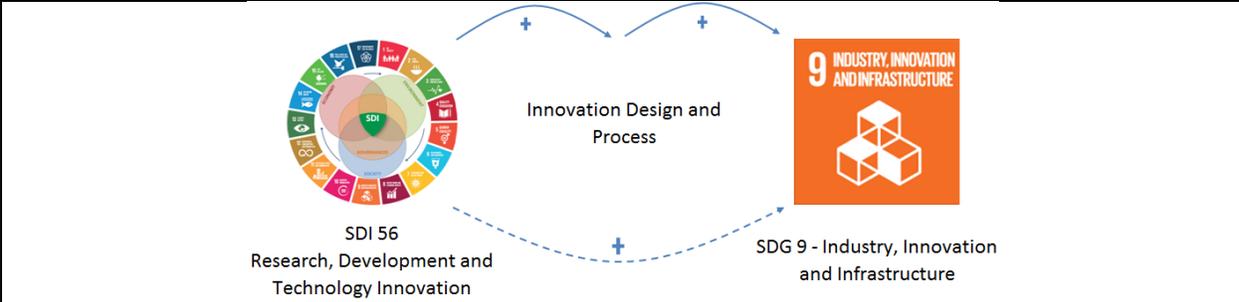
SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation by enhancing scientific research, upgrade the technological capabilities of industrial sectors in all countries, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending (United Nations, 2015). Rooted in mass production, mass consumption, and mass disposal, our societies worldwide face constraints on the availability of material resources and fossil fuel resources. Innovation in product life cycle design is critical for realizing a circular economy and sustainable society (Matsumoto, Masui, Fukushige, & Kondoh, 2017). Therefore, to invest in innovation at the design phase contributes directly and positively to SDG 9.

Impacted SDG: SDG 12



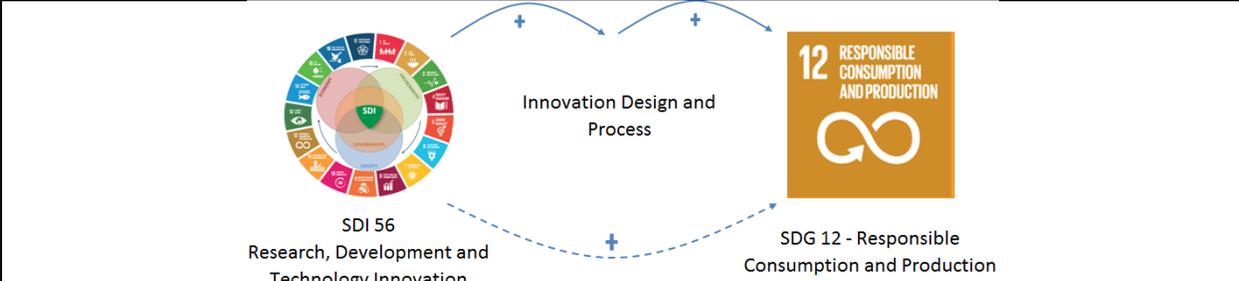
SDG 12 aims to ensure sustainable consumption and production patterns by encouraging companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015). Environment-Community-Human-Oriented (ECHO) design is a process that strives to create solutions that not only meet the needs of the potential users but also create positive experiences and meaningfully influence their communities and the environment. As important as the users, the environment and communities are also key design considerations and target beneficiaries of the design outcomes (Sukkasi, 2016). Therefore, identifying and addressing sustainable impact at the design phase contributes directly and positively to SDG 12.

SDI 56	Category:	Governances
	Subcategory:	Innovation
	Sustainability Target:	Research, Development and Technology Innovation
	Description:	Implement an effective research, development, and technology innovation program, keeping up-to-date with new technologies.
Impacted SDG:		SDG 9



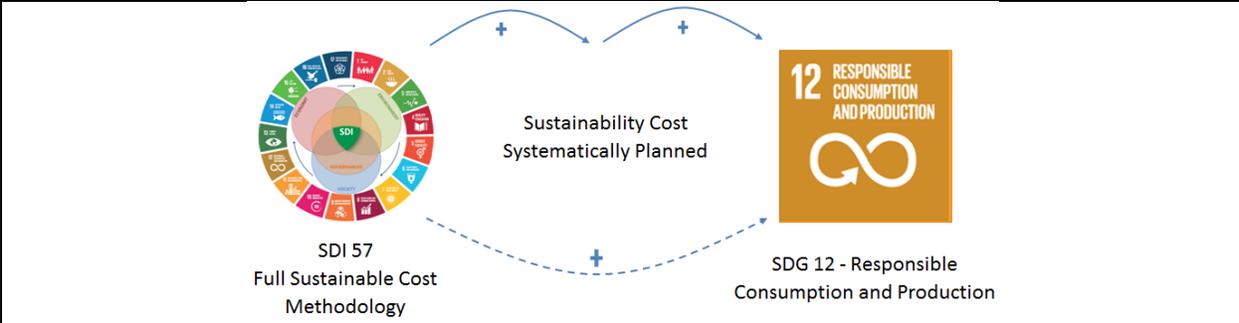
SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation by enhancing scientific research, upgrade the technological capabilities of industrial sectors in all countries, and encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending (United Nations, 2015). Innovation in product life cycle design is critical for realizing a circular economy and sustainable society (Matsumoto, Masui, Fukushige, & Kondoh, 2017). Therefore, to invest in innovation at the design phase contributes directly and positively to SDG 9.

Impacted SDG: SDG 12



SDG 12 aims to ensure sustainable consumption and production patterns by encouraging companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015). Environment-Community-Human-Oriented (ECHO) design is a process that strives to create solutions that not only meet the needs of the potential users but also create positive experiences and meaningfully influence their communities and the environment. As important as the users, the environment and communities are also key design considerations and target beneficiaries of the design outcomes (Sukkasi, 2016). Therefore, investing in innovative products and process contributes directly and positively to SDG 12.

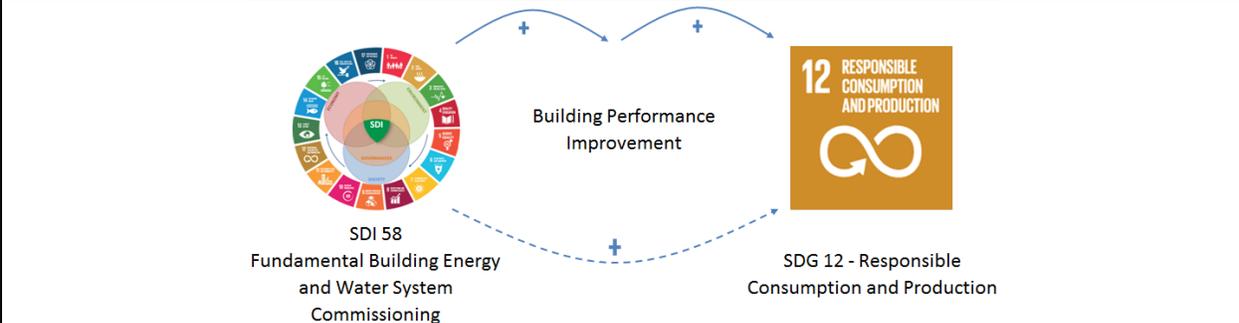
SDI 57	Category:	Governances
	Subcategory:	Management
	Sustainability Target:	Full Sustainable Cost Methodology
	Description:	Determine the full life-cycle sustainable cost of processes, managing the cost of sustainable practice during the whole construction phase.
Impacted SDG:		SDG 12



SDG 12 aims to ensure sustainable consumption and production patterns by achieving sustainable management and efficient natural resource use (United Nations, 2015). The sooner sustainability efforts take place in the development process, the less they cost. Sustainability must be systematically planned and implemented straight from the early phases of the development process to develop a sustainable product with a minimum of financial expenses (Matsumoto, Masui, Fukushige, & Kondoh, 2017) and manage through the whole process. Measures aiming for sustainability need to be cost-efficient and effective to lead to a positive cost-benefit ratio (Matsumoto, Masui, Fukushige, & Kondoh, 2017). Therefore, investing in sustainable cost management contributes directly and positively to SDG 12.

SDI 58	Category:	Governances
	Subcategory:	Management
	Sustainability Target:	Fundamental Building Energy and Water System Commissioning
	Description:	To create commission energy and water system to verify the building systems' operation according to the owner's requirements and project documents.

Impacted SDG: SDG 12

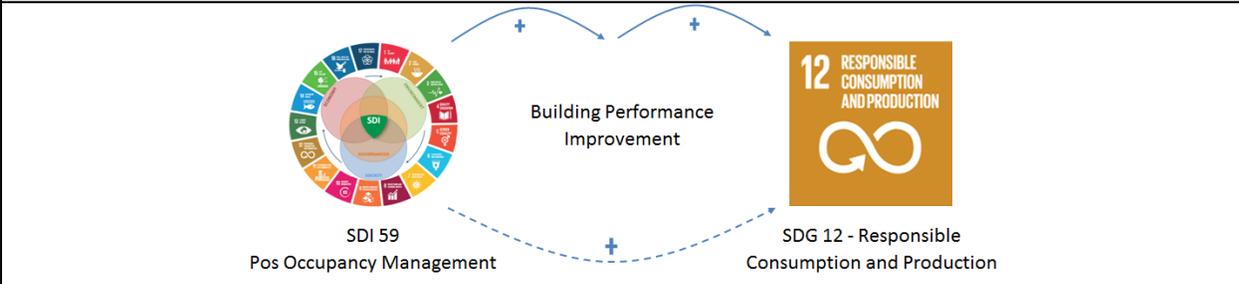


SDG 12 aims to ensure sustainable consumption and production patterns by achieving sustainable management and efficient natural resource use (United Nations, 2015). Experience and large-scale studies of the benefits of commissioning have shown the effectiveness of these services in improving commercial buildings' energy efficiency. Commissioning services help reduce energy consumption and improve buildings' performance (Bynum, Claridge, & Curtin, 2012). Therefore, to invest in System Commissioning contributes directly and positively to SDG 12.

SDI 59	Category:	Governances
	Subcategory:	Management
	Sustainability Target:	Post Occupancy Management

	Description:	Provide a high level of thermal, ventilation and lighting systems control.
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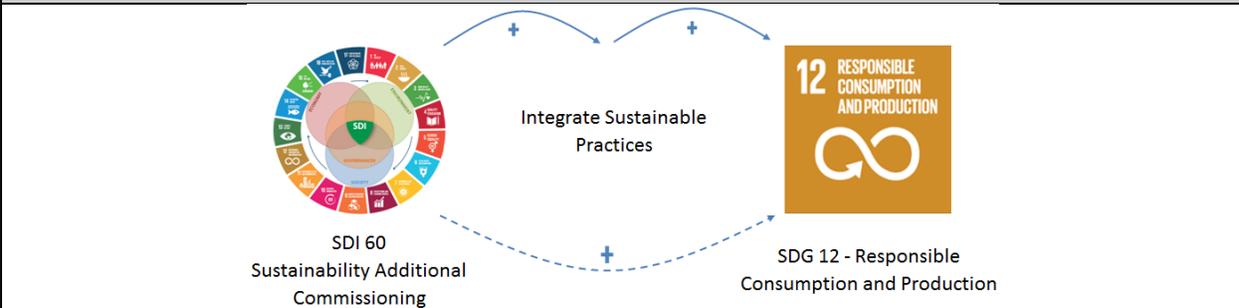
Impacted SDG:	SDG 12
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SDG 12 aims to ensure sustainable consumption and production patterns by achieving sustainable management and efficient natural resource use (United Nations, 2015). Building elements have created an indoor environment with adverse effects on man's activities, comfort and wellbeing. The indoor environmental quality (IEQ) has been a significant concern of the world with its enormous influence on building occupants' health and productivity. The first four leading indicators of IEQ performance are thermal quality, acoustic quality, visual quality, and indoor air quality (Nimlyat, 2018). The choice of the control system profoundly influences the energy-saving potential (Rubeis, et al., 2017). Therefore, pos occupancy management improves the building's performance and contributes directly and positively to SDG 12.

SDI 60	Category:	Governances
	Subcategory:	Management
	Sustainability Target:	Sustainability Additional Commissioning
	Description:	Implement additional commissioning to address conflicting regulations and policies, identifying and addressing laws, standards, regulations, or policies that may unintentionally create barriers to implementing sustainable infrastructure.

Impacted SDG:	SDG 12
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SDG 12 aims to ensure sustainable consumption and production patterns by encouraging companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015). Commissioning services help reduce energy consumption and improve buildings' performance (Bynum, Claridge, & Curtin, 2012). Sustainability commissioning provides sustainability practices into the organization's operation; therefore, it contributes directly and positively to SDG 12.

SDI 61	Category:	Governances
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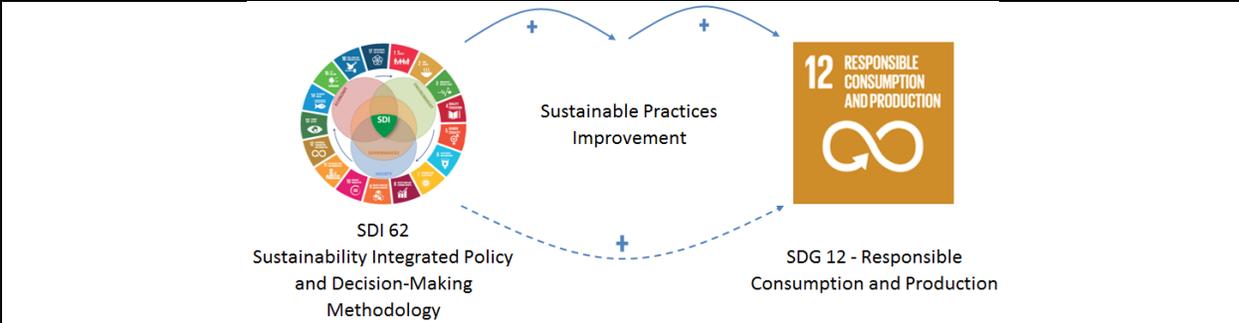
	Subcategory:	Management
	Sustainability Target:	Sustainability Culture
	Description:	Implement a sustainability culture in the organization through an effective sustainability leadership program, clear mission and value statements, codes of conduct, rewards, people interaction, material selection, etc.

Impacted SDG:	SDG 12
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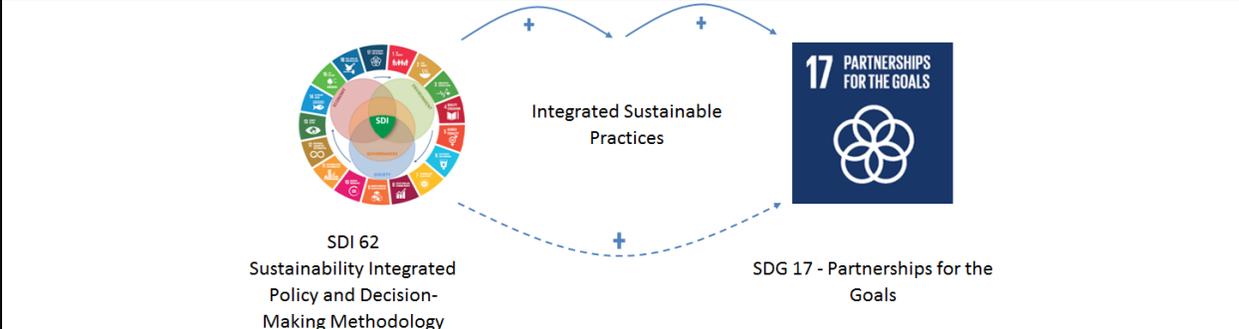
SDG 12 aims to ensure sustainable consumption and production patterns by providing relevant information, and awareness for sustainable development and lifestyles in harmony with nature to people everywhere have (United Nations, 2015). Business expectations have grown from society, adding new stakeholders along the way, and sustainability management became a structure to a set of emerging societal expectations regarding environment, community, and economy. Sustainability involves optimizing the economy, environment and social elements. Since the economy and society are human constructions, what is considered sustainable is, to some degree, governed by culture (Hitchcock & Willard, 2009). Therefore, implement sustainable strategies into the organization's values contributes directly and positively to SDG 12.

SDI 62	Category:	Governances
	Subcategory:	Management
	Sustainability Target:	Sustainability Integrated Policy and Decision-Making Methodology
	Description:	Implement an integrated policy and decision-making methodology considering environmental, social, and economic priorities.
Impacted SDG:	SDG 12	



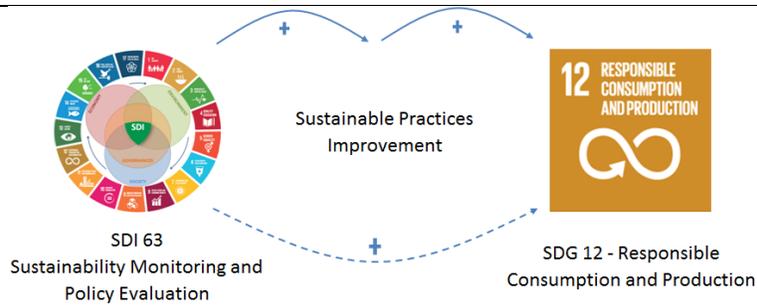
SDG 12 aims to ensure sustainable consumption and production patterns by encouraging companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015). Business expectations have grown from society, adding new stakeholders along the way, and sustainability management became a structure to a set of emerging societal expectations regarding environment, community, and economy. Sustainability involves optimizing the economy, environment and social elements. Since the economy and society are human constructions, what is considered sustainable is, to some degree, governed by culture (Hitchcock & Willard, 2009). Therefore, to implement sustainable strategies into the organization’s values contributes directly and positively to SDG 12.

Impacted SDG: SDG 17



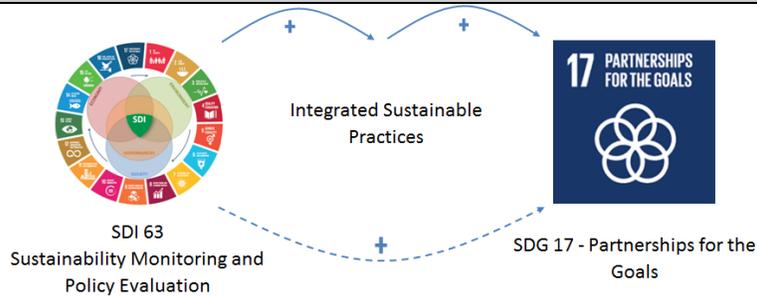
SDG 17 aims to strengthen the means of implementation and revitalize the global partnership for sustainable development by enhancing policy coherence for sustainable development (United Nations, 2015). CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, to invest in sustainability integrated policies contribute to SDG 17.

SDI 63	Category:	Governances
	Subcategory:	Management
	Sustainability Target:	Sustainability Monitoring and Policy Evaluation
	Description:	Implement a sustainable monitoring and evaluation policy, increasing resilience (short-term) and long-term recovery prospects of the project and site from natural and human effects.
Impacted SDG:		SDG 12



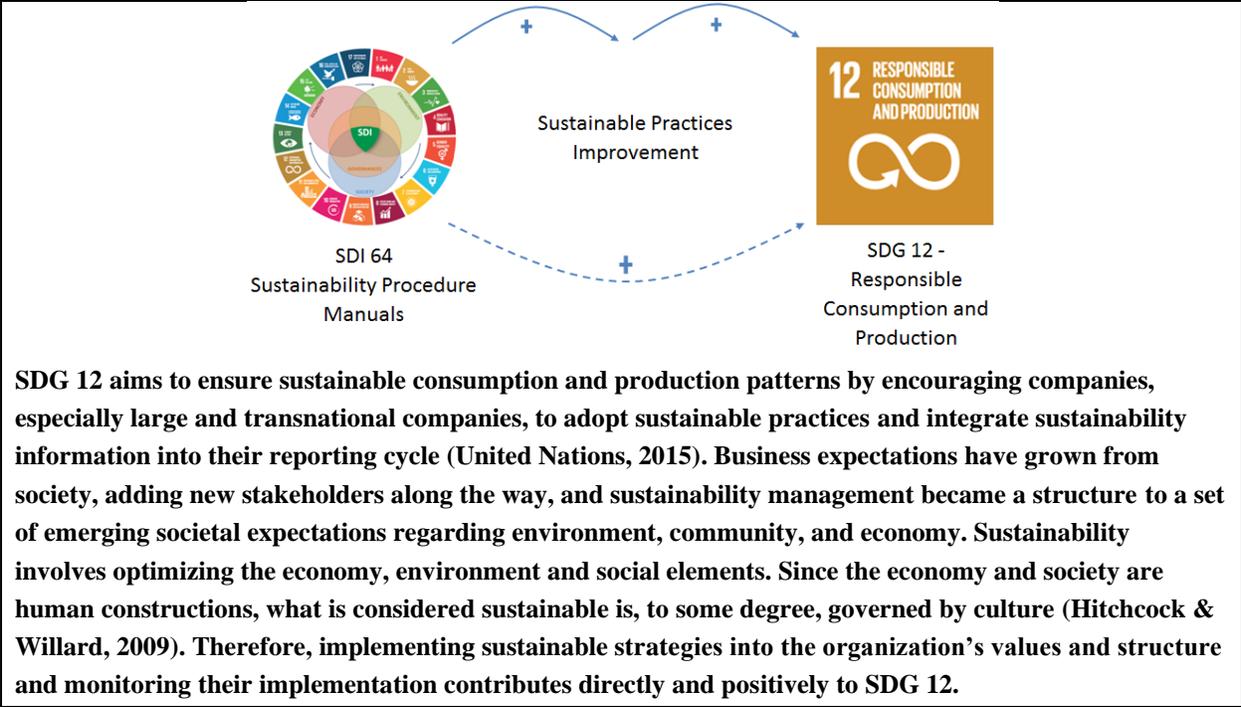
SDG 12 aims to ensure sustainable consumption and production patterns by encouraging companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015). Business expectations have grown from society, adding new stakeholders along the way, and sustainability management became a structure to a set of emerging societal expectations regarding environment, community, and economy. Sustainability involves optimizing the economy, environment and social elements. Since the economy and society are human constructions, what is considered sustainable is, to some degree, governed by culture (Hitchcock & Willard, 2009). Therefore, implementing sustainable strategies into the organization's values and monitoring their implementation contributes directly and positively to SDG 12.

Impacted SDG: SDG 17



SDG 17 aims to strengthen the means of implementation and revitalize the global partnership for sustainable development by enhancing policy coherence for sustainable development (United Nations, 2015). CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, to invest in sustainability integrated policies and monitor their implementation contribute to SDG 17.

SDI 64	Category:	Governances
	Subcategory:	Management
	Sustainability Target:	Sustainability Procedure Manuals
	Description:	Implement sustainability manuals and policies, creating a project management system that can manage the scope, scale, and complexity of a project and improve sustainable performance.
Impacted SDG:		SDG 12



SDI 65	Category:	Governances
	Subcategory:	Management
	Sustainability Target:	Sustainable indicators Metric Accounting and Reporting
	Description:	Implement sustainability indicators assessment and reporting, promoting sustainable results, risks, opportunities and best practices.

Impacted SDG: SDG 12



SDG 12 aims to ensure sustainable consumption and production patterns by encouraging companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015). Business expectations have grown from society, adding new stakeholders along the way, and sustainability management became a structure to a set of emerging societal expectations regarding environment, community, and economy. Sustainability involves optimizing the economy, environment and social elements. Since the economy and society are human constructions, what is considered sustainable is, to some degree, governed by culture (Hitchcock & Willard, 2009). Therefore, implementing sustainable strategies into the organization’s values and structure, monitoring, and reporting the results contribute directly and positively to SDG 12.

Impacted SDG: SDG 16



SDG 16 aims to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels by developing effective, responsible and transparent institutions at all levels (United Nations, 2015). The construction industry faces pressure to increase the sustainability of its practices. That implies significant changes in the industry’s understanding of society's demands and its clients and its sense of corporate social responsibility and suggests significant changes in its working practices (Wilson & Rezgui, 2013). Efficient sustainable practices management includes indicators of measure to report its performance, contributing directly to SDG 16.

SDI 66	Category:	Governances
	Subcategory:	Social Development
	Sustainability Target:	Fighting Corruption and Illicit Financial Flows Policies
	Description:	Implement policies for fighting corruption and illicit financial flows, providing training on anti-corruption policies and procedures and promoting actions taken for corruption incidents.

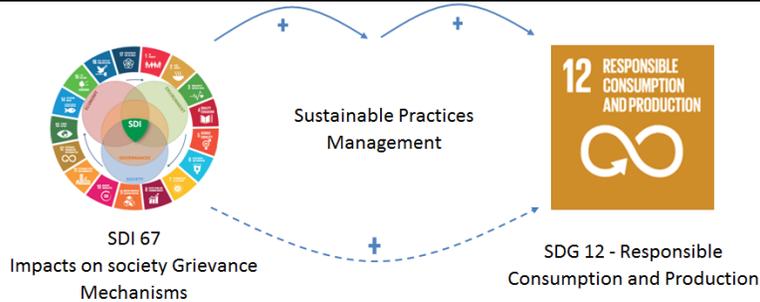
Impacted SDG: SDG 16



SDG 16 aims to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels by developing effective, responsible and transparent institutions at all levels and substantially reducing corruption and bribery in all their forms (United Nations, 2015). As businesses expand globally into new and emerging markets, bribery and corruption risks have increased exponentially. The Foreign Corrupt Practices Act (FCPA) requires companies to keep accurate records of all business transactions and maintain an effective internal accounting system. Internationally, the Organization of Economic Cooperation and Development's (OECD) anti-bribery convention has been adopted by 38 countries and creates legally binding standards related to bribery of foreign public officials (Sibery, Loughman, & Loughman, 2011). An efficient bribery and corruption reduction plan, therefore, contributing directly to SDG 16.

SDI 67	Category:	Governances
	Subcategory:	Social Development
	Sustainability Target:	Impacts on society Grievance Mechanisms
	Description:	Implement effective social grievance mechanisms, filling, addressing, and resolving impacts on society.

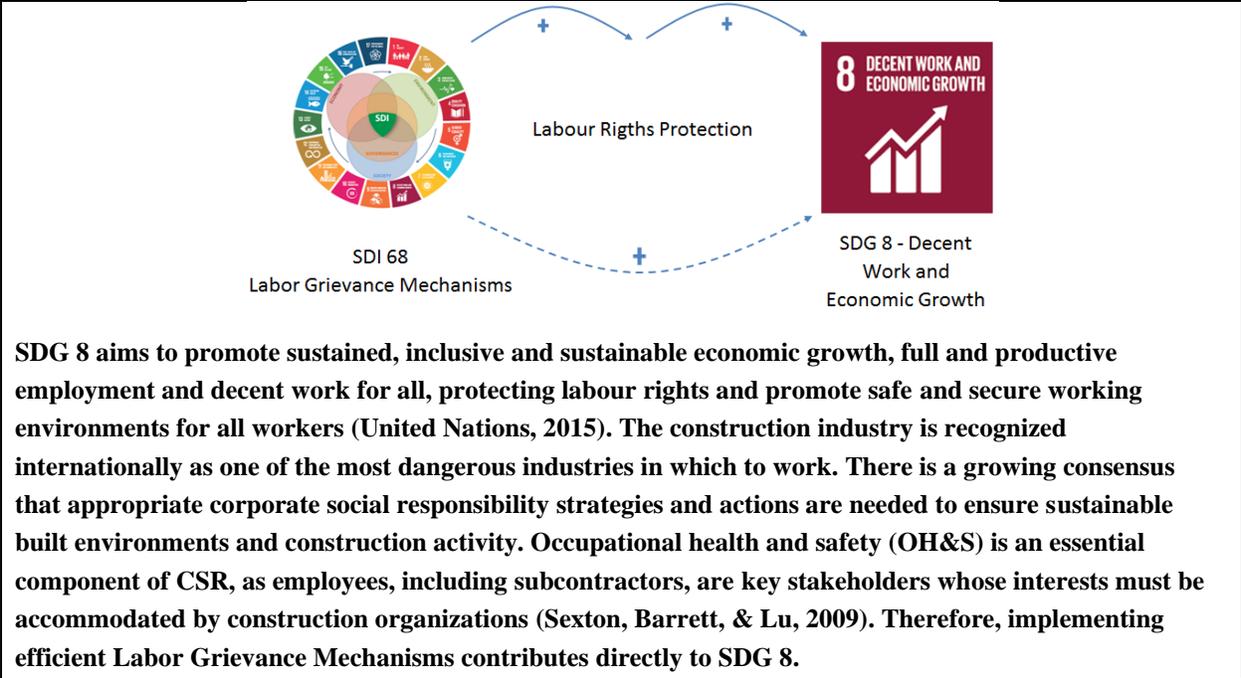
Impacted SDG: **SDG 12**



SDG 12 aims to ensure sustainable consumption and production patterns by encouraging companies, especially large and transnational companies, to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015). Business expectations have grown from society, adding new stakeholders along the way, and sustainability management became a structure to a set of emerging societal expectations regarding environment, community, and economy. Sustainability involves optimizing the economy, environment and social elements (Hitchcock & Willard, 2009). Therefore, implementing sustainable strategies into the organization's values and structure, monitoring and reporting their practices contributes directly and positively to SDG 12.

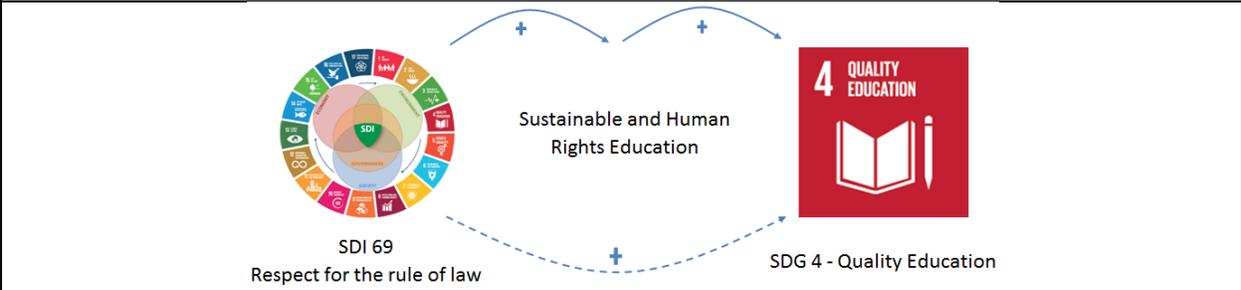
SDI 68	Category:	Governances
	Subcategory:	Social Development
	Sustainability Target:	Labor Grievance Mechanisms
	Description:	Implement effective labour grievance mechanisms, filling, addressing, and resolving labour impacts.

Impacted SDG: **SDG 8**



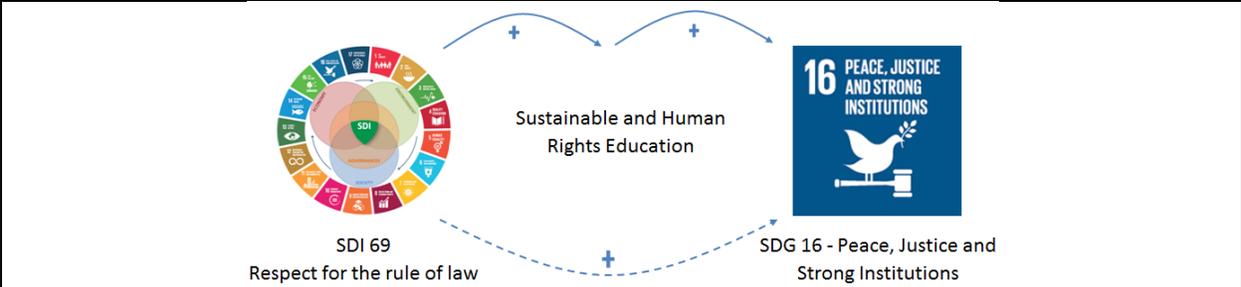
SDI 69	Category:	Governances
	Subcategory:	Social Development
	Sustainability Target:	Respect for the rule of law
	Description:	Implement an education plan that promotes the law to all employees, encouraging respect for the rules and the law.

Impacted SDG: **SDG 4**



SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by ensuring that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and culture’s contribution to sustainable development (United Nations, 2015). Education as a body of knowledge shows indispensable and necessary tools to contribute to awareness and change of individuals' attitudes and values regarding consumption (A.Dias, R.Mattos, & A.P.Balestieri, 2004) other behaviours. Therefore, the education and knowledge of sustainable and human rights contribute directly and positively to SDG 4.

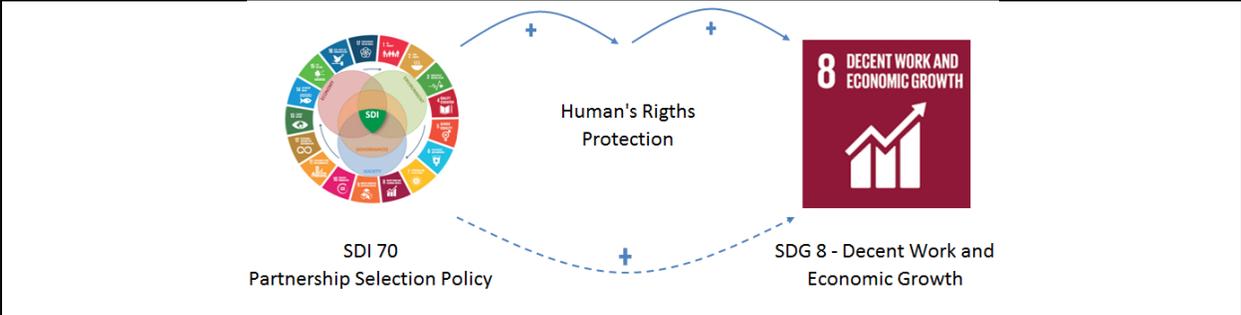
Impacted SDG: **SDG 16**



SDG 16 aims to promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions by promoting the rule of law at the national and international levels and ensuring equal access to justice to all (United Nations, 2015). CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, implementing education to promote human rights contributes to SDG 16.

SDI 70	Category:	Governances
	Subcategory:	Social Development
	Sustainability Target:	Partnership Selection Policy (Contract)
	Description:	Implement a policy of selecting partnerships, not accepting organizations that encourage any action against any state's territorial integrity or political independence, or incentivize terrorism, or do not implement the human rights and sustainability indicators.

Impacted SDG: SDG 8



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by taking immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers (United Nations, 2015). The construction industry is recognized internationally as one of the most dangerous industries in which to work. There is a growing consensus that appropriate corporate social responsibility strategies and actions are needed to ensure sustainable built environments and construction activity (Sexton, Barrett, & Lu, 2009). Therefore, implementing a policy that considers the whole supply chain and their social responsibility implementation contributes directly to SDG 8.

Impacted SDG: SDG 16



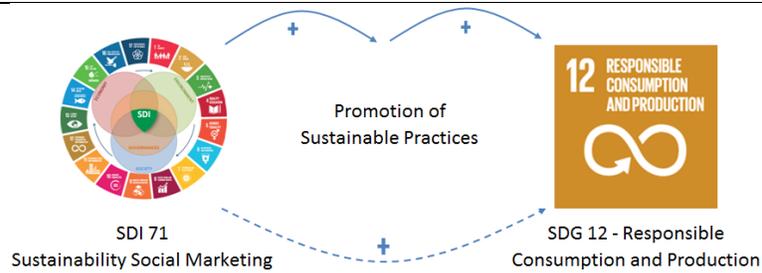
SDG 16 aims to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels by significantly reducing illicit financial and arms flows, strengthening the recovery and return of stolen assets and combating all forms of organized crime (United Nations, 2015). CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, implementing a policy that considers the whole supply chain and their social responsibility implementation contributes to SDG 16.

Impacted SDG: SDG 17



SDG 17 aims to strengthen the means of implementation and revitalize the global partnership for sustainable development by enhancing policy coherence for sustainable development (United Nations, 2015). CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, investing in sustainable supply chain policy contribute to SDG 17.

SDI 71	Category:	Governances
	Subcategory:	Social Development
	Sustainability Target:	Sustainable Social Marketing
	Description:	Implement a sustainability social marketing program, increasing public awareness and more sustainable behaviours relating to the environment.
Impacted SDG:		SDG 12



SDG 12 aims to ensure sustainable consumption and production patterns ensuring that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature (United Nations, 2015). Education as a body of knowledge shows indispensable and necessary tools to contribute to awareness and change of individuals' attitudes and values regarding energy consumption (A.Dias, R.Mattos, & A.P.Balestieri, 2004) and other behaviours. Marketing is a powerful influence of both material and non-material culture. Marketing, through lobbying, influences government policy. It occupies, in short, a unique position from which to make positive changes to both production and consumption practices (Martin & Schouten, 2014). Therefore, education marketing contributes directly and positively to SDG 12.

SDI 72	Category:	Governances
	Subcategory:	Social Development
	Sustainability Target:	Sustainability Specialist
	Description:	Hire, or invest in the training of professionals with sustainability program credential such as LEED credential.

Impacted SDG: SDG 4

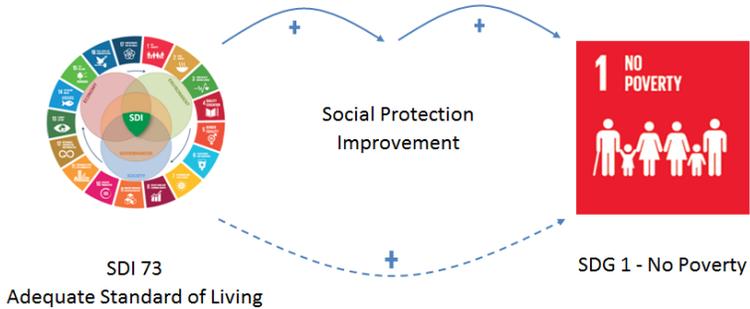


SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by ensuring that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and culture's contribution to sustainable development (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, investing in education contributes directly to SDG 4.

SDI 73	Category:	Social
	Subcategory:	Human rights

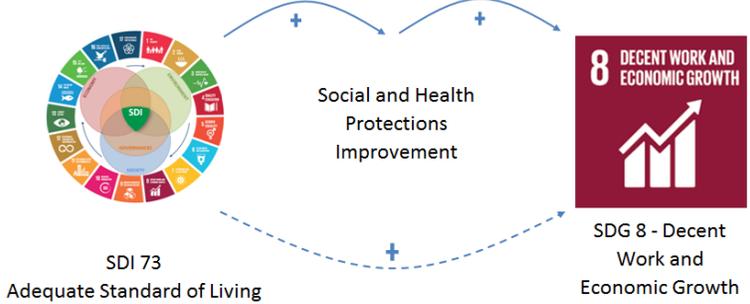
	Sustainability Target:	Adequate Standard of Living
	Description:	Provide an adequate standard of living through the necessary social and health protections.

Impacted SDG: **SDG 1**



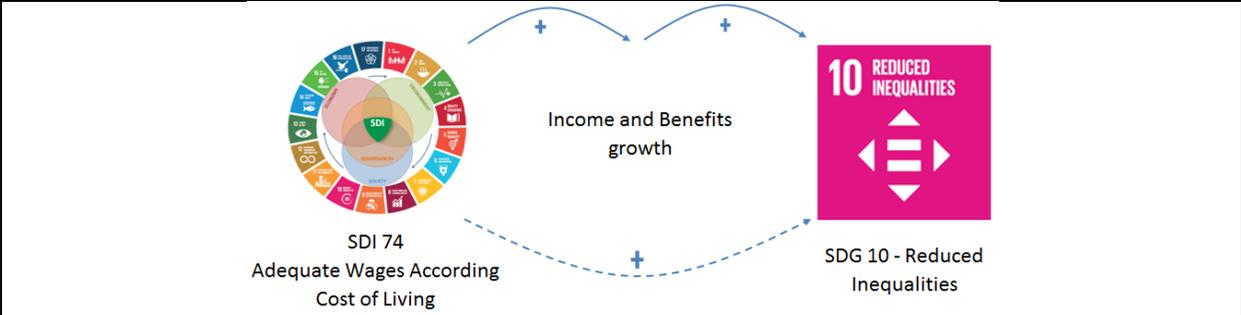
SDG 1 aims to end poverty in all its forms everywhere by implementing nationally appropriate social protection systems and measures for all, including floors (United Nations, 2015). The construction industry is recognized internationally as one of the most dangerous industries in which to work. Occupational health and safety (OH&S) is an essential component of CSR, as employees, including subcontractors, are key stakeholders whose interests must be accommodated by construction organizations (Sexton, Barrett, & Lu, 2009). Therefore, implementing an efficient social responsibility plan contribute directly to SDG 1.

Impacted SDG: **SDG 8**



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, protecting labour rights and promote safe and secure working environments for all workers (United Nations, 2015). The construction industry is recognized internationally as one of the most dangerous industries in which to work. There is a growing consensus that appropriate corporate social responsibility strategies and actions are needed to ensure sustainable built environments and construction activity. Occupational health and safety (OH&S) is an essential component of CSR, as employees, including subcontractors, are key stakeholders whose interests must be accommodated by construction organizations (Sexton, Barrett, & Lu, 2009). Therefore, implementing an efficient social responsibility plan contribute directly to SDG 8.

SDI 74	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Adequate Wages According to Cost of Living
	Description:	Implement a fair salary plan according to the local cost of living, contributing to the well-being and economic growth.
Impacted SDG:		SDG 10



SDG 10 aims to reduce inequality within and among countries by progressively achieving and sustaining the bottom 40 percent of the population at a rate higher than the national average (United Nations, 2015). Prevailing Wage Laws (PWLs) leads to a 12% decline in voluntary benefits— primarily health and pension benefits. It also suggests that a critical implication of prevailing wage repeal may be a loss of human capital due to less-experienced workers' retention. Lower remuneration due to repeals can imply a loss incurred by blue-collar construction workers. It can also relate to the loss of skilled workers posing as a problem for contractors and owners (Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018). Therefore, implementing an efficient salary plan contributes directly to SDG 10.

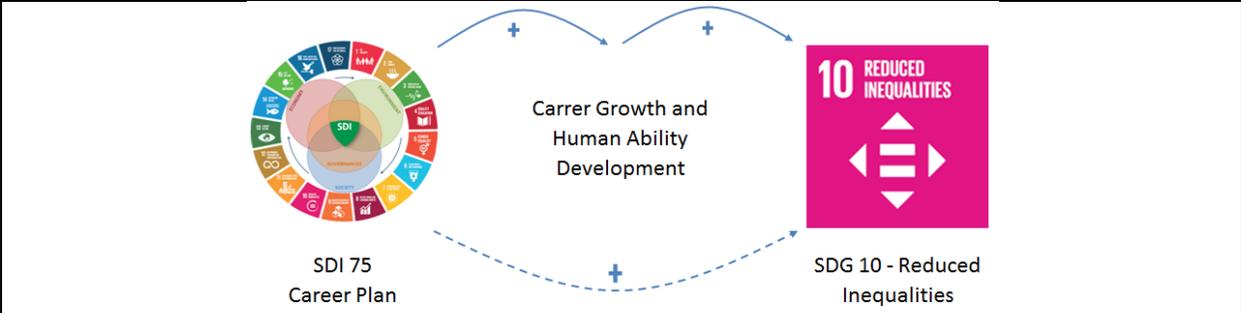
SDI 75	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Career Plan
	Description:	Implement a career plan for personal and professional growth of the employees without discrimination. Equality opportunity

Impacted SDG: SDG 5



SDG 5 aims to achieve gender equality and empower all women and girls by ending all forms of discrimination against all women and girls everywhere and ensuring women’s full and active participation and equal opportunities for leadership at all decision-making levels in political, economic and public life (United Nations, 2015). A more diverse workforce may work more effectively, widen the available pool of talent, reduce staff turnover and attrition, enhance innovation and creativity, and improve the industry's image and reputation. Other sectors' experiences suggest that developing opportunities for minority groups promote a more informed workforce and more adaptable organizations. It also makes organizations closer to their customers and more responsive to market changes (Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018). Therefore, investing in equal opportunities contribute to SDG 5

Impacted SDG: SDG 10



SDG 10 aims to reduce inequality within and among countries by empowering and promoting the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or another status, and also ensuring equal opportunity and reducing inequalities of outcome (United Nations, 2015). The development of human ability and knowledge in an applied context such as construction necessitates a combination of theoretical knowledge transfer, work-based training opportunities, and experiential learning. Investing in Human Resource Development (HRD) framing policies surrounding a range of issues, from education to economic development to immigration, reaps rational economic benefits for individuals. A more diverse workforce may work more effectively, widen the available pool of talent, reduce staff turnover and attrition, enhance innovation and creativity, and improve the industry's image and reputation. Other sectors' experiences suggest that developing opportunities for minority groups promote a more informed workforce and more adaptable organizations. It also makes organizations closer to their customers and more responsive to market changes (Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018). Therefore, investing in equal opportunities contribute to SDG 10.

SDI 76	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Child Labor - Complicity Avoidance
	Description:	Implement an effective program to abolish child labour, examining the whole supply chain.
Impacted SDG:		SDG 8



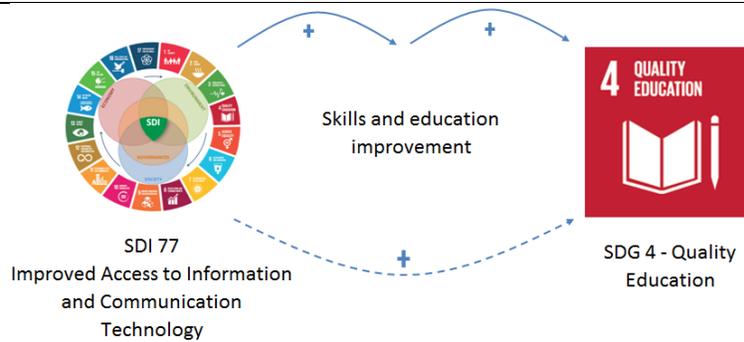
SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by taking immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour (United Nations, 2015). The construction industry is generally intensive laboured and extremely competitive. Many construction organizations have to operate under unsafe and unhealthy conditions, and in certain spheres, they engage in the globally condemned child labour practices (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, to analyze the internal process and the whole supply chain regarding this issue contribute positively to SDG 8.

Impacted SDG: SDG 16



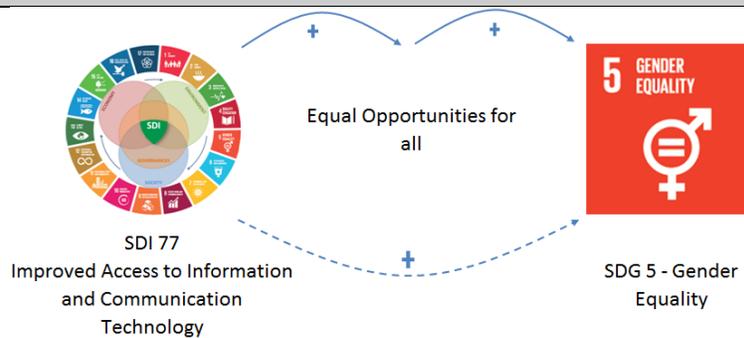
SDG 16 aims to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels by ending abuse, exploitation, trafficking and all forms of violence against children (United Nations, 2015). The construction industry is generally intensive laboured and extremely competitive. Many construction organizations have to operate under unsafe and unhealthy conditions, and in certain spheres, they engage in the globally condemned child labour practices (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, to analyze the internal process and the whole supply chain regarding this issue contribute positively to the SDG 16.

SDI 77	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Connectivity - Improved Access to Information and Communication Technology
	Description:	Promote connectivity, improving access to Information and communication technology.
Impacted SDG:		SDG 4



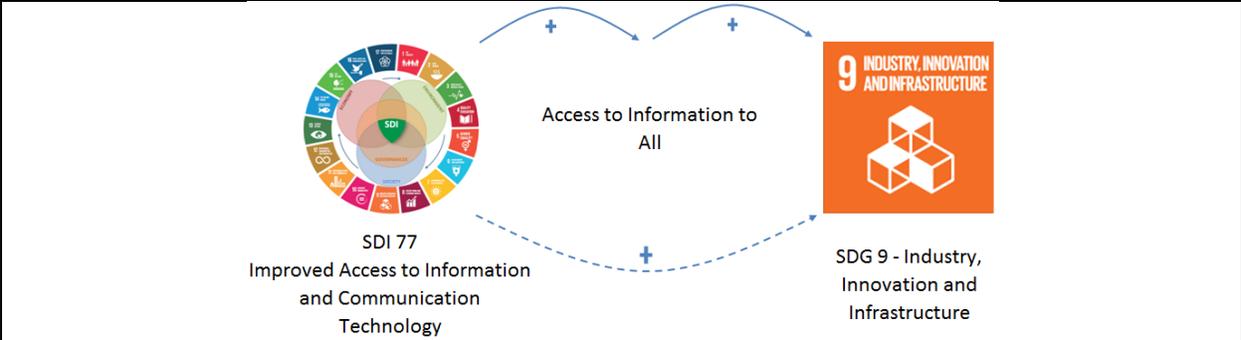
SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by building and upgrading education facilities that are child, disability and gender’s sensitive and provide safe, non-violent, inclusive and effective learning environments for all (United Nations, 2015). CSR’s social aspect is the obligation to make choices and take actions that contribute to society’s welfare and interests and those in the organization. CSR’s social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, implementing access to information and communication technology into a CSR plan of the construction industry strategies contribute to SDG 4.

Impacted SDG: SDG 5



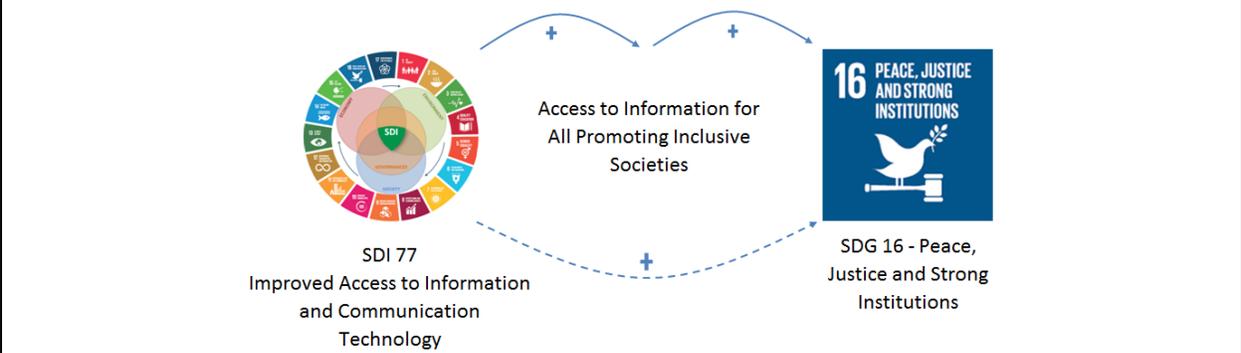
SDG 5 aims to achieve gender equality and empower all women and girls by enhancing the use of enabling technology, particularly information and communications technology, to promote women's empowerment (United Nations, 2015). Other sectors' experiences suggest that developing opportunities for minority groups promote a more informed workforce and more adaptable organizations. It also makes organizations closer to their customers and more responsive to market changes (Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018). Therefore, investing in equal opportunities contribute to SDG 5

Impacted SDG: SDG 9



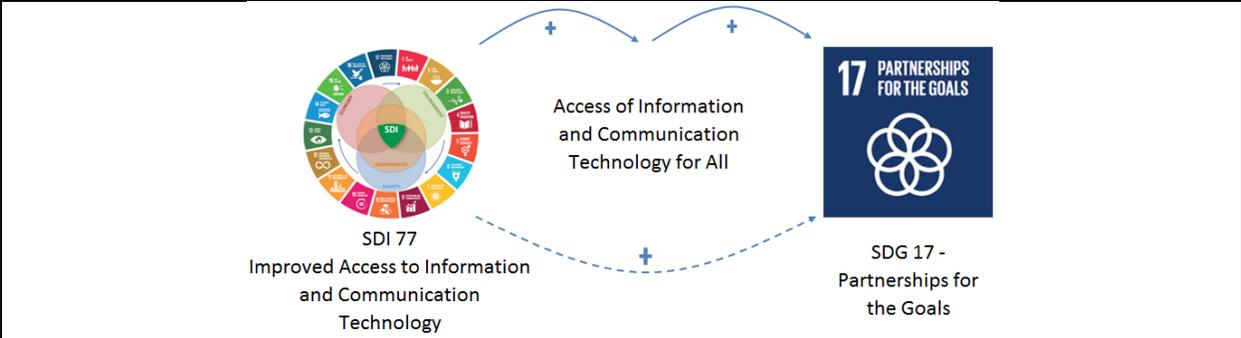
SDG 9 aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation by significantly increasing access to information and communications technology and providing universal and affordable access to the Internet (United Nations, 2015). Therefore, investing in access to information and communication technology contribute directly to SDG 9.

Impacted SDG: SDG 16



SDG 16 aims to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels by ensuring public access to information and protecting fundamental freedoms, according to national legislation and international agreements (United Nations, 2015). Therefore, investing in access to information contributes directly to SDG 16.

Impacted SDG: SDG 17



SDG 17 aims to strengthen the means of implementation and revitalize the global partnership for sustainable development by enhancing the use of enabling technology, particularly information and communications technology (United Nations, 2015). CSR's social aspect is the obligation to make choices and take actions that contribute to society's welfare and interests and those in the organization. CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, to invest in access to information and communication technology for all contribute to SDG 17.

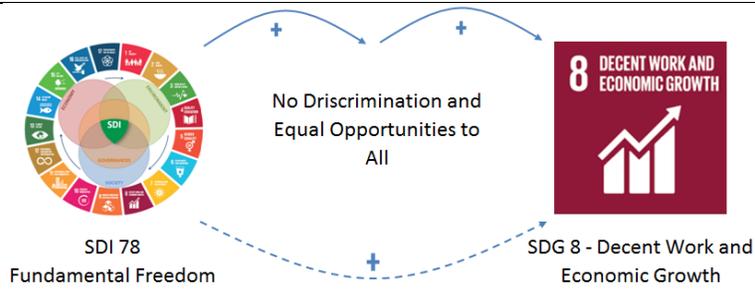
SDI 78	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Fundamental Freedom
	Description:	Implement fundamental freedom programs, guaranteeing no discrimination based on race; colour; sex; language; religion; political or other opinions; national or social origin; property; birth; disability or another status; association and collective bargaining.

Impacted SDG: SDG 5



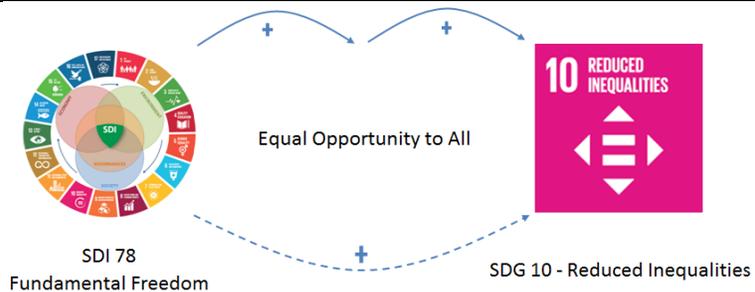
SDG 5 aims to achieve gender equality and empower all women and girls by ensuring women’s full and effective participation and equal leadership opportunities at all decision-making levels (United Nations, 2015). Following ILO conventions 100 (ILO, 1951) and 111 (ILO, 1958), no discrimination in hiring, compensation, access to training, promotion, termination and retirement is permitted based on race, caste, national origin, religion, disability, gender, sexual orientation, union membership or political affiliation. (Murray & Dainty, 2009). Therefore, investing in equal opportunities contribute to SDG 5

Impacted SDG: SDG 8



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by protecting labour rights and promoting safe and secure working environments for all workers, including migrant workers, particularly women migrants and those in precarious employment (United Nations, 2015). Following ILO conventions 100 (ILO, 1951) and 111 (ILO, 1958), no discrimination in hiring, compensation, access to training, promotion, termination and retirement is permitted based on race, caste, national origin, religion, disability, gender, sexual orientation, union membership or political affiliation (Murray & Dainty, 2009). Therefore, no discrimination plan contributes directly to SDG 8

Impacted SDG: SDG 10



SDG 10 aims to reduce inequality within and among countries by empowering and promoting the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or another status (United Nations, 2015). A more diverse workforce may work more effectively, widen the available pool of talent, reduce staff turnover and attrition, enhance innovation and creativity, and improve the industry's image and reputation. Other sectors' experiences suggest that developing opportunities for minority groups promote a more informed workforce and more adaptable organizations. It also makes organizations closer to their customers and more responsive to market changes (Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018). Therefore, investing in equal opportunities contribute to SDG 10.

Impacted SDG: SDG 16

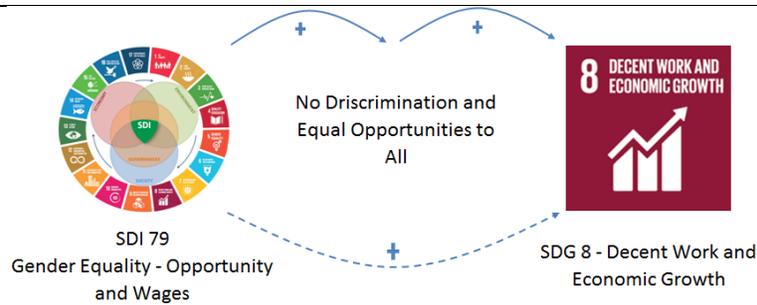


SDI 79	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Gender Equality - Opportunity and Wages
	Description:	Implement an effective and clear plan for gender equality, guaranteeing no difference in wages and career plans.

Impacted SDG: **SDG 5**

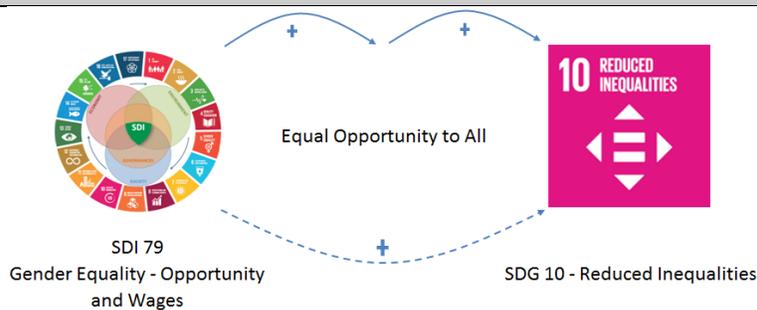


Impacted SDG: **SDG 8**



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by achieving full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value (United Nations, 2015). Following ILO conventions 100 (ILO, 1951) and 111 (ILO, 1958), no discrimination in hiring, compensation, access to training, promotion, termination and retirement is permitted based on race, caste, national origin, religion, disability, gender, sexual orientation, union membership or political affiliation (Murray & Dainty, 2009). Therefore, no discrimination plan contributes directly to SDG 8

Impacted SDG: SDG 10



SDG 10 aims to reduce inequality within and among countries by empowering and promoting the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or another status, ensuring equal opportunity and reducing inequalities of outcome (United Nations, 2015). A more diverse workforce may work more effectively, widen the available pool of talent, reduce staff turnover and attrition, enhance innovation and creativity, and improve the industry's image and reputation. Other sectors' experiences suggest that developing opportunities for minority groups promote a more informed workforce and more adaptable organizations. It also makes organizations closer to their customers and more responsive to market changes (Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018). Therefore, investing in equal opportunities contribute to SDG 10.

Impacted SDG: SDG 16



SDI 80	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Health and Safety
	Description:	Implement risk and safety management on the construction site and local community, considering the health and safety implications and regulatory requirements of using new materials, technologies, or methodologies.

Impacted SDG: SDG 3



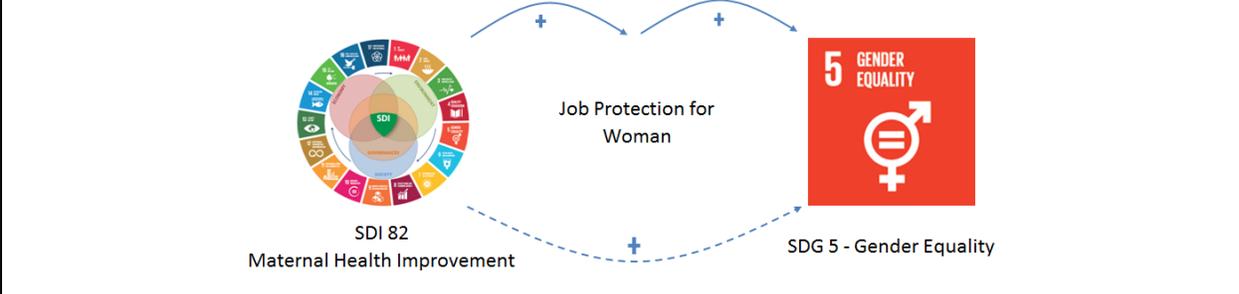
SDG 3 aims to ensure healthy lives and promote well-being for all, at all ages, by strengthening all countries ‘capacity, particularly developing countries, for early warning, risk reduction and management of national and global health risks (United Nations, 2015). The possibility of a positive safety culture is seriously undermined by workplaces that comprise a reduced number of permanent employees supplemented by contract and contingent workers. Therefore, the high percentage of non-standard forms of employment in the construction sector stands as a direct barrier to improved safety culture (Murray & Dainty, 2009). Therefore, to manage the health and safety of the construction employees contributes directly to SDG 3

SDI 81	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Health relationship between Labor and Manager

	Description:	Implement a quality communication plan between labour and management, improving the relationship between all levels (e.g., minimum notice periods regarding operational changes, including whether these are specified in collective agreements or not).
Impacted SDG:		SDG 8
<p>SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by protecting labour rights and promote safe and secure working environments for all workers (United Nations, 2015). Maternity leave is unpaid leave that allows employees time for pregnancy, childbirth, post-childbirth recuperation, adoption and childcare without compromise their job. Therefore, the maternal leave plan contributes directly to SDG 8</p>		

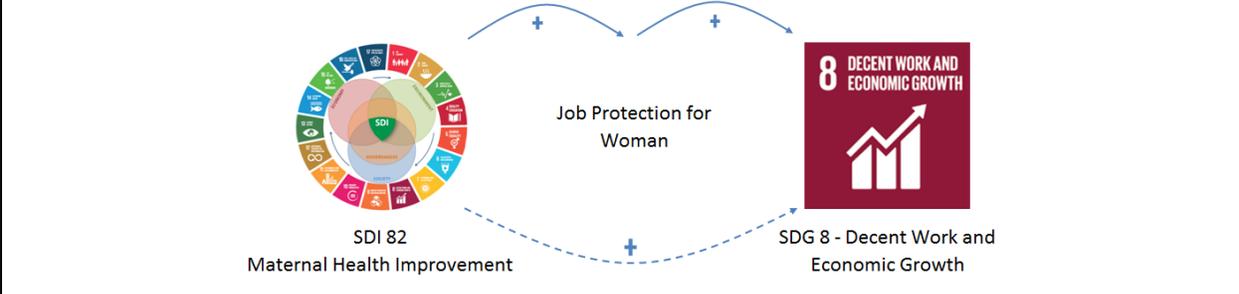
SDI 82	Category:	Social
	Subcategory:	Human rights
	Sustainability Target:	Maternal Health Improvement
	Description:	Implement an effective and clear plan for improving maternal health, guaranteeing women's careers.

Impacted SDG:		SDG 5
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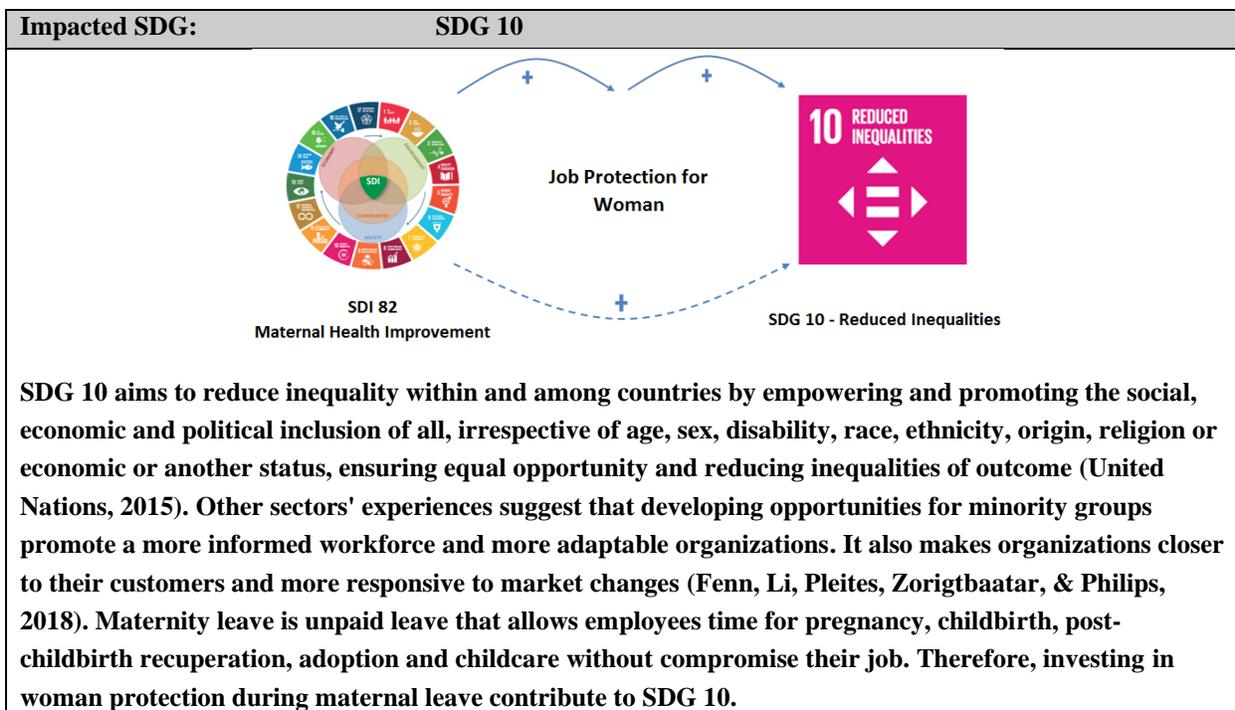


SDG 5 aims to achieve gender equality and empower all women and girls by ending all forms of discrimination against all women and girls everywhere (United Nations, 2015). Maternity leave allows expectant mothers to take unpaid leave from work without the fear of job loss. Therefore, investing in a maternal leave plan contribute to SDG 5

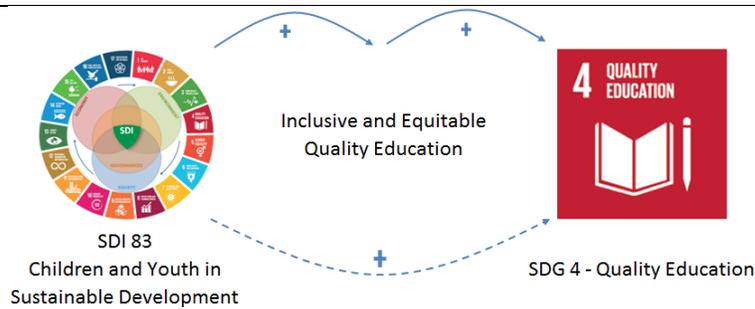
Impacted SDG:		SDG 8
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SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by protecting labour rights and promoting safe and secure working environments for all workers (United Nations, 2015). Maternity leave is unpaid leave that allows employees time for pregnancy, childbirth, post-childbirth recuperation, adoption and childcare without compromise their job. Therefore, a maternal leave plan contributes directly to SDG 8



SDI 83	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Children and Youth in Sustainable Development
	Description:	Implement education programs for children and youth (children of employees and community)
Impacted SDG:		SDG 4



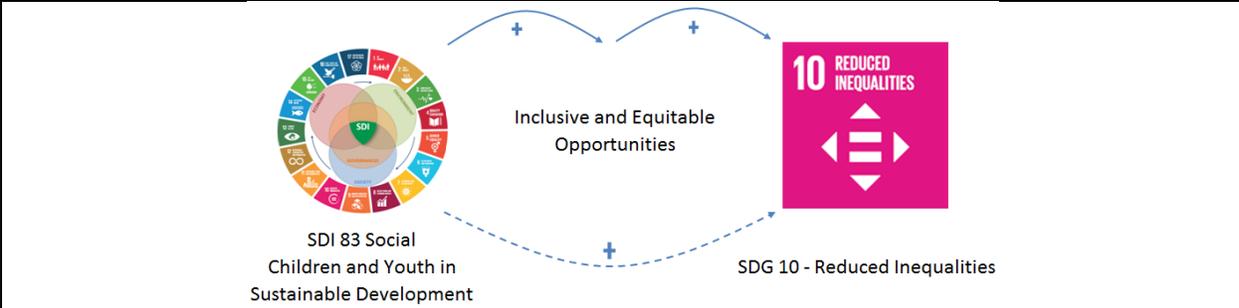
SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by ensuring that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education and equitable and quality primary and secondary education leading to relevant and effective learning outcomes (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Sustainable communities are defined as those which meet the diverse needs of existing and future residents, their children and other users, contribute to a high quality of life and provide opportunity and choice. They achieve this to make effective use of natural resources, enhance the environment, promote social cohesion and inclusion and strengthen economic prosperity (Murray & Dainty, 2009). Therefore, investing in children and youth program contributes to SDG 4.

Impacted SDG: SDG 8



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by substantially reducing the proportion of youth not in employment, education or training (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Young people (aged 15 to 29) who are not in employment, education or training (NEET) are often considered to be more vulnerable than their peers, as they may face a risk of becoming disengaged or socially excluded and could miss out on gaining skills or experience in the labour market (Symbol of the Government of Canada, 2019). Therefore, investing in youth employment and training contributes to SDG 8

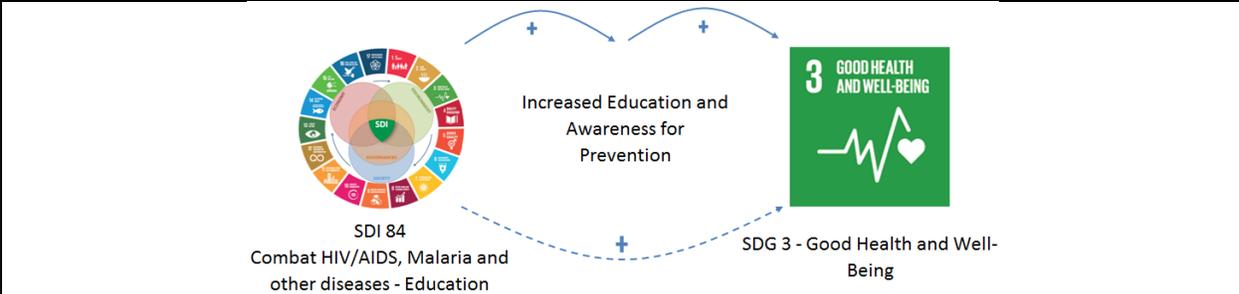
Impacted SDG: SDG 10



SDG 10 aims to reduce inequality within and among countries by empowering and promoting the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or another status (United Nations, 2015). Young people (aged 15 to 29) who are not in employment, education or training (NEET) are often considered to be more vulnerable than their peers, as they may face a risk of becoming disengaged or socially excluded and could miss out on gaining skills or experience in the labour market (Symbol of the Government of Canada, 2019). Therefore, investing in children and youth education and training opportunity contributes to SDG 10.

SDI 84	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Combat HIV/AIDS, Malaria and other diseases - Education
	Description:	Implement an education program to promote the combat of HIV/AIDS, Malaria, other diseases, and drug use.

Impacted SDG: SDG 3



SDG 3 aims to ensure healthy lives and promote well-being for all, at all ages, by ending the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other infectious diseases (United Nations, 2015). The education of children and youth merits the highest priority in a world afflicted by HIV/AIDS. This is because primary education ranks among the most effective-and cost-effective-means of HIV prevention (The International Bank for Reconstruction and Development / The World Bank, 2002). Therefore, to invest in education to prevent any kind of epidemics diseased contributes directly to SDG 3

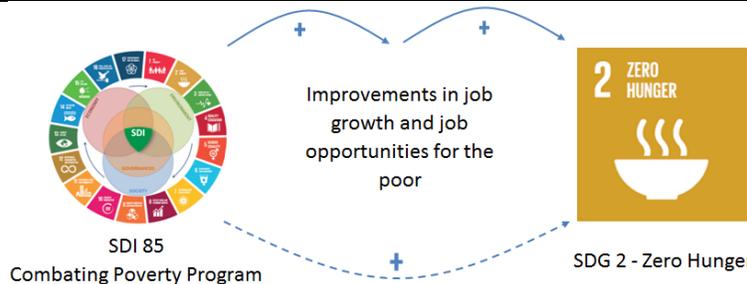
SDI 85	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Combating Poverty Program
	Description:	Implement a poverty reduction program, minimizing local and international famine.

Impacted SDG: SDG 1



SDG 1 aims to end poverty in all its forms everywhere by ensuring significant mobilization of resources from a variety of sources, including through enhanced development cooperation, to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions (United Nations, 2015). The generation of employment opportunities for the poor is considered important policy actions for poverty reduction. These are expected to increase income for the poor, improve their living standards, raise their health and nutrition status and reduce maternal and infant mortality (Sharif, 2016). Therefore, the generation of job opportunities for the poor contributes directly to SDG 1.

Impacted SDG: SDG 2



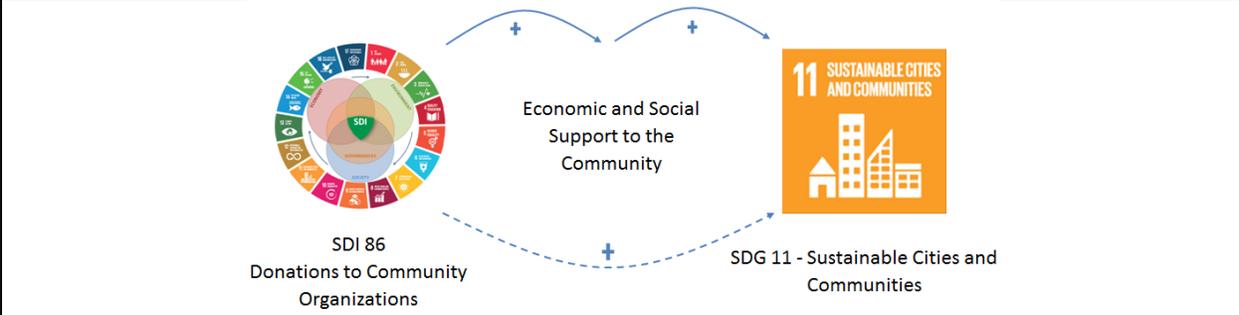
SDG 2 aims to end hunger, achieve food security and improved nutrition and promote sustainable agriculture by ending hunger and ensuring access by all people, particularly the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round (World Bank Group, 2015). Raising the income of the poor contributes to ending hunger, therefore contributing to SDG 2.

SDI 86	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Donations to Community Organizations
	Description:	Support community engagement and financial improvement.
Impacted SDG:		SDG 8



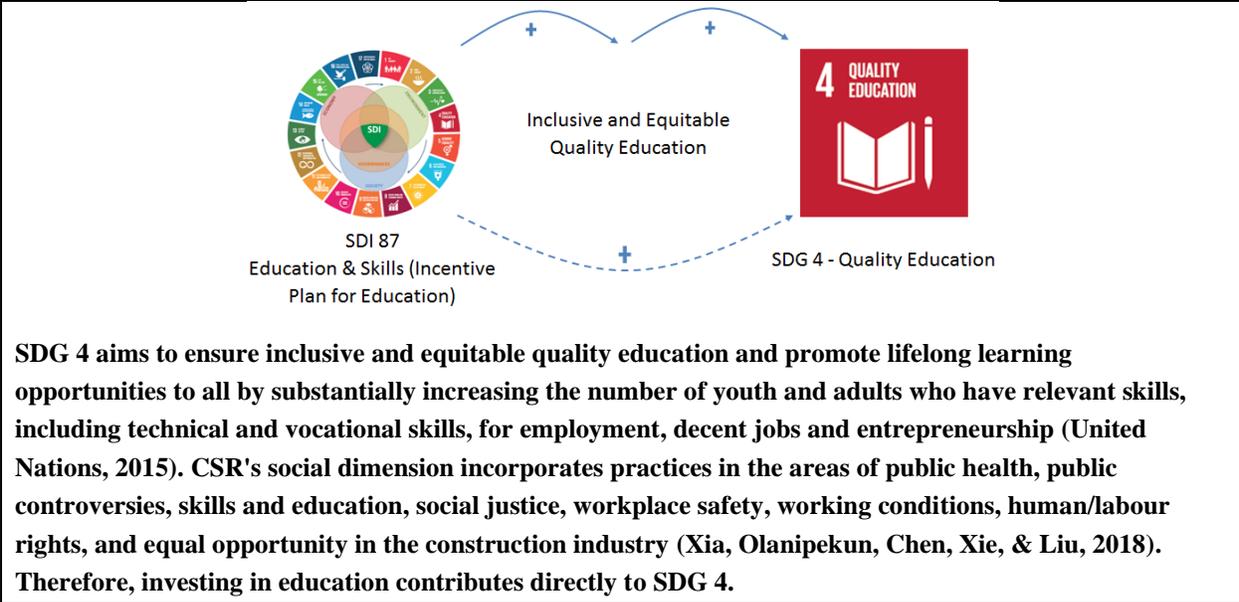
SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all by strengthening domestic financial institutions' capacity to encourage and expand access to banking, insurance, and financial services for all (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). In the UK housebuilding industry, CSR's key delivery objectives are engaging stakeholders and the community through active engagement, customer relations, and initiatives and donations. Therefore, donations for creating a sustainable community contributes to SDG 8

Impacted SDG: SDG 11



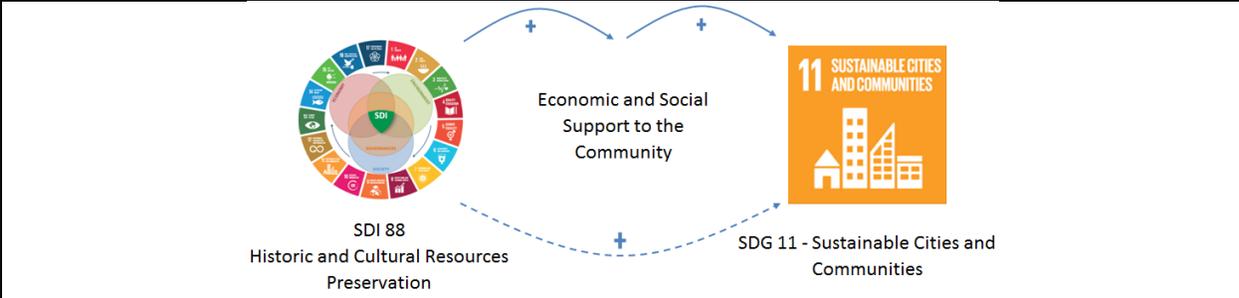
SDG 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable by economic, social and environmental positive support between urban, peri-urban and rural areas by strengthening national and regional development planning (United Nations, 2015). One of CSR's key delivery objectives in the UK housebuilding industry is engaging stakeholders and the community through active engagement, customer relations, understanding, initiatives, and donations. Key performance indicators formed a large part of housebuilders' transparent commitment to product and process responsibility. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and yard skip reductions, CO2 emissions, and water consumption (Murray & Dainty, 2009). Therefore, donations to support the community can contribute to SDG 11.

SDI 87	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Education & Skills (Incentive Plan for Education)
	Description:	Implement an education program, expanding the community workforce's knowledge, skills, and capacity to improve their growth and development ability.
Impacted SDG:		SDG 4



SDI 88	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Historic and Cultural Resources Preservation
	Description:	Preserve or restore significant historical and cultural sites to enhance community cultural resources, recognizing and strengthening the role of indigenous people and their communities.

Impacted SDG: SDG 11



SDG 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable by strengthening efforts to protect and safeguard the world’s cultural and natural heritage (United Nations, 2015). The alternative sustainable building movement represents a wide range of views and approaches to common themes such as retaining existing buildings and opposition to wholesale demolition and clearance. There are some overlaps between the green-building and the conservation of historic buildings lobby. The built environment is also instrumental in influencing human health and social behaviour, cultural identity, and civic pride (Murray & Dainty, 2009). Therefore, historic and cultural preservation can contribute to SDG 11.

SDI 89	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Low Turnover

	Description:	Manage employment stability/turnover rate, contributing to the local employment rate
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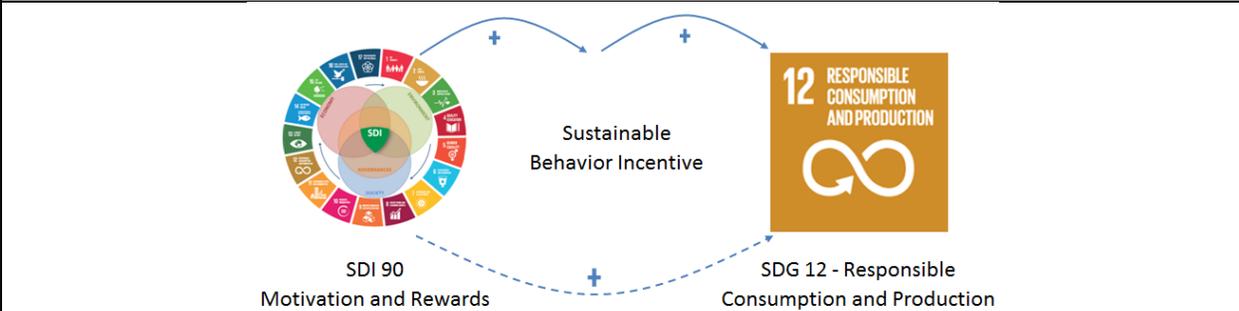
Impacted SDG:	SDG 8
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SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by achieving full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). One incentive for adopting CSR policies is the growing evidence that CSR can reduce staff turnover, increase loyalty and raise brand awareness while minimizing exposure to risks, legal and otherwise (Murray & Dainty, 2009). Therefore, minimizing the turnover of the organization contributes to SDG 8

SDI 90	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Motivation and Rewards
	Description:	Provide incentives and rewards that promote sustainable behaviours and results.

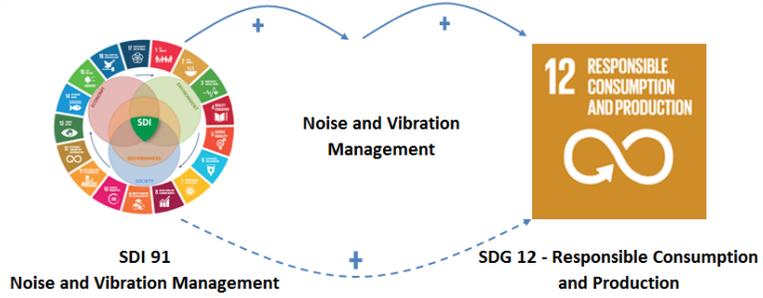
Impacted SDG:	SDG 12
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SDG 12 aims to ensure sustainable consumption and production patterns by substantially reducing waste generation through prevention, reduction, recycling, and reuse (United Nations, 2015). A study investigating whether education and explicit incentives affect sustainable behaviour indicated that incentives positively affect sustainable behaviour (Hubera, Sloof, & Praag, 2017). Therefore, investing in motivation and reward program (monetary or non-monetary) contributes directly and positively to SDG 12.

SDI 91	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Noise and Vibration Management
	Description:	Implement noise and vibration management, minimizing the noise and vibration generated during the construction, maintaining and improving community livability and building performance.

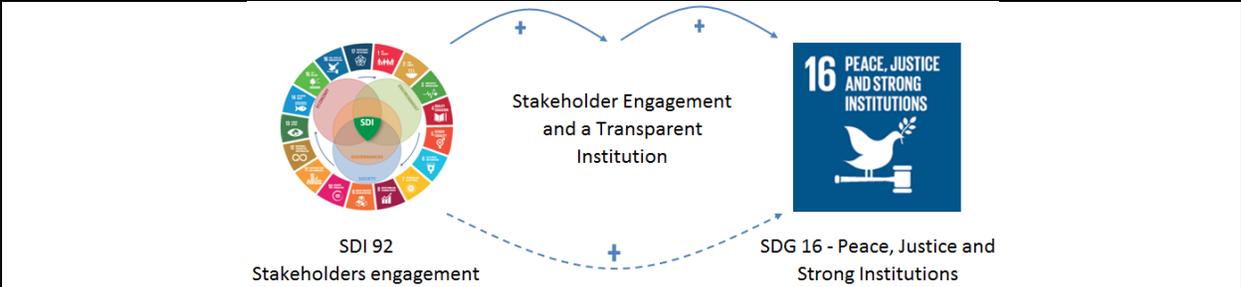
Impacted SDG: **SDG 12**



SDG 12 aims to ensure sustainable consumption and production patterns by encouraging companies to adopt sustainable practices and integrate sustainability information into their reporting cycle (United Nations, 2015). Current consumption patterns and production systems rely on traditional methods and older technologies that are highly inefficient. That generates a significant amount of waste and high energy consumption; thus, they cause various environmental issues, such as environmental pollution, greenhouse gas emission, and excessive use of resources (MA, WANG, SKIBNIEWSKI3, & GAJDA, 2019). Another impact during construction is also noise pollution. Social and technological nature must be overcome if noise is to be controlled, and if we are to restore our quality lives, technical successes and economic progress are threatening. Techniques and public actions for reducing noise must keep pace with the increased power and pervasiveness of machines that our society's dynamics and style foster (Bugliarello, Barnes, Alexandre, & Wakstein, 1976). Therefore, noise pollution contributes directly to SDG 12.

SDI 92	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Stakeholders engagement
	Description:	Implement an efficient stakeholder engagement plan, establishing programs for stakeholder identification, engagement, and involvement in project decision making.

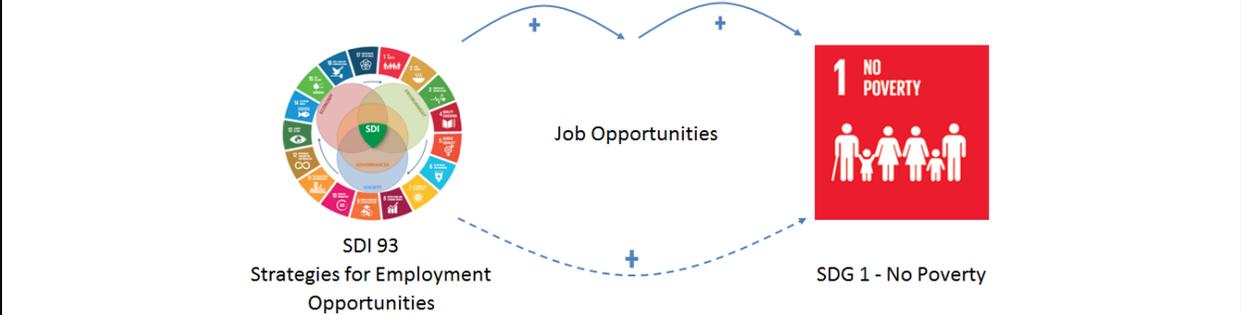
Impacted SDG: **SDG 16**



SDG 16 aims to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels by developing effective, responsible and transparent institutions at all levels (United Nations, 2015). The construction industry faces pressure to increase the sustainability of its practices. That implies significant changes in the industry’s understanding of society's demands and its clients and its sense of corporate social responsibility and suggests significant changes in its working practices (Wilson & Rezgui, 2013). An efficient stakeholder engagement plan contributes to a transparent institution, therefore, to SDG 16.

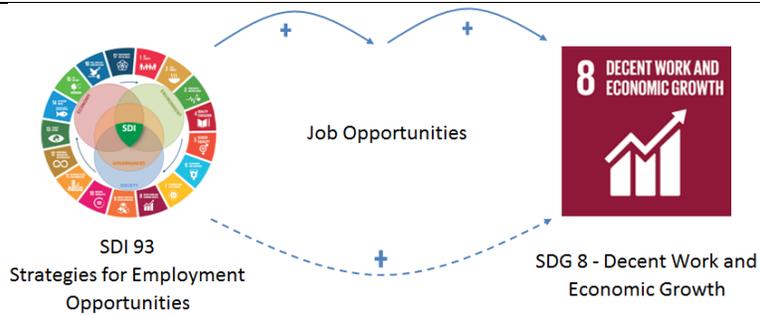
SDI 93	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Strategies for Employment Opportunities
	Description:	Implement an effective strategy for employment opportunities, including decent jobs for youth people.

Impacted SDG: SDG 1



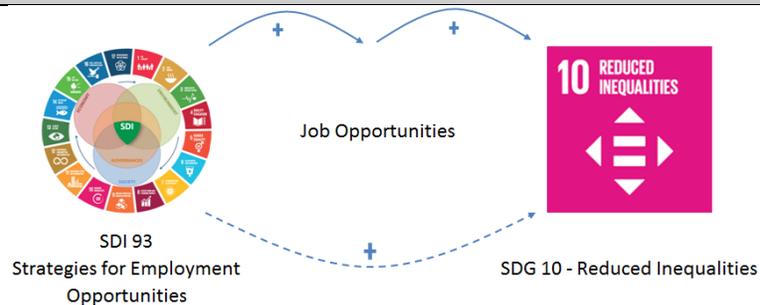
SDG 1 aims to end poverty in all its forms everywhere by reducing at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions (United Nations, 2015). One way of achieving poverty is through job creation. The construction industry stands as a significant employer. The number of new jobs created and the number of locals undertaking these jobs are good indicators of commitment to the community’s economic regeneration (Murray & Dainty, 2009). Therefore, the job creation strategy contributes directly to SDG 1.

Impacted SDG: SDG 8



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by promoting development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). A strategic plan for creating a job, therefore, contributes to SDG 8.

Impacted SDG: SDG 10



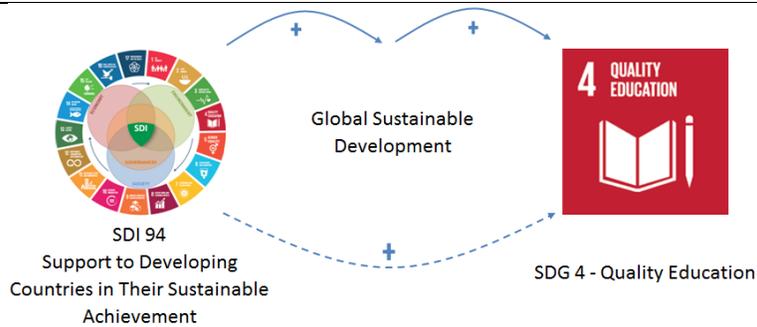
SDG 10 aims to reduce inequality within and among countries by progressively achieving and sustaining the bottom 40 percent of the population at a rate higher than the national average (United Nations, 2015). The construction industry stands as a major employer. The number of new jobs created and the number of locals undertaking these jobs are good indicators of commitment to the community's economic regeneration (Murray & Dainty, 2009). Therefore, the job creation strategy contributes directly to SDG 10.

SDI 94	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Support to Developing Countries in Their Sustainable Achievement
	Description:	Support developing countries in their sustainable achievements with a financial, technological, education, or sustainability program.
Impacted SDG:		SDG 1



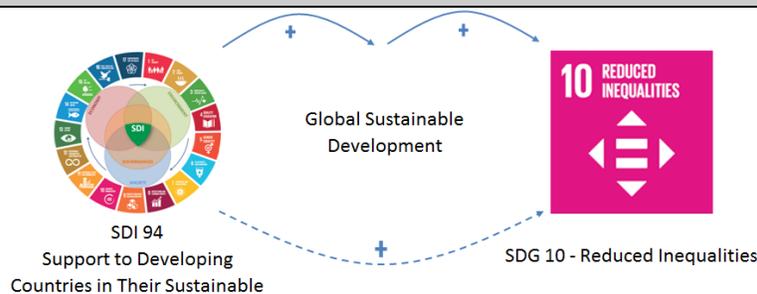
SDG 1 aims to end poverty in all its forms everywhere by ensuring significant mobilization of resources from a variety of sources, including through enhanced development cooperation, to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions (United Nations, 2015). To minimize the negative impacts of the construction process, recycle and reduce waste, increase resource efficiency and improve procurement processes are some of the measures of doing that. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and reductions in the number of yards skip removed, CO2 emissions and water consumption. The industry itself is also taking onboard activities that previously were regarded as government responsibilities. The construction companies can also demonstrate their philanthropic credentials through active participation within communities and financial donations to charitable foundations (Murray & Dainty, 2009). Therefore, support to developing countries in many different ways can contribute directly to SDG 1.

Impacted SDG: SDG 4



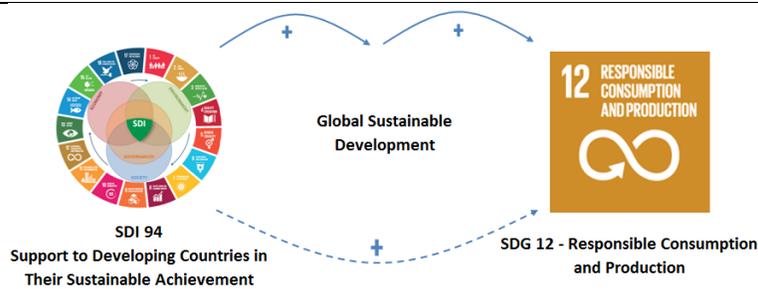
SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by substantially expanding the number of scholarships available to developing countries, in particular, least developed countries globally, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries (United Nations, 2015). To minimize the negative impacts of the construction process, recycle and reduce waste, increase resource efficiency and improve procurement processes are some of the measures of doing that. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and reductions of yards skip removed, CO2 emissions and water consumption. The industry itself is also taking onboard activities that previously were regarded as government responsibilities. The construction companies can also demonstrate their philanthropic credentials through active participation within communities and financial donations to charitable foundations (Murray & Dainty, 2009). Therefore, support to developing countries in many different ways can contribute directly to SDG 4.

Impacted SDG: SDG 10



SDG 10 aims to reduce inequality within and among countries by facilitating orderly, safe, regular and responsible migration and mobility of people, including implementing planned and well-managed migration policies (United Nations, 2015). To minimize the negative impacts of the construction process, recycle and reduce waste, increase resource efficiency and improve procurement processes are some of the measures of doing that. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and reductions in the number of yards skip removed, CO2 emissions and water consumption. The industry itself is also taking onboard activities that previously were regarded as government responsibilities. The construction companies can also demonstrate their philanthropic credentials through active participation within communities and financial donations to charitable foundations (Murray & Dainty, 2009). Therefore, support to developing countries in many different ways can contribute directly to SDG 10.

Impacted SDG: SDG 12



SDG 12 aims to ensure sustainable consumption and production patterns by supporting developing countries to strengthen their scientific and technological capacity to move towards more sustainable consumption and production (United Nations, 2015). To minimize the negative impacts of the construction process, recycle and reduce waste, increase resource efficiency and improve procurement processes are some of the measures of doing that. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and reductions in the number of yards skip removed, CO2 emissions and water consumption. The industry itself is also taking onboard activities that previously were regarded as government responsibilities. The construction companies can also demonstrate their philanthropic credentials through active participation within communities and financial donations to charitable foundations (Murray & Dainty, 2009). Therefore, support to developing countries in many different ways can contribute directly to SDG 12.

Impacted SDG: **SDG 13**



SDG 13 aims to take urgent action to combat climate change and its impacts by implementing the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible (United Nations, 2015). To minimize the negative impacts of the construction process, recycle and reduce waste, increase resource efficiency and improve procurement processes are some of the measures of doing that. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and reductions of yards skip removed, CO2 emissions and water consumption. The industry itself is also taking onboard activities that previously were regarded as government responsibilities. The construction companies can also demonstrate their philanthropic credentials through active participation within communities and financial donations to charitable foundations (Murray & Dainty, 2009). Therefore, support to developing countries in many different ways can contribute directly to SDG 13.

Impacted SDG: **SDG 15**



SDG 15 aims to protect, restore and promote sustainable use of terrestrial ecosystems by mobilizing significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation (United Nations, 2015). To minimize the negative impacts of the construction process, recycle and reduce waste, increase resource efficiency and improve procurement processes are some of the measures of doing that. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and reductions in the number of yards skip removed, CO2 emissions and water consumption. The industry itself is also taking onboard activities that previously were regarded as government responsibilities. The construction companies can also demonstrate their philanthropic credentials through active participation within communities and financial donations to charitable foundations (Murray & Dainty, 2009). Therefore, support to developing countries in many different ways can contribute directly to SDG 15.

Impacted SDG: SDG 17

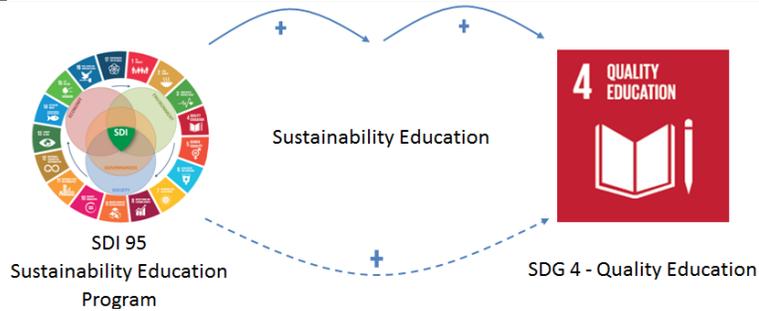


SDG 17 aims to strengthen the means of implementation and revitalize the global partnership for sustainable development by mobilizing additional financial resources for developing countries from multiple sources (United Nations, 2015). To minimize the negative impacts of the construction process, recycle and reduce waste, increase resource efficiency and improve procurement processes are some of the measures of doing that. For the construction process, housebuilders had developed KPIs in brownfield utilization, safety training, charitable donations, and reductions in the number of yards skip removed, CO2 emissions and water consumption. The industry itself is also taking onboard activities that previously were regarded as government responsibilities. The construction companies can also demonstrate their philanthropic credentials through active participation within communities and financial donations to charitable foundations (Murray & Dainty, 2009). Therefore, support to developing countries in many different ways can contribute directly to SDG 17.

SDI 95	Category:	Social
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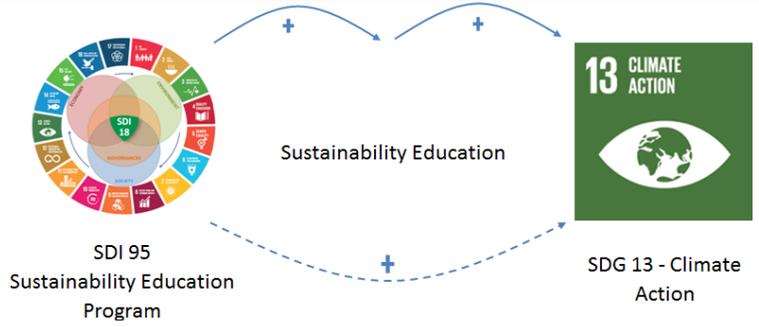
	Subcategory:	Social Development
	Sustainability Target:	Sustainability Education Program
	Description:	Implement an education program that promotes sustainable education to everyone at all levels (leadership and operational training).

Impacted SDG: **SDG 4**



SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by ensuring that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and culture’s contribution to sustainable development (United Nations, 2015). Education as a body of knowledge shows indispensable and necessary tools to contribute to awareness and change of individuals' attitudes and values regarding energy consumption (A.Dias, R.Mattos, & A.P.Balestieri, 2004) and other behaviours. Therefore, the education and knowledge of sustainable behaviour contribute directly and positively to SDG 4.

Impacted SDG: **SDG 13**

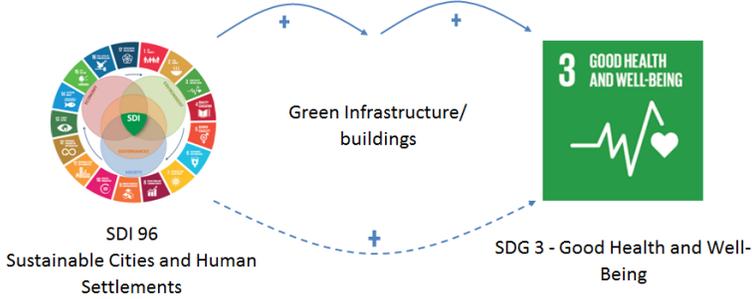


SDG 13 aims to take urgent action to combat climate change and its impacts by improving education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning (United Nations, 2015). Education as a body of knowledge shows indispensable and necessary tools to contribute to awareness and change of individuals' attitudes and values regarding energy consumption (A.Dias, R.Mattos, & A.P.Balestieri, 2004) and other behaviours. Therefore, the education and knowledge of sustainable behaviour contribute directly and positively to SDG 13.

SDI 96	Category:	Social
	Subcategory:	Social Development

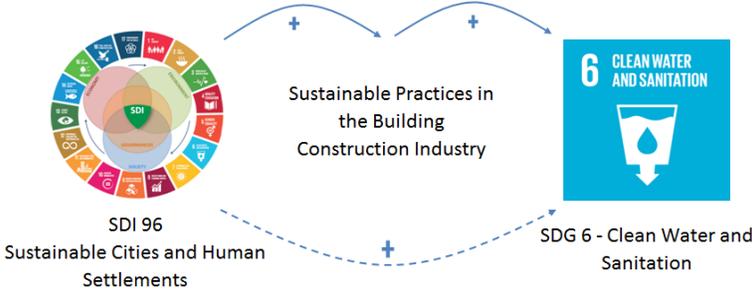
	Sustainability Target: Sustainable Cities and Human Settlements
	Description: Implement an effective plan for contributing to the local governmental sustainable goals.

Impacted SDG: SDG 3



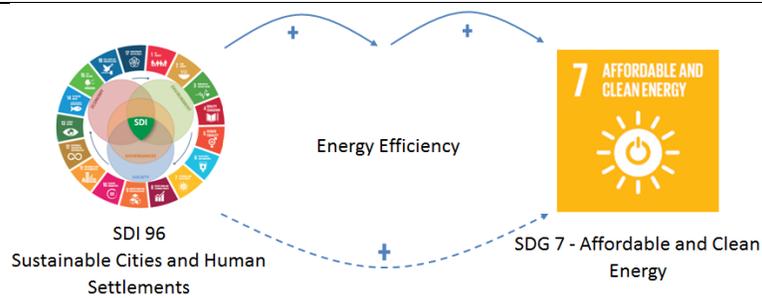
SDG 3 aims to ensure healthy lives and promote well-being for all, at all ages, by substantially reducing the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination (United Nations, 2015). Green infrastructure can help reduce particulate pollution and ground-level ozone and provide public health benefits (EPA - United States Environmental Protection Agency, 2017). Therefore, investing in sustainable cities contributes directly to SDG 3.

Impacted SDG: SDG 6



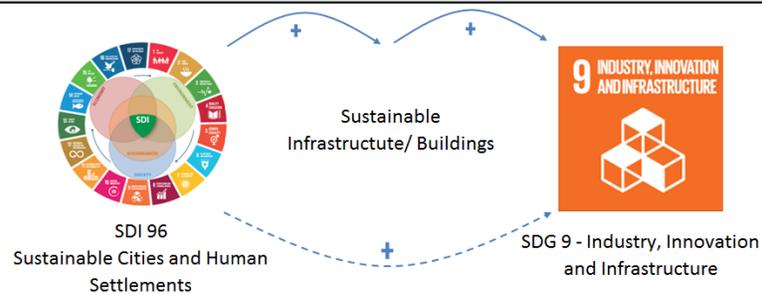
SDG 6 aims to ensure availability and sustainable management of water and sanitation for all by improving water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally and improving water and sanitation management (United Nations, 2015). Development can remove surface depressions that store rainfall. Construction activities can compact the soil and diminish its infiltration rate, resulting in an increased rate and volumes of stormwater runoff from the development site (New Jersey Department of Environmental Protection, 2004). Therefore, sustainable practices can minimize the impact of construction activities and contributes to SDG 6.

Impacted SDG: SDG 7



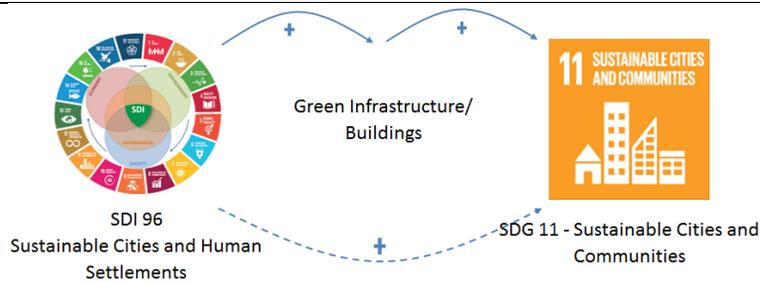
SDG 7 aims to ensure access to affordable, reliable, sustainable and modern energy for all by providing universal access to affordable, reliable and modern energy services (United Nations, 2015). Improving energy efficiency is one of the most constructive and cost-effective ways to address the challenges of high energy prices, energy security and independence, air pollution, and global climate change (EPA - United States Environmental Protection Agency, 2019). Therefore, the reduction of energy consumption can contribute directly and positively to SDG 7.

Impacted SDG: SDG 9



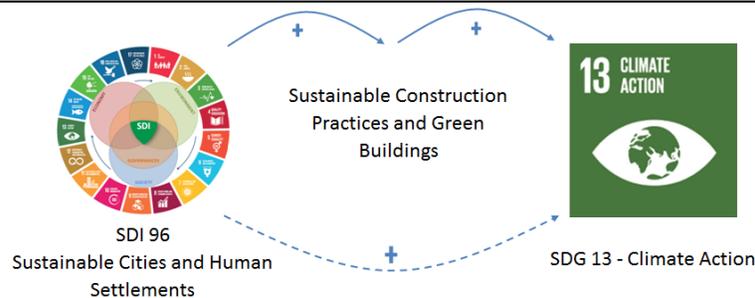
The SDG 9 - 9.1 aims to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation by upgrading infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes (United Nations, 2015). Green infrastructure can help communities manage stormwater, and vegetated systems like green roofs and tree barriers can also improve air quality and reduce urban heat island effects. Additionally, natural features such as urban forests and vegetative walls planted near roads, parking lots, and city centers help reduce vehicle emissions and improve local air quality. Green infrastructure can help reduce particulate pollution and ground-level ozone and provide public health benefits (EPA - United States Environmental Protection Agency, 2017). Therefore, using natural infrastructure impacts directly and positively on SDG 9.

Impacted SDG: SDG 11



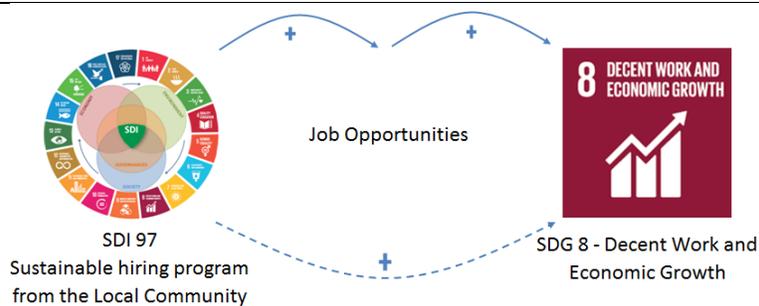
SDG 11 aims to make cities and human settlements inclusive, safe, resilient and sustainable by providing access to safe, affordable, accessible and sustainable transport systems for all, strengthening efforts to protect and safeguard the world’s cultural and natural heritage, reducing the adverse per capita environmental impact of cities, and providing universal access to safe, inclusive and accessible, green and public spaces (United Nations, 2015). Green infrastructure can help communities manage stormwater, and vegetated systems like green roofs and tree barriers can also improve air quality and reduce urban heat island effects. Additionally, natural features such as urban forests and vegetative walls planted near roads, parking lots, and city centers help reduce vehicle emissions and improve local air quality. Green infrastructure can help reduce particulate pollution and ground-level ozone and provide public health benefits (EPA - United States Environmental Protection Agency, 2017). Therefore, using natural infrastructure impacts directly and positively on SDG 11.

Impacted SDG: SDG 13



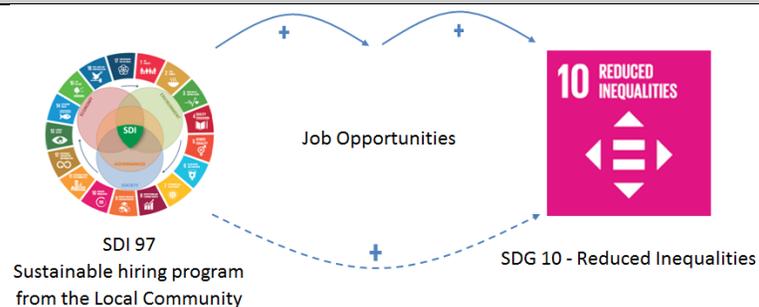
SDG 13 aims to take urgent action to combat climate change and its impacts by integrating climate change measures into national policies, strategies and planning (United Nations, 2015). The construction site's diverse activities, including energy consumption during the construction phase, can cause climate change, human health problems, and resource depletion (Hong, Hong, Kang, & Lee, 2019). Therefore, the improvement of the construction practices can contribute directly and positively to SDG 13.

SDI 97	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Sustainable hiring program from the Local Community
	Description:	Implement employment of all ages, hiring senior professionals from the local community.
Impacted SDG:		SDG 8



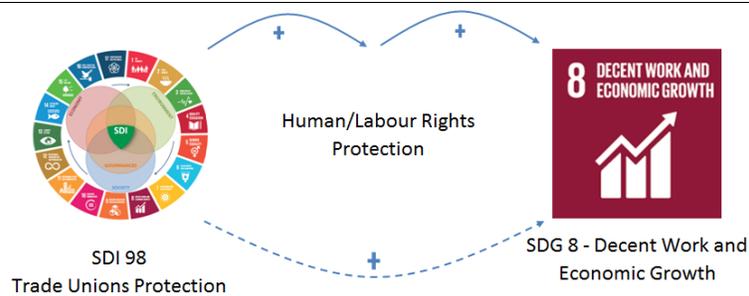
SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by achieving full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). A strategic plan for creating a job, therefore, contributes to SDG 8.

Impacted SDG: SDG 10



SDG 10 aims to reduce inequality within and among countries by progressively achieving and sustaining income growth of the bottom 40 percent of the population at a rate higher than the national average and empowering and promoting the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or another status (United Nations, 2015). The construction industry stands as a major employer. The number of new jobs created and the number of locals undertaking these jobs are good indicators of commitment to the community's economic regeneration (Murray & Dainty, 2009). Therefore, the job creation strategy contributes directly to SDG 10.

SDI 98	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Trade Unions Protection
	Description:	Encourage the trade unions in the construction field at different levels, strengthening the role of workers.
Impacted SDG:		SDG 8



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by protecting labour rights and promoting safe and secure working environments for all workers, including migrant workers, particularly women migrants and those in precarious employment (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). A strategic plan for creating a job, therefore, contributes to SDG 8.

SDI 99	Category:	Social
	Subcategory:	Social Development
	Sustainability Target:	Worker Wellbeing
	Description:	Implement a worker well-being plan, providing free time and leisure area (recreation), art, access to green space.
Impacted SDG:		SDG 8



SDG 8 aims to promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all by protecting labour rights and promoting safe and secure working environments for all workers, including migrant workers, particularly women migrants and those in precarious employment (United Nations, 2015). CSR's social dimension incorporates practices in the areas of public health, public controversies, skills and education, social justice, workplace safety, working conditions, human/labour rights, and equal opportunity in the construction industry (Xia, Olanipekun, Chen, Xie, & Liu, 2018). Therefore, creating a safe and secure working environment contributes to SDG 8.

Appendix B: The 100 Sustainable Development Indices (SDI)

This appendix contains material that supports the 100 SDI document.

B.1. Sustainable Development Goals (SDGs) Table

Table B-1 is a list of the SDGs and their targets. The table also presents the list of certifications and standards that approach the goal.

Table B-1. Sustainable Development Goals (SDGs) and Associated Targets

<p>SDG 1 (United Nations, 2015)</p> 	<p>No Poverty—To end poverty in all its forms everywhere. (United Nations, 2015) According to the International Science Council (2015), to achieve this goal requires both the provision of basic income and social protection to eliminate extreme poverty and adequate and equitable processes of wealth creation and distribution, employment and insurance in the present and the future.</p>
<p>Certifications/ Standards</p>	<p>ICC; GRI4; Green Globe; Envision; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>1.1—By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day</p> <p>1.2—By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions</p> <p>1.3—Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable</p> <p>1.4—By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance</p> <p>1.5—By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters</p> <p>1.A—Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions</p> <p>1.B—Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions</p>	

<p>SDG 2 (United Nations, 2015)</p> 	<p>Zero Hunger—to end hunger, achieve food security and improved nutrition and promote sustainable agriculture (United Nations, 2015). Scientific evidences support this multi-dimensional goal because human development requires food security and nutritional improvement and environmental issues are critical for sustainable agricultural development. Achieving this goal is complex and involves achieving other goals such as safe drinking water and sanitation and decreasing inequality (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>2.1—By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round</p> <p>2.2—By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons</p> <p>2.3—By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment</p> <p>2.4—By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality</p> <p>2.5—By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed</p> <p>2.A—Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries</p> <p>2.B—Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round</p> <p>2.C—Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility</p>	

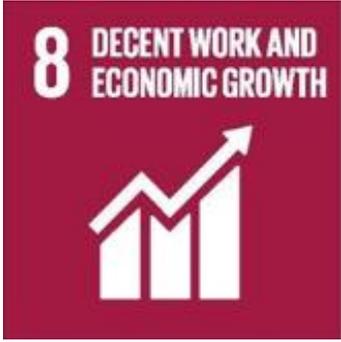
<p>SDG 3 (United Nations, 2015)</p> 	<p>Good health and Well-Being—To ensure healthy lives and promote well-being for all at all ages (United Nations, 2015). This goal is a critical element in the cycle of sustainable development: improving health leads to economic growth which usually leads to improvements in health (International Council for Science (ICSU), International Social Science Council (ISSC), 2015) creating a positive feedback loop.</p>
<p>Certification/ Standard</p>	<p>Envision;Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>3.1—By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births</p> <p>3.2—By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births</p> <p>3.3—By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases</p> <p>3.4—By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being</p> <p>3.5—Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol</p> <p>3.6—By 2020, halve the number of global deaths and injuries from road traffic accidents</p> <p>3.7—By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes</p> <p>3.8—Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all</p> <p>3.9—By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination</p> <p>3.A—Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate</p> <p>3.B—Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all</p> <p>3.C—Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States</p> <p>3.D—Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks</p>	

<p>SDG 4 (United Nations, 2015)</p> 	<p>Quality Education—To ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (United Nations, 2015). Research evidence recognizes education as a critical factor in addressing environmental and sustainability issues and ensuring human well-being. The research performed by ICSU-ISSC also recognizes the importance of education in supporting change. The education is a crucial part of contributing to reducing vulnerability to economic, social and environmental dislocation and building more resilient systems (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>4.1—By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes</p> <p>4.2—By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education</p> <p>4.3—By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university</p> <p>4.4—By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship</p> <p>4.5—By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations</p> <p>4.6—By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy</p> <p>4.7—By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development</p> <p>4.A—Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all</p> <p>4.B—By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries</p> <p>4.C—By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States</p>	

<p>SDG 5 (United Nations, 2015)</p> 	<p>Gender Equality—To achieve gender equality and empower all women and girls (United Nations, 2015). Women and girls continue to face discrimination across economic, social and political spheres. Decreasing gender disparities remain a significant driver of reducing poverty and inequality. The boy child is also vulnerable in some countries with cases of enforced labour and sexual abuse and trafficking, and so need social protection as well (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>GRI4; ICC; ISO; Green Globe; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>5.1—End all forms of discrimination against all women and girls everywhere</p> <p>5.2—Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation</p> <p>5.3—Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation</p> <p>5.4—Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate</p> <p>5.5—Ensure women’s full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life</p> <p>5.6—Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences</p> <p>5.A—Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws</p> <p>5.B—Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women</p> <p>5.C—Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels</p>	

<p>SDG 6 (United Nations, 2015)</p> 	<p>Clean Water and Sanitation—To ensure availability and sustainable management of water and sanitation for all (United Nations, 2015). Water resource management is crucial for sustainable development. Extensive science links water supply and sanitation management to improved health, wellbeing and economic productivity. Also, to keep reliable records of wastewater production, treatment and reuse are essential for manage this goal (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>6.1—By 2030, achieve universal and equitable access to safe and affordable drinking water for all</p> <p>6.2—By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations</p> <p>6.3—By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally</p> <p>6.4—By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity</p> <p>6.5—By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate</p> <p>6.6—By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes</p> <p>6.A—By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies</p> <p>6.B—Support and strengthen the participation of local communities in improving water and sanitation management</p>	

<p>SDG 7 (United Nations, 2015)</p> 	<p>Affordable and Clean Energy—To ensure access to affordable, reliable, sustainable and modern energy for all (United Nations, 2015). Reputable research efforts such as IIASA Global Energy Assessment and the World Energy Outlook of the IEA have demonstrated that it is feasible to reach universal access to modern energy services for all by 2030 (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>7.1—By 2030, ensure universal access to affordable, reliable and modern energy services</p> <p>7.2—By 2030, increase substantially the share of renewable energy in the global energy mix</p> <p>7.3—By 2030, double the global rate of improvement in energy efficiency</p> <p>7.A—By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology</p> <p>7.B—By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support</p>	

<p>SDG 8 (United Nations, 2015)</p> 	<p>Decent Work and Economic Growth—To promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (United Nations, 2015). Recent science suggests that inclusiveness—full and productive employment and decent work for all are essential to economic inclusiveness—is critical for economic growth (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>8.1—Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries</p> <p>8.2—Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors</p> <p>8.3—Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services</p> <p>8.4—Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead</p> <p>8.5—By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value</p> <p>8.6—By 2020, substantially reduce the proportion of youth not in employment, education or training</p> <p>8.7—Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms</p> <p>8.8—Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment</p> <p>8.9—By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products</p> <p>8.10—Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all</p> <p>8.A—Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries</p> <p>8.B—By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization</p>	

<p>SDG 9 (United Nations, 2015)</p> 	<p>Industry, Innovation and Infrastructure—To build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (United Nations, 2015). According to the UN System of Environmental and Economic Accounts, a combination of indicators on resource extraction and emissions, economic structure and relations, and economic, social and environmental stocks could identify the ecological consequences of infrastructure (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; Green Globe; GRI4; ICC; ISO; LEED; OECD; SeparArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>9.1—Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all</p> <p>9.2—Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry’s share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries</p> <p>9.3—Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets</p> <p>9.4—By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities</p> <p>9.5—Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending</p> <p>9.A—Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States</p> <p>9.B—Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities</p> <p>9.C—Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020</p>	

<p>SDG 10 (United Nations, 2015)</p> 	<p>Reduced Inequalities—To reduce inequality within and among countries (United Nations, 2015). There is a vast dimension of inequality, and they have been increasing over time. Research shows that economic inequality damages health, well-being and social cohesion, promotes status competition and consumerism, and increases violence. Inequality impedes poverty reduction and economic growth and compromises democracy (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; GRI4; ICC; ISO; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>10.1—By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average</p> <p>10.2—By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status</p> <p>10.3—Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard</p> <p>10.4—Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality</p> <p>10.5—Improve the regulation and monitoring of global financial markets and institutions and strengthen the implementation of such regulations</p> <p>10.6—Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions</p> <p>10.7—Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies</p> <p>10.A—Implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with World Trade Organization agreements</p> <p>10.B—Encourage official development assistance and financial flows, including foreign direct investment, to States where the need is greatest, in particular least developed countries, African countries, small island developing States and landlocked developing countries, in accordance with their national plans and programmes</p> <p>10.C—By 2030, reduce to less than 3 per cent the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5 per cent</p>	

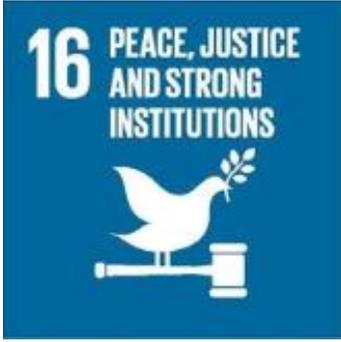
<p>SDG 11 (United Nations, 2015)</p> 	<p>Sustainable Cities and Communities—To make cities and human settlements inclusive, safe, resilient and sustainable (United Nations, 2015). Demography, economics, climate science, ecology, health, engineering, planning and humanities are one of the science disciplines behind the urban goal. The complex social, cultural, economic, environmental, technological, physical and political realities of urban life require stronger city-focused institutions, once urbanization is likely to persist and intensify driving to consumption and increase demand on global resources (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>11.1—By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums</p> <p>11.2—By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons</p> <p>11.3—By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries</p> <p>11.4—Strengthen efforts to protect and safeguard the world’s cultural and natural heritage</p> <p>11.5—By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations</p> <p>11.6—By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management</p> <p>11.7—By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities</p> <p>11.A—Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning</p> <p>11.B—By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels</p> <p>11.C—Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials</p>	

<p>SDG 12 (United Nations, 2015)</p> 	<p>Responsible Consumption and Production—To ensure sustainable consumption and production patterns (United Nations, 2015). Sustainable patterns of consumption and production in a world of limited resources is crucial for achieving sustainable development. Sustainable consumption and production respond to basic needs and bring an about better quality of life while minimizing the use of natural resources and toxic materials as well as the emissions of waste and pollutants over the lifecycle of the service or product. It implies a broad societal change that requires a systematic approach to human development based on ecological, social and economic dimensions (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; ISO; Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup ; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>12.1—Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries</p> <p>12.2—By 2030, achieve the sustainable management and efficient use of natural resources</p> <p>12.3—By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses</p> <p>12.4—By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment</p> <p>12.5—By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse</p> <p>12.6—Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle</p> <p>12.7—Promote public procurement practices that are sustainable, in accordance with national policies and priorities</p> <p>12.8—By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature</p> <p>12.A—Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production</p> <p>12.B—Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products</p> <p>12.C—Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities</p>	

<p>SDG 13 (United Nations, 2015)</p> 	<p>Climate Action—To take urgent action to combat climate change and its impacts (United Nations, 2015). According to the International Panel on Climate Change (IPCC) 5th Assessment Report (AR5), the effects of climate change constitute a significant risk for all dimensions of sustainable development. In addition, the actions to address climate change have significant implications to other aspects of sustainable development (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>13.1—Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries</p> <p>13.2—Integrate climate change measures into national policies, strategies and planning</p> <p>13.3—Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning</p> <p>13.A—Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible</p> <p>13.B—Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities</p> <p>* Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change.</p>	

<p>SDG 14 (United Nations, 2015)</p> 	<p>Life Below Water—To conserve and sustainably use the oceans, seas and marine resources for sustainable development (United Nations, 2015). The ocean is a vital role regarding the three dimensions of sustainable development—social, economic and environmental. It plays a central role in climate stability, oxygen generation, nutrient cycling, food production and coastal protection (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>14.1—By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution</p> <p>14.2—By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans</p> <p>14.3—Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels</p> <p>14.4—By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics</p> <p>14.5—By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information</p> <p>14.6—By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation</p> <p>14.7—By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism</p> <p>14.A—Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries</p> <p>14.B—Provide access for small-scale artisanal fishers to marine resources and markets</p> <p>14.C—Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want</p>	

<p>SDG 15 (United Nations, 2015)</p> 	<p>Life on Land—To protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss (United Nations, 2015). The sustainable development and conservation of terrestrial and inland freshwater ecosystems and their biodiversity are crucial for achieving the environmental, socio-cultural and economic needs (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; Green Globe; GRI4; ICC; ISO; LEED; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>15.1—By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements</p> <p>15.2—By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally</p> <p>15.3—By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world</p> <p>15.4—By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development</p> <p>15.5—Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species</p> <p>15.6—Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed</p> <p>15.7—Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products</p> <p>15.8—By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species</p> <p>15.9—By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts</p> <p>15.A—Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems</p> <p>15.B—Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation</p> <p>15.C—Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities</p>	

<p>SDG 16 (United Nations, 2015)</p> 	<p>Peace, Justice and Strong Institutions—To promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (United Nations, 2015). According to International Council for Science, countries and communities that engage in sustained, thoughtful, deliberate efforts to maintain peace, promote justice and inclusion, and build accountable and inclusive institutions, have higher economic performance (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; ISO; GRI4; ICC; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>16.1—Significantly reduce all forms of violence and related death rates everywhere</p> <p>16.2—End abuse, exploitation, trafficking and all forms of violence against and torture of children</p> <p>16.3—Promote the rule of law at the national and international levels and ensure equal access to justice for all</p> <p>16.4—By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime</p> <p>16.5—Substantially reduce corruption and bribery in all their forms</p> <p>16.6—Develop effective, accountable and transparent institutions at all levels</p> <p>16.7—Ensure responsive, inclusive, participatory and representative decision-making at all levels</p> <p>16.8—Broaden and strengthen the participation of developing countries in the institutions of global governance</p> <p>16.9—By 2030, provide legal identity for all, including birth registration</p> <p>16.10—Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements</p> <p>16.A—Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime</p> <p>16.B—Promote and enforce non-discriminatory laws and policies for sustainable development</p>	

<p>SDG 17 (United Nations, 2015)</p> 	<p>Partnerships for the goals—To strengthen the means of implementation and revitalize the global partnership for sustainable development (United Nations, 2015). This goal is tremendously important for the implementation of all the other goals, avoiding the SDG’s becoming a “wish list” with little prospect of execution (International Council for Science (ICSU), International Social Science Council (ISSC), 2015).</p>
<p>Certification/ Standard</p>	<p>Envision; GRI4; ICC; ISO; OECD; SpearArup; WBCSD</p>
<p>SDG Targets (United Nations, 2015)</p> <p>17.1—Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection</p> <p>17.2—Developed countries to implement fully their official development assistance commitments, including the commitment by many developed countries to achieve the target of 0.7 per cent of ODA/GNI to developing countries and 0.15 to 0.20 per cent of ODA/GNI to least developed countries; ODA providers are encouraged to consider setting a target to provide at least 0.20 per cent of ODA/GNI to least developed countries</p> <p>17.3—Mobilize additional financial resources for developing countries from multiple sources</p> <p>17.4—Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries to reduce debt distress</p> <p>17.5—Adopt and implement investment promotion regimes for least developed countries</p> <p>17.6—Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism</p> <p>17.7—Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed</p> <p>17.8—Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology</p> <p>17.9—Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation</p> <p>17.10—Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda</p> <p>17.11—Significantly increase the exports of developing countries, in particular with a view to doubling the least developed countries’ share of global exports by 2020</p> <p>17.12—Realize timely implementation of duty-free and quota-free market access on a lasting basis for all least developed countries, consistent with World Trade Organization decisions, including by ensuring that preferential</p>	

rules of origin applicable to imports from least developed countries are transparent and simple, and contribute to facilitating market access

17.13—Enhance global macroeconomic stability, including through policy coordination and policy coherence

17.14—Enhance policy coherence for sustainable development

17.15—Respect each country’s policy space and leadership to establish and implement policies for poverty eradication and sustainable development

17.16—Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries

17.17—Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships

17.18—By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts

17.19—By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building in developing countries

B.2. OECD Targets Table

Table B-2 is OECD's targets list categorized as used by this research.

Table B-2. OECD Sustainability Targets

OECD Target	Category—Subcategory
OECD—Agriculture: Agricultural Land	Environmental—Local Impact
OECD—Agriculture: Agricultural Support	Economic—Economy Growth
OECD—Agriculture: Crop Production	Environment—Soil; Local Impact
OECD—Agriculture: Fisheries Support	Economic—Economy Growth
OECD—Agriculture: Meat Consumption	Social—Social Development
OECD—Benefits and Wages: Financial Disincentive to Return to Work	Social—Human Rights
OECD—benefits and Wages: Net childcare Costs	Social—Human Rights
OECD—Bribery and Corruption	Governances—Social Development
OECD—Development: Food Aid	Social—Social Development
OECD—Development: Total Official and Private Flows	Social—Social Development
OECD—Earning and wages: Wage Levels	Social—Human Rights
OECD—Earnings and Wages: Average Wages	Social—Human Rights
OECD—Earnings and Wages: Gender Wage Gap	Social—Human Rights
OECD—Economic: Financial Corporations Debt to Equity Ratio	Economic —Business Growth
OECD—Economic: Foreign Direct Investment (FDI)	Economic—Economy Growth
OECD—Economic: Housing prices	Economic—Economy Growth
OECD—Economic: Labor productivity and utilization	Economy—Economic Growth
OECD—Economic: Non-Financial Corporations Debt to Surplus Ratio	Economic—Business Growth
OECD—Economic: Value-Added in Non-Financial Corporations	Economic—Economy Growth
OECD—Education: Adult Education Level	Social—Social Development
OECD—Education: International Student Assessment	Social—Social Development
OECD—Education: Population with Tertiary Education	Social—Social Development
OECD—Education: Population with tertiary education	Governances —Social Development
OECD—Education: Youth Not in Employment, Education or Training	Social—Social Development
OECD—Employment: Employment Rate by Age Group	Social—Social Development
OECD—Employment: Employment Rate	Social—Social Development
OECD—Energy: Electricity Generation	Environmental—Energy
OECD—Energy: Renewable Energy	Environmental—Energy
OECD—Entrepreneurship: Employees by Business Size	Social—Social Development
OECD—Entrepreneurship: Starting a Business	Economic—Economy Growth; Social—Social Development

OECD—Environment: Air and GHG Emissions	Environmental—Local Impact; Environmental—Air Emission; Economic—Business Growth; Governances—Environment
OECD—Environment: Air Pollution Exposure	Environmental—Local Impact; Environmental—Air Emission; Economic—Business Growth; Governances—Environment
OECD—Environment: Built-up Area	Environmental—Soil; Environmental—Biodiversity
OECD—Environment: Forest Resources	Environmental—Resource Consumption
OECD—Environment: Land Cover Change	Environmental—Soil Environmental—Biodiversity
OECD—Environment: Material Consumption	Environmental—Resource Consumption
OECD—Environment: Municipal Waste	Environmental—Local Impact Social—Social Development
OECD—Environment: Patents on Environment Technologies	Social—Social Development Governances—Innovation
OECD—Environment: Protected Areas	Environmental—Soil
OECD—Environment: Threatened Species	Environmental—Biodiversity
OECD—Environment: Waste Water Treatment	Environmental—Water
OECD—Environment: Water Withdrawals	Environmental—Water
OECD—Health Care: Alcohol consumption	Social—Social Development Social—Human Rights
OECD—Health Care: Daily Smokers	Social—Social Development Social—Human Rights
OECD—Health Care: Health Spending	Social—Human Rights
OECD—Health Care: Influenza Vaccination Rates	Social—Human Rights
OECD—Health Care: Length of Hospital Stay	Social—Human Rights
OECD—Health Care: Overweight or Obese Population	Social—Social Development
OECD—Health Care: Pharmaceutical Spending	Social—Human Rights
OECD—Health Care: Suicide Rates	Social—Human Rights
OECD—Inequality: Income Inequality	Social—Human Rights
OECD—Inequality: Poverty rate	Social—Social Development
OECD—Inequality: Social Institutions and Gender	Social—Human Rights
OECD—Inequality: Violence against women	Governances—Social Development
OECD—Innovation and technology	Social—Human Rights
OECD—Migration: Foreign-Born Employment	Social—Social Development
OECD—Migration: Native-Born Employment	Social—Social Development
OECD—Transport: Container Transport	Environmental Impact
OECD—Transport: Freight Transport	Environmental Impact
OECD—Transport: Infrastructure Investment	Social Development

OECD—Transport: Passenger Transport	Environmental—Local Impact
OECD Data—Finance: Conversion Rates	Economic—Economy Growth
OECD Data—Finance: Insurance Spending	Economic—Economy Growth
OECD Data—Finance: Pension	Economic—Economy Growth

B.3. ICC Targets Table

Table B-3 is ICC's targets list categorized as used by this research.

Table B-3. ICC Targets Table

ICC Targets	Category—Subcategory
ECONOMIC INNOVATION—Finance and investment	Economic—Business growth; Economic—Economy growth; Governances—Management; Social—Social Development
ECONOMIC INNOVATION—Metric Accounting and reporting	Economic—Business growth; Economic—Economy growth Governances—Innovation Governances—Management
ECONOMIC INNOVATION: Open and Competitive Markets: a green economy	Economic—Business Growth Economic—Economy Growth Governances—Innovation Governances—Management
ENVIRONMENTAL INNOVATION—Life Cycle Approach	Environmental—Local Impact
ENVIRONMENTAL INNOVATION—Resource efficiency and decoupling (resource consumption reduction)	Environmental—Local Impact Environmental—Resource Consumption
MUTUALLY REINFORCING AND CROSS-CUTTING ELEMENT—Governance and partnership	Environmental—Local Impact Economic—Business Growth
MUTUALLY REINFORCING AND CROSS-CUTTING ELEMENT—Integrated environmental, social and economic policy and decision-making	Governances—Management
SOCIAL INNOVATION—Awareness	Economic—Business Growth Governances—Management Governances—Social Development Social—Social Development
SOCIAL INNOVATION—Education and Skills	Governances—Social Development Social—Social Development
SOCIAL INNOVATION—Employment	Economic—Business Growth Economic—Economy Growth Social—Human Rights Social—Social Development

B.4. WBCSD Targets Table

Table B-4 is WBCSD’s targets list categorized as used by this research.

Table B-4. WBCSD Targets Table

WBCSD Targets	Category—Subcategory
CIRCULAR ECONOMY—Circular Suppliers	Environmental—Local Impact; Environmental—Research Consumption; Social—Social Development
CIRCULAR ECONOMY—Product as a Service	Environmental—Local Impact; Economic—Business Growth; Governances—Management
CIRCULAR ECONOMY—Product life extension	Environmental—Local Impact; Economic—Business Growth; Governances—Management
CIRCULAR ECONOMY—Sharing Platforms	Environmental—Local Impact; Economic—Economy Growth Economic—Business Growth; Governances—Management
CIRCULAR ECONOMY—Resource Recovery	Environmental—Resource Consumption
CITIES & MOBILITY—Transforming Mobility	Environmental—Local Impact; Social—Social Development
CITIES & MOBILITY—Sustainable Cities	Social—Social Development
CLIMATE & ENERGY—Climate	Environmental—Air Emission; Social—Social Development; Governances—Environment
CLIMATE & ENERGY—Energy	Environmental—Local Impact; Environmental—Air Emission; Environmental—Energy; Governances—Environment
FOOD & NATURE—Water	Environmental—Local Impact
FOOD & NATURE—Food and Land Use	Environmental—Local Impact
PEOPLE—Social Impact	Economic—Economy Growth; Social—Social Development; Social—Human Rights; Governances—Social Development
PEOPLE—Sustainable Development Goals	Economic—Business Growth
PEOPLE—Sustainable Lifestyles	Economic—Business Growth
REDEFINING VALUE—Business Decision-Making	Economic—Business Growth; Governances—Management
REDEFINING VALUE—External Disclosure	Governances—Management
REDEFINING VALUE—Investor Decision-Making	Economic—Business Growth; Governances—Management

B.5. GRI Targets Table

Table B-5 is GRI's targets list categorized as used by this research.

Table B-5. GRI Targets Table

GRI Targets	Category—Subcategory
(EC1 ECONOMIC) Economic Performance—Direct economic value generated and distributed	Economic—Economy Growth; Social—Human Rights
(EC2 ECONOMIC) Economic Performance—Financial implications and other risks and opportunities due to climate change	Environmental—Air Emission
(EC3 ECONOMIC) Economic Performance—Defined benefit plan obligations and other retirement plans	Social—Social Development
(EC4 ECONOMIC) Economic Performance—Financial assistance received from government	-
(EC5 ECONOMIC) Market Presence—Ratios of standard entry level wage by gender compared to local minimum wage	Social—Human Rights
(EC6 ECONOMIC) Market Presence—Proportion of senior management hired from the local community	Social—Social Development
(EC7 ECONOMIC) Indirect Economic Impacts—Infrastructure investments and services supported	Environmental—Local Impact Environmental—Air Emission Social—Social Development
(EC8 ECONOMIC) Indirect Economic Impacts—Significant indirect economic impacts	Social—Social Development Governances—Social Development
(EC9 ECONOMIC) Procurement Practices—Proportion of spending on local suppliers	Environmental—Local Impact
(EC10 ECONOMIC) Anti-corruption—Operations assessed for risks related to corruption	Governances—Social Development
(EC11 ECONOMIC) Anti-corruption—Communication and training about anti-corruption policies and procedures	Governances—Social Development
(EC12 ECONOMIC) Anti-corruption—Confirmed incidents of corruption and actions taken	Governances—Social Development
(EC13 ECONOMIC) Anti-competitive Behavior—Legal actions for anti-competitive behavior, anti-trust, and monopoly practices	-
(EN1 ENVIRONMENTAL) Materials—Materials used by weight or volume	Environmental—Resource Consumption
(EN2 ENVIRONMENTAL) Materials—Recycled input materials used	Environmental—Resource Consumption
(EN3 ENVIRONMENTAL) Materials—Reclaimed products and their packaging materials	Environmental—Resource Consumption
(EN4 ENVIRONMENTAL) Energy—Energy consumption within the organization	Environmental—Energy
(EN5 ENVIRONMENTAL) Energy—Energy consumption outside of the organization	Environmental—Energy

(EN6 ENVIRONMENTAL) Energy—Energy intensity: context of an organization-specific metric.	Environmental—Energy
(EN7 ENVIRONMENTAL) Energy—Reduction of energy consumption	Environmental—Energy
(EN8 ENVIRONMENTAL) Energy—Reductions in energy requirements of products and services	Environmental—Energy
(EN9 ENVIRONMENTAL) Energy—Reduction of Energy Consumption: Calculate energy savings using like-for-like analysis, based on absolute consumption	Environmental—Energy
(EN10 ENVIRONMENTAL) Water and Effluents—Interactions with water as a shared resource: Through its value chain	Environmental—Water
(EN11 ENVIRONMENTAL) Water and Effluents—Management of water discharge-related impacts	Environmental—Soil; Environmental—Water
(EN12 ENVIRONMENTAL) Water and Effluents—Water withdrawal	Environmental—Water
(EN13 ENVIRONMENTAL) Water and Effluents—Water discharge	Environmental—Soil; Environmental—Water
(EN14 ENVIRONMENTAL) Water and Effluents—Water consumption	Environmental—Water
(EN15 ENVIRONMENTAL) Water and Effluents—Water Sources Significantly Affected By Withdrawal of Water	Environmental—Water
(EN16 ENVIRONMENTAL) Water and Effluents—Percentage And Total Volume Of Water Recycled And Reused	Environmental—Water
(EN17 ENVIRONMENTAL) Biodiversity—Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas	Environmental—Soil; Environmental—Local Impact; Environmental—Biodiversity
(EN18 ENVIRONMENTAL) Biodiversity—Significant impacts of activities, products, and services on biodiversity	Environmental—Soil; Environmental—Biodiversity
(EN19 ENVIRONMENTAL) Biodiversity—Habitats protected or restored	Environmental—Soil; Environmental—Local Impact; Environmental—Biodiversity
(EN20 ENVIRONMENTAL) Biodiversity—IUCN Red List species and national conservation list species with habitats in areas affected by operations	Environmental—Local Impact; Environmental—Biodiversity
(EN21 ENVIRONMENTAL) Emissions—Direct (Scope 1) GHG emissions: Direct (Scope 1) GHG emissions include, but are not limited to, the CO2 emissions from the fuel consumption	Environmental—Local Impact; Environmental—Energy; Environmental—Air Emission; Governances—Environment
(EN22 ENVIRONMENTAL) Emissions—Energy indirect (Scope 2) GHG emissions: Energy indirect (Scope 2) GHG emissions include, but are not limited to, the CO2 emissions from the generation of purchased or acquired electricity, heating, cooling, and steam consumed by an organization.	Environmental—Local Impact; Environmental—Energy; Environmental—Air Emission

(EN23 ENVIRONMENTAL) Emissions—Other indirect (Scope 3) GHG emissions: Other indirect (Scope 3) GHG emissions are a consequence of an organization’s activities, but occur from sources not owned or controlled by the organization	Environmental—Local Impact
(EN24 ENVIRONMENTAL) Emissions—GHG emissions intensity: Intensity ratios define GHG emissions in the context of an organization-specific metric	Environmental—Local Impact; Environmental—Air Emission
(EN25 ENVIRONMENTAL) Emissions—Reduction of GHG emissions	Environmental—Local Impact; Environmental—Energy; Environmental—Air Emission; Governances—Environment
(EN26 ENVIRONMENTAL) Emissions—Emissions of ozone-depleting substances (ODS)	Environmental—Air Emission
(EN27 ENVIRONMENTAL) Emissions—Nitrogen oxides (NOX), sulfur oxides (SOX), and other significant air emissions	Environmental—Air Emission
(EN28 ENVIRONMENTAL) Effluents and Waste—Water discharge by quality and destination	Environmental—Water
(EN29 ENVIRONMENTAL) Effluents and Waste—Waste by type and disposal method	Environmental—Local Impact; Environmental—Waste
(EN30 ENVIRONMENTAL) Effluents and Waste—Significant spills	Environmental—Waste
(EN31 ENVIRONMENTAL) Effluents and Waste—Transport of hazardous waste	Environmental—Waste
(EN32 ENVIRONMENTAL) Effluents and Waste—Water bodies affected by water discharges and/or runoff	Environmental—Water
(EN33 ENVIRONMENTAL) Environmental Compliance—Non-compliance with environmental laws and regulations	Governances—Environment
(EN34 ENVIRONMENTAL) Supplier Environmental Assessment—New suppliers that were screened using environmental criteria	Environmental—Local Impact; Governances—Social Development
(EN35 ENVIRONMENTAL) Supplier Environmental Assessment—Negative environmental impacts in the supply chain and actions taken	Governances—Social Development
(EN36 ENVIRONMENTAL) Products and Services—Extent of Impact Mitigation of Environmental Impacts of Products and Services	Environmental—Resource Consumption
(EN37 ENVIRONMENTAL) Transport—Significant Environmental Impacts of Transporting Products and Other Goods and Materials for The Organization’s Operations, And Transporting Members Of The Workforce	Environmental—Local Impact
(EN38 ENVIRONMENTAL) Land Degradation, Contamination and Remediation	Environmental—Social; Environmental—Water
(SO1 SOCIAL) Employment—New employee hired and employee turnover	Social—Social Development

(SO2 SOCIAL) Employment—Benefits provided to full-time employees that are not provided to temporary or part-time employees	Social—Human Rights; Economic—Economy Growth
(SO3 SOCIAL) Employment—Parental leave	Social—Human Rights
(SO4 SOCIAL) Labor/Management Relations—Minimum notice periods regarding operational changes	Social—Human Rights
(SO5 SOCIAL) Occupational Health and Safety—Occupational health and safety management system	Social—Human Rights
(SO6 SOCIAL) Occupational Health and Safety—Hazard identification, risk assessment, and incident investigation	Social—Human Rights
(SO7 SOCIAL) Occupational Health and Safety—Occupational health services	Social—Human Rights
(SO8 SOCIAL) Occupational Health and Safety—Worker participation, consultation, and communication on occupational health and safety	Social—Human Rights
(SO9 SOCIAL) Occupational Health and Safety—Worker training on occupational health and safety	Social—Human Rights
(SO10 SOCIAL) Occupational Health and Safety—Promotion of worker health	Social—Human Rights
(SO11 SOCIAL) Occupational Health and Safety—Prevention and mitigation of occupational health and safety impacts directly linked by business relationships	Social—Human Rights
(SO12 SOCIAL) Occupational Health and Safety—Workers covered by an occupational health and safety management system	Social—Human Rights
(SO13 SOCIAL) Occupational Health and Safety—Work-related injuries	Social—Human Rights
(SO14 SOCIAL) Occupational Health and Safety—Work-related illness prevention	Social—Human Rights
(SO15 SOCIAL) Training and Education—Average hours of training per year per employee	Social—Social Development; Governances—Social Development
(SO16 SOCIAL) Training and Education—Programs for upgrading employee skills and transition assistance programs	Social—Social Development; Governances—Social Development
(SO17 SOCIAL) Training and Education—Percentage of employees receiving regular performance and career development reviews	Social—Human Rights
(SO18 SOCIAL) Diversity and Equal Opportunity—Diversity of governance bodies and employees	Social—Human Rights; Social—Social Development
(SO19 SOCIAL) Diversity and Equal Opportunity—Ratio of basic salary and remuneration of women to men	Social—Human Rights
(SO20 SOCIAL) Non-discrimination—According to International Labour Organization (ILO) instruments, discrimination can occur on the grounds of race, color, sex, religion, political opinion, national extraction, and social origin.	Social—Human Rights

(SO21 SOCIAL) Freedom of Association and Collective Bargaining—Operations and suppliers in which the right to freedom of association and collective bargaining may be at risk	Social—Human Rights; Social—Social Development
(SO22 SOCIAL) Child Labor—Operations and suppliers at significant risk for incidents of child labor]	Social—Human Rights
(SO23 SOCIAL) Forced or Compulsory Labor—Operations and suppliers at significant risk for incidents of forced or compulsory labor	Governances—Social Development
(SO24 SOCIAL) Security Practices—Security personnel trained in human rights policies or procedures	Governances—Social Development
(SO25 SOCIAL) Rights of Indigenous Peoples—Incidents of violations involving rights of indigenous peoples	Social—Human Rights
(SO26 SOCIAL) Human Rights Assessment—Operations that have been subject to human rights reviews or impact assessments	Governances—Social Development
(SO27 SOCIAL) Human Rights Assessment—Employee training on human rights policies or procedures	Governances—Social Development
(SO28 SOCIAL) Human Rights Assessment—Significant investment agreements and contracts that include human rights clauses or that underwent human rights screening	Governances—Social Development
(SO29 SOCIAL) Local Communities—Operations with local community engagement, impact assessments, and development programs	Social—Social Development
(SO30 SOCIAL) Local Communities—Operations with significant actual and potential negative impacts on local communities	Governances—Social Development
(SO31 SOCIAL) Supplier Social Assessment—New suppliers that were screened using social criteria	Governances—Social Development
(SO32 SOCIAL) Supplier Social Assessment—Negative social impacts in the supply chain and actions taken	Governances—Social Development
(SO33 SOCIAL) Anti-corruption	Governances—Social Development
(SO34 SOCIAL) Anti-competitive Behavior	Economic—Economy Growth
(SO35 SOCIAL) Public Policy—Political contributions	-
(SO36 SOCIAL) Customer Health and Safety—Assessment of the health and safety impacts of product and service categories	Governances—Management
(SO37 SOCIAL) Customer Health and Safety—Incidents of non-compliance concerning the health and safety impacts of products and services	Governances—Social Development
(SO38 SOCIAL) Marketing and Labeling—Requirements for product and service information and labeling	-
(SO39 SOCIAL) Marketing and Labeling—Incidents of non-compliance concerning product and service information and labeling	-
(SO40 SOCIAL) Marketing and Labeling—Incidents of non-compliance concerning marketing communications	Governances—Social Development

(SO41 SOCIAL) Product and Service Labeling—Results of Surveys Measuring Customer Satisfaction	Governances—Management
(SO42 SOCIAL) Product and Service Labeling—Type and Number Of Sustainability Certification, Rating And Labeling Schemes For New Construction, Management, Occupation And Redevelopment	Governances—Management

B.6. BREEAM Targets Table

Table B-6 is BREEAM's targets list categorized as used by this research.

Table B-6. BREEAM Targets Table

BREEAM's Targets	Category—Subcategory
Energy—Ene 01 Reduction of energy use and carbon Emissions	Environmental—Energy
Energy—Ene 02a Energy Monitoring	Governances—Management
Energy—Ene 03 External Lighting	Environmental—Energy
Energy—Ene 04 Low Carbon Design	Environmental—Energy
Energy—Ene 05 Energy Efficient Cold Storage	Environmental—Energy
Energy—Ene 06 Energy Efficient Transport Systems	Environmental—Energy
Energy—Ene 07 Energy Energy-efficient laboratory systems	-
Energy—Ene 08 Energy Efficient Equipment	Environmental—Energy
Energy—Ene 09 Drying Space	Environmental—Energy
Health And Wellbeing—Hea 01 Visual Comfort	Environmental—Energy; Environmental—Management
Health And Wellbeing—Hea 02 Indoor Air Quality	Environmental—Air Emission; Governances—Environment
Health And Wellbeing—Hea 03 Safe Containment in Laboratories	-
Health and wellbeing—Hea 04 Thermal Comfort	Environmental—Management
Health And Wellbeing—Hea 05 Acoustic Performance	Social—Well-being
Health And Wellbeing—Hea 06 Accessibility	Environmental—Local Impact; Social—Social Development
Health And Wellbeing—Hea 07 Hazards	Environmental—Soil; Environmental—Waste; Social—Human Rights
Health And Wellbeing—Hea 08 Private Space	Social—Social Development; Social—Human Rights
Health And Wellbeing—Hea 09 Water Quality	Environmental—Water
Innovation—Inn 01 Innovation	Governances—Innovation
Land Use & Ecology—LE 01 Site Selection	Environmental—Soil; Environmental—Local Impact; Environmental—Water; Environmental—Biodiversity
Land Use & Ecology—LE 02 Ecological Value Of Site And Protection Of Ecological Features	Environmental—Soil; Environmental—Biodiversity
Land Use & Ecology—LE 02 Minimizing impact on existing site ecology	Environmental—Soil; Environmental—Biodiversity
Land Use & Ecology—LE 04 Enhancing Site Ecology	Environmental—Local Impact; Environmental—Soil; Environmental—Biodiversity
Land Use & Ecology—LE 05 Long Term Impact On Biodiversity	Environmental—Biodiversity
Man 01 Project Brief And Design	Social—Social Development

Man 02 Life Cycle Cost And Service Life Planning	Environmental—Local Impact; Governances—Management
Man 03 Responsible Construction Practices	Environmental—Soil; Environmental—Local Impact; Environmental—Water; Environmental—Air Emission; Environmental—Resource Consumption; Environmental—Waste; Environmental—Biodiversity; Economic—Business Growth; Social—Social Development; Social—Well-being; Social—Human Rights; Governances—Social Development; Governances—Environment; Governances—Management
Man 04 Commissioning and Handover	Governances—Management
Man 05 Aftercare	Governances—Management
Materials—Mat 01 Life Cycle Impacts	Environmental—Local Impact
Materials—Mat 02 Hard landscaping and boundary protection	Environmental—Local Impact; Environmental—Social
Materials—Mat 03 Responsible Sourcing of Construction	Environmental—Air Emission; Environmental—Resource Consumption
Materials—Mat 05 Designing for Durability and Resilience	Environmental—Local Impact
Materials—Mat 06 Material Efficiency	Environmental—Local Impact; Environmental—Resource Consumption
Pollution—Pol 01 Impact of Refrigerants	Environmental—Air Emission
Pollution—Pol 02 Nox Emissions	Environmental—Air Emission
Pollution—Pol 03 Surface Water Run-Off	Environmental—Water
Pollution—Pol 04 Reduction of Night Time Light Pollution	Environmental—Energy
Pollution—Pol 05 Reduction of Noise Pollution	Social—Well-being
Transport—Tra 01 Public Transport Accessibility	Environmental—Local Impact; Social—Social Development
Transport—Tra 02 Proximity to Amenities	Environmental—Local Impact; Social—Social Development
Transport—Tra 03 A and B Alternative Modes of Transport	Environmental—Local Impact; Social—Social Development
Transport—Tra 04 Maximum Car Parking Capacity	Environmental—Local Impact
Transport—Tra 05 Travel Plan	Environmental—Local Impact
Transport—Tra 06 Home Office	Social—Social Development
Waste—Wst 01 Construction Waste Management	Environmental—Local Impact; Environmental—Waster; Economic—Business Growth

Waste—Wst 02 Recycled Aggregates	Environmental—Local Impact; Environmental—Resource Consumption
Waste—Wst 03 Operational Waste	Environmental—Local Impact; Environmental—Waste
Waste—Wst 04 Speculative Finishes	Environmental—Local Impact
Waste—Wst 05 Adaptation to Climate Change	Governances—Innovation
Waste—Wst 06 Functional Adaptability	Governances—Innovation
Water—Wat 01 Water Consumption	Environmental—Water
Water—Wat 02 Water Monitoring	Governances—Management
Water—Wat 03 Water Leak Detection and Prevention	Environmental—Water
Water—Wat 04 Water Efficient Equipment	Environmental—Water Governances—Management

B.7. LEED Targets Table

Table B-7 is LEED’s targets list categorized as used by this research.

Table B-7. LEED Targets Table

LEED’s Targets	Category—Subcategory
Integrative Process	Governances—Management; Governances—Innovation
(LT) LEED for Neighborhood Development Location	
(LT) Sensitive Land Protection	Environmental—Local Impact
(LT) High Priority Site	Environmental—Soil; Environmental—Local Impact
(LT) Surrounding Density and Diverse Uses	Environmental—Local Impact
(LT) Access to Quality Transit	Environmental—Local Impact
(LT) Bicycle Facilities	Environmental—Local Impact
(LT) Reduced Parking Footprint	Environmental—Local Impact
(LT) Green Vehicles	Environmental—Local Impact
(SS) Construction Activity Pollution Prevention	Environmental—Soil
(SS) Site Assessment	Environmental—Soil
(SS) Site Development—Protect or Restore Habitat	Environmental—Biodiversity
(SS) Open Space	Social—Human Rights
(SS) Rainwater Management	Environmental—Water
(SS) Heat Island Reduction	Environmental—Air Emission
(SS) Light Pollution Reduction	Environmental—Energy
(WE) Outdoor Water Use Reduction	Environmental—Water
(WE) Indoor Water Use Reduction	Environmental—Water
(WE) Building-Level Water Metering	Environmental—Water
(WE) Outdoor Water Use Reduction	Environmental—Water
(WE) Indoor Water Use Reduction	Environmental—Water
(WE) Cooling Tower Water Use	Environmental—Water
(WE) Water Metering	Environmental—Water
(EA) Fundamental Commissioning and Verification	Governances—Management
(EA) Minimum Energy Performance	Environmental—Energy
(EA) Building-Level Energy Metering	Environmental—Energy
(EA) Fundamental Refrigerant Management	Environmental—Air Emission; Environmental—Energy
(EA) Enhanced Commissioning	Governances—Management
(EA) Optimize Energy Performance	Environmental—Energy
(EA) Advanced Energy Metering	Environmental—Energy
(EA) Demand Response	Environmental—Energy
(EA) Renewable Energy Production	Environmental—Energy
(EA) Enhanced Refrigerant Management	Environmental—Air Emission; Environmental—Energy
(EA) Green Power and Carbon Offsets	Environmental—Energy

(MR) Storage and Collection of Recyclables	Environmental—Local Impact
(MR) Construction and Demolition Waste Management Planning	Environmental—Waste
(MR) Building Life-Cycle Impact Reduction	Environmental—Local Impact; Environmental—Resource Consumption
(MR) Building Product Disclosure and Optimization— Environmental Product	Environmental—Local Impact; Environmental—Resource Consumption
(MR) Building Product Disclosure and Optimization—Sourcing of Raw Materials	Environmental—Resource Consumption
(MR) Building Product Disclosure and Optimization—Material Ingredients	Environmental—Resource Consumption; Environmental—Local Impact
(MR) Construction and Demolition Waste Management	Environmental—Waste
(IQ) Minimum Indoor Air Quality Performance	Environmental—Air Emission
(IQ) Environmental Tobacco Smoke Control	Environmental—Air Emission Social—Well-being
(IQ) Enhanced Indoor Air Quality Strategies	Environmental—Air Emission
(IQ) Low-Emitting Materials	Environmental—Air Emission
(IQ) Construction Indoor Air Quality Management Plan	Environmental—Air Emission
(IQ) Indoor Air Quality Assessment	Environmental—Air Emission
(IQ) Thermal Comfort	Environmental—Management Social—Well-being
(IQ) Interior Lighting	Environmental—Management
(IQ) Daylight	Environmental—Energy
(IQ) Quality Views	Environmental—Energy Social—Well-being
(IQ) Acoustic Performance	Social—Well-being
(ID) Innovation in Design	Governances—Innovation
(ID) LEED Accredited Professional	Governances—Social Development
(RP) Regional Priority: Specific Credit	Governances—Social Development

B.8. Envision Targets Table

Table B-8 is Envision’s targets list categorized as used by this research.

Table B-8. Envision Targets Table

ENVISION’s Targets	Category—Subcategory
CLIMATE AND RESILIENCE: EMISSIONS—CR1.1 Reduce Net Embodied Carbon	Environmental—Air Emission; Environmental—Local Impact; Environmental—Resource Consumption
CLIMATE AND RESILIENCE: EMISSIONS—CR1.2 Reduce Greenhouse Gas Emissions	Environmental—Air Emission; Environmental—Local Impact; Environmental—Soil
CLIMATE AND RESILIENCE: EMISSIONS—CR1.3 Reduce Air Pollutant Emissions	Environmental—Air Emission
CLIMATE AND RESILIENCE: RESILIENCE—CR2.1 Avoid Unsuitable Development	Environmental—Local Impact; Environmental—Soil
CLIMATE AND RESILIENCE: RESILIENCE—CR2.2 Assess Climate Change Vulnerability	Environmental—Air Emission
CLIMATE AND RESILIENCE: RESILIENCE—CR2.3 Evaluate Risk and Resilience	Environmental—Local Impact
CLIMATE AND RESILIENCE: RESILIENCE—CR2.4 Establish Resilience Goals and Strategies	Environmental—Local Impact
CLIMATE AND RESILIENCE: RESILIENCE—CR2.5 Maximize Resilience	Economic—Economy growth
CLIMATE AND RESILIENCE: RESILIENCE—CR2.6 Improve Infrastructure Integration	Environmental—Local Impact
INNOVATION—Innovate or Exceed Credit Requirements	All—All
LEADERSHIP: COLLABORATION—LD1.1 Provide Effective Leadership and Commitment	Governances—Management
LEADERSHIP: COLLABORATION—LD1.2 Foster Collaboration and Teamwork	Governances—Management
LEADERSHIP: COLLABORATION—LD1.3 Provide for Stakeholder Involvement	Social—Social Development
LEADERSHIP: COLLABORATION—LD1.4 Pursue By product Synergies	Environmental—Local Impact; Environmental—Resource Consumption; Governances—Management
LEADERSHIP: ECONOMY—LD3.1 Stimulate Economic Prosperity and Development	Economic—Business growth; Economic—Economy growth
LEADERSHIP: ECONOMY—LD3.2 Develop Local Skills and Capabilities	Governances—Social Development; Social—Human Rights; Social—Social Development
LEADERSHIP: ECONOMY—LD3.3 Conduct a Life-Cycle Economic Evaluation	Economic—Economy growth

LEADERSHIP: PLANNING—LD2.1 Establish a Sustainability Management Plan	Governances—Management
LEADERSHIP: PLANNING—LD2.2 Plan for Sustainable Communities	Social—Social Development
LEADERSHIP: PLANNING—LD2.3 Plan for Long-Term Monitoring and Maintenance	Environmental—Local Impact; Governances—Management
LEADERSHIP: PLANNING—LD2.4 Plan for End-of-Life	Environmental—Local Impact
NATURAL WORLD: CONSERVATION—NW2.1 Reclaim Brownfields	Environmental—Soil
NATURAL WORLD: CONSERVATION—NW2.2 Manage Stormwater	Environmental—Water
NATURAL WORLD: CONSERVATION—NW2.3 Reduce Pesticide and Fertilizer Impacts	Environmental—Biodiversity
NATURAL WORLD: CONSERVATION—NW2.4 Protect Surface and Groundwater Quality	Environmental—Soil; Environmental—Water
NATURAL WORLD: ECOLOGY—NW3.1 Enhance Functional Habitats	Environmental—Biodiversity
NATURAL WORLD: ECOLOGY—NW3.2 Enhance Wetland and Surface Water Functions	Environmental—Biodiversity; Environmental—Water
NATURAL WORLD: ECOLOGY—NW3.3 Maintain Floodplain Functions	Environmental—Water
NATURAL WORLD: ECOLOGY—NW3.4 Control Invasive Species	Environmental—Biodiversity
NATURAL WORLD: ECOLOGY—NW3.5 Protect Soil Health	Environmental—Soil
NATURAL WORLD: SITING—NW1.1 Preserve Sites of High Ecological Value	Environmental—Local Impact
NATURAL WORLD: SITING—NW1.2 Provide Wetland and Surface Water Buffers	Environmental—Biodiversity; Environmental—Soil
NATURAL WORLD: SITING—NW1.3 Preserve Prime Farmland	Environmental—Local Impact
NATURAL WORLD: SITING—NW1.4 Preserve Undeveloped Land	Environmental—Biodiversity; Environmental—Local Impact
QUALITY OF LIFE: COMMUNITY—QL3.1 Advance Equity and Social Justice	Economic—Business growth; Governances—Social Development; Social—Human rights
QUALITY OF LIFE: COMMUNITY—QL3.2 Preserve Historic and Cultural Resources	Social—Social Development
QUALITY OF LIFE: COMMUNITY—QL3.3 Enhance Views and Local Character	Environmental—Air Emission; Environmental—Local Impact; Social—Social Development
QUALITY OF LIFE: COMMUNITY—QL3.4 Enhance Public Space and Amenities	Environmental—Local Impact
QUALITY OF LIFE: MOBILITY—QL2.1 Improve Community Mobility and Access	Environmental—Local Impact; Social—Social Development

QUALITY OF LIFE: MOBILITY—QL2.2 Encourage Sustainable Transportation	Environmental—Local Impact
QUALITY OF LIFE: MOBILITY—QL2.3 Improve Access and Wayfinding	Environmental—Local Impact
QUALITY OF LIFE: WELLBEING—QL1.1 Improve Community Quality of Life	Social—Human Rights
QUALITY OF LIFE: WELLBEING—QL1.2 Enhance Public Health and Safety	Environmental—Air Emission; Social—Human rights
QUALITY OF LIFE: WELLBEING—QL1.3 Improve Construction Safety	Governances—Social Development; Social—Human rights
QUALITY OF LIFE: WELLBEING—QL1.4 Minimize Noise and Vibration	Social—Well-being
QUALITY OF LIFE: WELLBEING—QL1.5 Minimize Light Pollution	Environmental—Energy
QUALITY OF LIFE: WELLBEING—QL1.6 Minimize Construction Impacts	Environmental—Air Emission; Environmental—Waste; Governances—Social Development; Social—Human rights
RESOURCE ALLOCATION: ENERGY—RA2.1 Reduce Operational Energy Consumption	Environmental—Energy
RESOURCE ALLOCATION: ENERGY—RA2.2 Reduce Construction Energy Consumption	Environmental—Energy
RESOURCE ALLOCATION: ENERGY—RA2.3 Use Renewable Energy	Environmental—Energy
RESOURCE ALLOCATION: ENERGY—RA2.4 Commission and Monitor Energy Systems	Governances—Management
RESOURCE ALLOCATION: MATERIALS—RA1.1 Support Sustainable Procurement Practices	Environmental—Local Impact; Environmental—Resource Consumption; Governances—Management
RESOURCE ALLOCATION: MATERIALS—RA1.2 Use Recycled Materials	Environmental—Resource Consumption
RESOURCE ALLOCATION: MATERIALS—RA1.3 Reduce Operational Waste	Economic—Business growth; Environmental—Waste
RESOURCE ALLOCATION: MATERIALS—RA1.4 Reduce Construction Waste	Environmental—Waste
RESOURCE ALLOCATION: MATERIALS—RA1.5 Balance Earthwork On Site	Environmental—Soil
RESOURCE ALLOCATION: WATER—RA3.1 Preserve Water Resources	Environmental—Water
RESOURCE ALLOCATION: WATER—RA3.2 Reduce Operational Water Consumption	Environmental—Water
RESOURCE ALLOCATION: WATER—RA3.3 Reduce Construction Water Consumption	Environmental—Water

RESOURCE ALLOCATION: WATER—RA3.4 Monitor Water Systems	Governances—Management
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B.9. Living Building Challenge Targets Table

Table B-9 is LBC’s targets list categorized as used by this research.

Table B-9. LBC Targets Table

LBC’s Targets	Category—Subcategory
PLACE PETAL 01—Ecology of Place	Environmental—Soil; Environmental—Local Impact; Environmental—Biodiversity
PLACE PETAL 02—Urban Agriculture	Environmental—Local Impact; Economic—Business Growth; Social—Social Development
PLACE PETAL 03—Habitat Exchange	Economic—Business Growth; Social—Social Development
PLACE PETAL 04—Human-Scaled Living	Environmental—Local Impact; Economic—Business Growth; Social—Social Development; Social—Human Rights
WATER PETAL 05—Responsible Water Use	Environmental—Water; Social—Social Development
WATER PETAL 06—Net Positive Water	Environmental—Water
ENERGY PETAL 07—Energy + Carbon Reduction	Environmental—Energy
ENERGY PETAL 08—Net Positive Carbon	Environmental—Energy; Governances—Environment
HEALTH & HAPPINESS PETAL 09—Healthy Interior Environment	Environmental—Energy Environmental—Air Emission
HEALTH & HAPPINESS PETAL 10—Healthy Interior Performance	Environmental—Air Emission; Governances—Environment
HEALTH & HAPPINESS PETAL 11—Access to Nature	Environmental—Air Emission
MATERIALS PETAL 12—Responsible Materials	Environmental—Local Impact; Environmental—Air Emission; Environmental—Resource Consumption; Environmental—Waste
MATERIALS PETAL 13—Red List	Environmental—Air Emission; Environmental—Resource Consumption
MATERIALS PETAL 14—Responsible Sourcing	Environmental—Resource Consumption
MATERIALS PETAL 15—Living Economy Sourcing	Environmental—Local Impact
MATERIALS PETAL 16—Net Positive Waste	Environmental—Local Impact; Environmental—Resource Consumption; Environmental—Waste
EQUITY PETAL 17—Universal Access	Environmental—Local Impact; Environmental—Air Emission
EQUITY PETAL 18—Inclusion	Environmental—Local Impact; Economic—Business Growth;

	Economic—Economy Growth; Social—Social Development
BEAUTY PETAL 19—Beauty + Biophilia	Governances—Innovation
BEAUTY PETAL 20—Inspiration and Education	Governances—Management; Governances—Social Development

B.10. Spear Arup Targets Table

Table B-10 is Spear Arup’s targets list categorized as used by this research.

Table B-10. Spear Arup Target Table

SPeAR’s Targets	Category—Subcategory
(Social) Community Facilities	Environmental—Local Impact; Environmental—Air Emission; Social—Social Development; Social—Human Rights
(Social) Culture	Social—Social Development; Social—Human Rights
(Social) Form and Space	Environmental—Local Impact; Environmental—Air Emission; Social—Social Development
(Social) Health and wellbeing	Environmental—Energy; Social—Human Rights
(Social) Transport	Environmental—Local Impact
(Social) Stakeholder Engagement	Social—Social Development
(Environmental) Soil and Land	Environmental—Soil; Environmental—Local Impact; Environmental—Water
(Environmental) Biodiversity	Environmental—Biodiversity
(Environmental) Waste	Environmental—Local Impact; Environmental—Waste
(Environmental) Materials	Environmental—Local Impact; Environmental—Resource Consumption
(Environmental) Water	Environmental—Water
(Environmental) Energy	Environmental—Local Impact; Environmental—Energy; Economic—Business Growth; Governances—Environment
(Environmental) Climate Change	Environmental—Local Impact; Environmental—Air Emission; Governances—Environment
(Environmental) Air Quality	Environmental—Local Impact; Environmental—Air Emission; Governances—Environment
(Environmental) Lighting	Environmental—Management; Governances—Innovation
(Economic) Economic Effect	Environmental—Local Impact; Social—Social Development; Economic—Economy Growth; Governances—Management;

	Economic—Business Growth
(Economic) Site Selection	Environmental—Soil; Environmental—Local Impact
(Economic) Employment and Skills	Social—Social Development; Economic—Economy Growth; Social—Human Rights
(Economic) Equality	Social—Social Development; Social—Human Rights
(Economic) Governance and Reporting	Governances—Management
(Economic) Digital Technologies	Social—Human Rights
(Economic) Operations	Environmental—Management; Governances—Management
(Economic) Risk	Environmental—Local Impact; Governances—Management
(Economic) Procurement	Environmental—Local Impact; Economic—Economy Growth

B.11. Green Globe Targets Table

Table B-11 is Green Globe’s targets list categorized as used by this research.

Table B-11. Green Globes Targets Table

Green Globe’s Targets	Category—Subcategory
A.1 Project Management—Integrated Design Process	Governances—Management; Social—Social Development
A.2 Project Management—Environmental Management During Construction	Environmental—Air Emission; Environmental—Waste; Social—Well-Being; Social—Human Rights; Economic—Business Growth
A.3 Project Management—Commissioning	Environmental—Water; Environmental—Energy; Governances—Management
B.1 Site—Development Area	Environmental—Soil; Environmental—Local Impact; Environmental—Biodiversity
B.2 Site—Ecological Impacts	Environmental—Soil; Environmental—Air Emission; Environmental—Biodiversity
B.3 Site—Stormwater Management:	Environmental—Water
B.4 Site—Landscaping	Environmental—Biodiversity
B.5 Site—Exterior Light Pollution	Governances—Environment
B.6 Site—Site Innovation	Governances—Innovation
C.1 Energy—Energy Performance	Environmental—Management Environmental—Energy
C.2 Energy—Energy Demand	Environmental—Energy
C.3 Energy—Metering, Measurement & Verification	Environmental—Management; Governances—Management
C.4 Energy—Building Opaque Envelope	Environmental—Energy
C.5 Energy—Lighting	Environmental—Energy
C.6 Energy—HVAC Systems and Controls	Environmental—Management
C.7 Energy—Other Equipment and Measures	Governances—Management Governances—Innovation
C.8 Energy—Renewable Energy	Environmental—Energy
C.9 Energy—Energy Efficient Transportation	Environmental—Local Impact
C.10 Energy—Energy Innovation	Governances—Innovation
D.1 Water—Water Consumption	Environmental—Water
D.2 Water—Cooling Towers	Environmental—Water
D.3 Water—Boilers and Water Heaters	Environmental—Water
D.4 Water—Water Intensive Applications	Environmental—Water
D.5 Water—Water Treatment	Environmental—Water

D.6 Water—Alternate Sources of Water	Environmental—Water
D.7 Water—Metering	Governances—Management
D.8 Water—Irrigation	Environmental—Water
D.9 Water—Water Innovation	Environmental—Water
E.1 Materials & Resources—Building Assembly (Core and Shell including the Envelope)	Environmental—Local Impact; Environmental—Resource Consumption
E.2 Materials & Resources—Interior Fit-Outs(including Finishes and Furnishings)	Environmental—Resource Consumption
E.3 Materials & Resources—Re-Use of Existing Structures	Environmental—Resource Consumption
E.4 Materials & Resources—Waste	Environmental—Local Impact; Environmental—Resource Consumption Environmental—Waste
E.5 Materials & Resources—Building Service Life Plan	Governances—Management
E.6 Materials & Resources—Resource Conservation	Economic—Economy Growth; Governances—Innovation
E.7 Materials & Resources—Envelope—Roofing / Openings	Economic—Economy Growth; Governances—Innovation
E.8 Materials & Resources—Envelope—Foundation / Waterproofing	Economic—Economy Growth; Governances—Innovation
E.9 Materials & Resources—Envelope—Cladding	Environmental—Energy; Governances—Innovation
E.10 Materials & Resources—Envelope—Barriers	Environmental—Energy; Governances—Innovation
E.11 Materials & Resources—Resource Innovation	Governances—Innovation
F.1 Emissions, effluents & other impacts—Heating	Environmental—Air Emission
F.2 Emissions, effluents & other impacts—Cooling	Environmental—Air Emission
F.3 Emissions, effluents & other impacts—Janitorial Equipment	Environmental—Air Emission
G.1 Indoor environment—Ventilation	Environmental—Air Emission
G.2 Indoor environment—Source Control and Measurement of Indoor Pollutant	Environmental—Air Emission
G.3 Indoor environment—Lighting Design and Systems	Environmental—Energy
G.4 Indoor environment—Thermal comfort	Environmental—Management
G.5 Indoor environment—Acoustic comfort	Social—Well-being

B.12. ISO Targets Table and ISO Standards Contribution to the SDGs.

Table B-12 is ISO's targets list categorized as used by this research.

Table B-12. ISO Targets Table

ISO Sustainability Target	Category	Subcategory
Air Quality	Environmental	Air Emission
Water Quality	Environmental	Water
Land Preservation	Environmental	Local Impact
Preservation of Flora	Environmental	Biodiversity
Preservation of Fauna	Environmental	Biodiversity
Human Health	Social	Human Rights
Cultural Preservation (aesthetics, heritage, etc.)	Social	Social Development

Table B-13 is a list of standards that according to ISO, contribute to the SDGs.

Table B-13. ISO Standards Contribution to the SDGs

ISO	OBJECTIVE	Sector	SDG's
All	ISO recognizes the importance of global partnerships. An ISO International Standard is developed with the collaboration and consensus of a wide range of stakeholders from all over the world, including representatives from government, industry and standardization bodies.	All	17
ISO 13065	Sustainability criteria for bioenergy	All	9, 13
ISO 19011	Guidelines for auditing management systems	All	8
ISO 20400	Sustainable procurement — Guidance	All	8
ISO 26000	Guidance on social responsibility	All	8
ISO 30500	Non-sewered sanitation systems — Prefabricated integrated treatment units — General safety and performance requirements for design and testing	All	8
ISO/CD TS 17021	Conformity assessment — Requirements for bodies providing audit and certification of management systems — Part 12: Competence requirements for auditing and certification of collaborative business relationship management systems	All	8
ISO/DGUIDE 84	Guidelines for addressing climate change in standards	All	10
ISO/IEC NP 17030	Conformity assessment — General requirements for third-party marks of conformity	All	12
ISO 1006	Building construction — Modular coordination — Basic module	Building and construction	15
ISO 1040	Building construction — Modular coordination — Multi modules for horizontal coordinating dimensions	Building and construction	15

ISO 10845	Construction procurement—Part 5, 7, 8, CD 1	Building and construction	12
ISO 15392	Sustainability in buildings and civil engineering works — General principles	Building and construction	1, 5, 8, 10
ISO 16745	Sustainability in buildings and civil engineering works — Carbon metric of an existing building during the use stage — Part 1, 2	Building and construction	15
ISO 21542	Building construction — Accessibility and usability of the built environment	Building and construction	15
ISO 21723	Buildings and civil engineering works — Modular coordination — Module	Building and construction	15
ISO 21929	Sustainability in building construction — Sustainability indicators — Part 1, 2	Building and construction	3, 8
ISO 21930	Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services	Building and construction	7, 8
ISO 21931	Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment — Part 2: Civil engineering works	Building and construction	1, 2, 3, 4, 6, 7, 8, 9, 12, 13, 14, 15
ISO 24353	Hygrothermal performance of building materials and products — Determination of moisture adsorption/desorption properties in response to humidity variation — Amendment 1	Building and construction	13
ISO 2445	Joints in building — Fundamental principles for design	Building and construction	11, 13
ISO 2848	Building construction — Modular coordination — Principles and rules	Building and construction	13
ISO 3008	Fire resistance tests — Door and shutter assemblies — Part 1, 2, 3	Building and construction	15
ISO 3443	Tolerances for building — Part 1: Basic principles for evaluation and specification	Building and construction	13
ISO 3881	Building construction — Modular co-ordination — Stairs and stair openings — Co-ordinating dimensions	Building and construction	13
ISO 4463	Measurement methods for building — Setting-out and measurement — Part 3: Check-lists for the procurement of surveys and measurement services	Building and construction	13, 14, 15
ISO 52000	Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures	Building and construction	13
ISO 6511	Building construction — Modular coordination — Modular floor plane for vertical dimensions	Building and construction	12, 13

ISO 6512	Building construction — Modular coordination — Storey heights and room heights	Building and construction	12, 13
ISO 6513	Building construction — Modular coordination — Series of preferred multimodular sizes for horizontal dimensions	Building and construction	6, 13, 14
ISO 6514	Building construction — Modular coordination — Sub-modular increments	Building and construction	13, 15
ISO 6589	Joints in building — Laboratory method of test for air permeability of joints	Building and construction	9, 13
ISO 6707	Buildings and civil engineering works — Vocabulary — Part 1, 2, 3	Building and construction	13
ISO 7077	Measuring methods for building — General principles and procedures for the verification of dimensional compliance	Building and construction	12, 13
ISO 7361	Performance standards in building — Presentation of performance levels of facades made of same-source components	Building and construction	11, 13
ISO 7728	Typical horizontal joints between an external wall of prefabricated ordinary concrete components and a concrete floor — Properties, characteristics and classification criteria	Building and construction	3, 6
ISO 7729	Typical vertical joints between two prefabricated ordinary concrete external wall components — Properties, characteristics and classification criteria	Building and construction	6
ISO 7737	Tolerances for building — Presentation of dimensional accuracy data	Building and construction	3, 8, 9, 10, 11, 12, 13, 14, 15
ISO 7976	Tolerances for building — Methods of measurement of buildings and building products — Part 1, 2	Building and construction	3
ISO/AWI 18319	Fibre-reinforced polymer (FRP) reinforcement for concrete structures — Part 2: Specifications of CFRP strips	Building and construction	13
ISO/AWI 19650	Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 4: Information exchange	Building and construction	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
ISO/AWI 23869	Determination of Self-leveling Properties of Sealant	Building and construction	15
ISO/AWI 24068	Building and civil engineering works — Determination of the rate of cure of sealants — Part 1, 2	Building and construction	9, 11, 13
ISO/AWI 24070	Building and civil engineering works — Determination of depth of cure of one-component sealants — Part 1, 2	Building and construction	11, 12, 13

ISO/AWI 24147	Sweepers — Terminology and commercial specifications	Building and construction	11, 12, 13
ISO/AWI 24260	Thermal insulation products—Hemp fiber mat and board—Specification	Building and construction	10, 16
ISO/AWI 24283	Geotechnical investigation and testing — Qualification criteria and assessment — Part 1, 2, 3	Building and construction	3
ISO/AWI 24322	Timber structures — Methods of test for evaluation of long-term performance — Part 1: wood-based products in bending	Building and construction	12
ISO/AWI 24678	Fire safety engineering — Requirements governing algebraic equations — Part 9: Ejected flame from an opening	Building and construction	2
ISO/AWI 29465	Thermal insulating products for building applications — Determination of length and width	Building and construction	8, 9
ISO/AWI 29466	Thermal insulating products for building applications — Determination of thickness	Building and construction	9, 16
ISO/AWI 29468	Thermal insulating products for building applications — Determination of flatness	Building and construction	2, 5, 8, 10, 11, 12, 16
ISO/AWI 29469	Thermal insulating products for building applications — Determination of compression behaviour	Building and construction	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16
ISO/AWI 29766	Thermal insulating products for building applications — Determination of tensile strength parallel to faces	Building and construction	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
ISO/AWI 29768	Thermal insulating products for building applications — Determination of linear dimensions of test specimens	Building and construction	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 14, 15, 16
ISO/AWI 29770	Thermal insulating products for building applications — Determination of thickness for floating-floor insulating products	Building and construction	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16
ISO/CD 22057	Enabling use of Environmental Product Declarations (EPD) at construction works level using building information modelling (BIM)	Building and construction	3, 8
ISO/CD 22496	Windows and pedestrian doors — Terminology	Building and construction	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
ISO/CD 23234	Buildings and civil engineering works — Security — Planning of security measures in the built environment	Building and construction	1, 2, 4, 5, 6, 7, 8, 9, 10,

			11, 12, 13, 14, 15, 16
ISO/CD 24323	Design methods for vibrational serviceability of timber floors	Building and construction	1, 2, 3, 5, 6, 7, 9, 10, 11
ISO/CD 7170	Furniture — Storage units — Test methods for the determination of strength, durability and stability	Building and construction	3, 13
ISO/CD TS 23624	Safe Use of High Performance — Fibre ropes in Crane applications	Building and construction	10, 11
ISO/DIS 20414	Fire safety engineering — Verification and validation protocol for building fire evacuation models	Building and construction	12
ISO/DIS 21678	Sustainability in buildings and civil engineering works — Indicators and benchmarks — Principles for the development and use of benchmarks	Building and construction	3, 6, 7, 8, 10, 11, 13, 14, 15
ISO/DIS 6707	Buildings and civil engineering works — Vocabulary — Part 1: General terms	Building and construction	3, 6, 12, 13, 14, 15
ISO/FDIS 20887	Sustainability in buildings and civil engineering works — Design for disassembly and adaptability — Principles, requirements and guidance	Building and construction	1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15
ISO/TR 21932	Sustainability in buildings and civil engineering works — A review of terminology	Building and construction	6, 7, 8, 9, 11, 16
ISO/TS 12720	Sustainability in buildings and civil engineering works — Guidelines on the application of the general principles in ISO 15392	Building and construction	11
ISO/TS 21929	Sustainability in building construction — Sustainability indicators — Part 2: Framework for the development of indicators for civil engineering works	Building and construction	9, 11
ISO/WD 15686	Buildings and constructed assets — Service life planning — Part 10: When to assess functional performance	Building and construction	11, 12
ISO/WD 15928	Houses — Description of performance — Part 7: Accessibility and usability	Building and construction	11, 15
ISO/WD 15928	Houses — Description of performance — Part 6: Contribution to sustainable development	Building and construction	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
ISO/WD 20432	Guidelines for the determination of the long-term strength of geosynthetics for soil reinforcement	Building and construction	8, 9, 11
ISO/WD 21725	Simplified design of prestressed concrete bridges — Part 1, 2	Building and construction	8, 9, 11
ISO/WD 21931	Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of	Building and construction	8, 9, 11

	construction works as a basis for sustainability assessment — Part 1: Buildings		
ISO/WD 22476	Geotechnical investigation and testing — Field testing — Part 16: Borehole shear test	Building and construction	8, 9, 11
ISO/WD 23237	Glass in building—Testing method of light transmittance for glass photovoltaic (PV) module in buildings	Building and construction	8, 9, 11
ISO/WD 24144	Thermal insulation — Test method for Specific heat capacity of thermal insulation for buildings in the high-temperature range — DSC method	Building and construction	12
ISO/WD 24285	Thermal insulation for building equipment and industrial applications — Cellular Glass products — Specification	Building and construction	9
ISO/WD 24658	Cranes—Principles of safety management for wind by users — Part 1: General	Building and construction	1, 4
ISO/WD 26367	Guidelines for assessing the adverse environmental impact of fire effluents — Part 3: Sampling and analysis	Building and construction	3, 8, 9, 11, 14, 15, 16
ISO/WD 52016	Energy performance of buildings — Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads — Part 5: Specific criteria and validation procedures	Building and construction	11, 12
ISO/WD 52016	Energy performance of buildings — Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads — Part 5: Specific criteria and validation procedures	Building and construction	8, 10, 11, 16
ISO/WD 7240	Fire detection and fire alarm systems — Part 31, 32	Building and construction	1, 2, 11
ISO/WD 8102	Electrical requirements for lifts, escalators and moving walks — Part 20: Cybersecurity	Building and construction	1, 8, 10, 13, 15, 16
ISO/WD TR 22845	Resilience of buildings and civil engineering works	Building and construction	12
ISO/WD TS 21602	Fire safety engineering — Estimating the reduction in movement speed based on visibility and irritant species concentration	Building and construction	11, 12
ISO 10001	Quality management — Customer satisfaction — Guidelines for codes of conduct for organizations	Business management and innovation	3, 8, 9, 10, 11, 16
ISO 10002	Quality management — Customer satisfaction — Guidelines for complaints handling in organizations	Business management and innovation	11, 12, 13
ISO 10003	Quality management — Customer satisfaction — Guidelines for dispute resolution external to organizations	Business management and innovation	11, 12, 13

ISO 10015	Quality management — Guidelines for competence management and people development	Business management and innovation	11, 12, 13
ISO 10015	Quality management — Guidelines for competence management and people development	Business management and innovation	11, 12, 13
ISO 10015	Quality management — Guidelines for competence management and people development	Business management and innovation	11, 12, 13
ISO 18091	Quality management systems — Guidelines for the application of ISO 9001 in local government	Business management and innovation	11
ISO 19600	Compliance management systems — Guidelines	Business management and innovation	11, 12, 13
ISO 37001	Anti-bribery management systems — Requirements with guidance for use	Business management and innovation	11, 12, 13
ISO 55000	Asset management — Overview, principles and terminology	Business management and innovation	12, 13
ISO 55001	Asset management — Management systems — Requirements	Business management and innovation	6, 7, 8, 9, 11, 12, 13
ISO 55002	Asset management — Management systems — Guidelines for the application of ISO 55001	Business management and innovation	6, 7, 8, 9, 11, 12, 13
ISO 9001	Quality management systems — Requirements	Business management and innovation	6, 7, 8, 9, 11, 12, 13
ISO 9004	Quality management — Quality of an organization — Guidance to achieve sustained success	Business management and innovation	3
ISO/AWI 10009	Quality management — Guidance for quality tools and their application	Business management and innovation	12
ISO/AWI 30426	Compensation System	Business management and innovation	12
ISO/AWI 56008	Innovation management — tools and methods for innovation operation measurements — Guidance	Business management and innovation	12

ISO/CD 10014	Quality management — Guidance for realizing financial and economic benefits	Business management and innovation	12
ISO/CD 10017	Quality management—Guidance for statistical techniques for ISO 9001	Business management and innovation	12
ISO/CD 55011	Guidance on the development of government asset management policy	Business management and innovation	9, 11, 12, 13, 15
ISO/CD TS 24179	Human Resource Management — Occupational Health and Safety Metrics — Technical Specification	Business management and innovation	12
ISO/CD TS 30423	Human resource management — Compliance and ethics metrics cluster	Business management and innovation	11
ISO/DIS 10018	Quality management — Guidance for people engagement	Business management and innovation	11, 12
ISO/DIS 22095	Chain of custody — General terminology and models	Business management and innovation	11, 12
ISO/FDIS 10018	Quality management — Guidance for people engagement	Business management and innovation	12
ISO/NP 30424	Knowledge management — Vocabulary	Business management and innovation	12
ISO/NP 44004	Collaborative business relationship management — Guidance for large organizations seeking to engage MSME within their Collaborative relationship programmes	Business management and innovation	3, 6
ISO/NP TS 30425	Human resource management — Workforce availability metrics	Business management and innovation	1, 9, 12, 14
ISO/TS 54001	Quality management systems — Particular requirements for the application of ISO 9001:2015 for electoral organizations at all levels of government	Business management and innovation	8, 9, 10
ISO/TS 55010	Asset management — Guidance on the alignment of financial and non-financial functions in asset management	Business management and innovation	4, 12
ISO/WD 10010	Quality management — Guidance to evaluate and improve quality culture to drive sustained success	Business management and innovation	3

ISO/WD 24561	Sharing Economy — Terminology and Principles	Business management and innovation	15
ISO/WD TS 21512	Earned Value Management (EVM) in Project and Programme Management — Implementation Guide	Business management and innovation	9, 13, 15
ISO 17741	General technical rules for measurement, calculation and verification of energy savings of projects	Energy	3, 6, 7, 11
ISO 17743	Energy savings — Definition of a methodological framework applicable to calculation and reporting on energy savings	Energy	9, 12
ISO 50001	Energy management systems — Requirements with guidance for use	Energy	9, 11, 12
ISO 50002	Energy audits — Requirements with guidance for use	Energy	11
ISO 50003	Energy management systems — Requirements for bodies providing audit and certification of energy management systems	Energy	2
ISO 50004	Energy management systems — Guidance for the implementation, maintenance and improvement of an energy management system	Energy	9
ISO 50006	Energy management systems — Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) — General principles and guidance	Energy	6, 9, 12, 15
ISO 50007	Energy services — Guidelines for the assessment and improvement of the energy service to users	Energy	9
ISO 50015	Energy management systems — Measurement and verification of energy performance of organizations — General principles and guidance	Energy	9
ISO 50047	Energy savings — Determination of energy savings in organizations	Energy	3, 4, 9
ISO/AWI 50010	Energy management and energy savings—Guidance for zero net energy in operations	Energy	3, 11, 13
ISO/CD TS 21274	Light and lighting — Commissioning process of smart lighting systems in buildings	Energy	4, 9, 12
ISO/IEC 13273	Energy efficiency and renewable energy sources — Common international terminology — Part 1, 2	Energy	3, 7, 8, 9, 11, 12, 13, 15
ISO/WD 50006	ISO 50006 Energy management systems — Evaluating Energy Performance using Energy Baselines and Energy Performance Indicators	Energy	4, 7, 9, 11, 12
ISO/AWI 24096	Technical product documentation — Classification of requirements on manufacturing documentation	Horizontal subjects	9, 11
ISO/AWI 24183	Technical Communication — Vocabulary	Horizontal subjects	6

ISO/AWI TR 21636	Identification and description of language varieties	Horizontal subjects	11
ISO/AWI TS 19488	Acoustics — Acoustic classification of dwellings	Horizontal subjects	7, 11
ISO/CD 24620	Language resource management — Controlled human communication (CHC) — Part 3, 4	Horizontal subjects	6
ISO/WD 24620	Language resource management — Controlled human communication (CHC) — Part 4: Multilingual technical requirements	Horizontal subjects	7
ISO/WD PAS 1996	Acoustics — Description, measurement and assessment of environmental noise — Part 3: Objective method for the measurement of prominence of impulsive sounds and for adjustment of Laeq	Horizontal subjects	7, 9, 11, 13
ISO 12100	Safety of machinery — General principles for design — Risk assessment and risk reduction	Mechanical engineering	7
ISO/AWI 10121	Test method for assessing the performance of gas-phase air cleaning media and devices for general ventilation — Part 3: Classification system for treatment of makeup air	Mechanical engineering	7
ISO/CD 21815	Earth-moving machinery — Collision warning and avoidance — Part 1, 3	Mechanical engineering	7
ISO/CD 8041	Human response to vibration — Measuring instrumentation — Part 2: Personal vibration exposure meters	Mechanical engineering	1, 8, 9, 10, 12, 15, 16
ISO/WD 24131	Internal protection by polymeric lining for ductile iron pipes	Mechanical engineering	3, 8, 10
ISO/AWI 24448	Fine ceramics (advanced ceramics, advanced technical ceramics) — LED light source for testing semiconducting photocatalytic materials used under indoor lighting environment	Non-metallic materials	11, 12, 13
ISO/DIS 22863	Fireworks — Test methods for determination of specific chemical substances — Part 4, 5, 6, 7, 8, 9	Non-metallic materials	3, 4, 8, 9, 11
ISO 22301	Societal security — Business continuity management systems — Requirements	Security, safety and risk	9
ISO 22319	Security and resilience — Community resilience — Guidelines for planning the involvement of spontaneous volunteers	Security, safety and risk	3, 11
ISO 28000	Specification for security management systems for the supply chain	Security, safety and risk	8, 9, 10
ISO 28001	Security management systems for the supply chain — Best practices for implementing supply chain security, assessments and plans — Requirements and guidance	Security, safety and risk	9

ISO 28002	Security management systems for the supply chain — Development of resilience in the supply chain — Requirements with guidance for use	Security, safety and risk	8, 9, 13
ISO 28003	Security management systems for the supply chain — Requirements for bodies providing audit and certification of supply chain security management systems	Security, safety and risk	8, 11, 13
ISO 28004	Security management systems for the supply chain — Guidelines for the implementation of ISO 28000 — Part 1: General principles	Security, safety and risk	3
ISO 31000	Risk management — Guidelines	Security, safety and risk	3, 9, 11, 12, 13
ISO 45001	Occupational health and safety management systems — Requirements with guidance for use	Security, safety and risk	12, 13, 15, 16
ISO/AWI 22361	Security and resilience — Crisis Management — Guidelines for developing a strategic capability	Security, safety and risk	9, 11, 12
ISO/AWI 22371	Security and resilience—Urban resilience— Framework, model and guidelines for strategy and implementation	Security, safety and risk	12
ISO/AWI 45002	Occupational health and safety management — General guidelines for the implementation of ISO 45001:2018	Security, safety and risk	8, 9, 11, 12, 13
IEC/DIS 62959	Environmental conscious design (ECD) — Principles, requirements and guidance	Sustainability and environment	3, 11
ISO 10382	Soil quality — Determination of organochlorine pesticides and polychlorinated biphenyls — Gas- chromatographic method with electron capture detection	Sustainability and environment	11, 12, 13
ISO 10390	Soil quality — Determination of pH	Sustainability and environment	3
ISO 10930	Soil quality — Measurement of the stability of soil aggregates subjected to the action of water	Sustainability and environment	3, 8
ISO 11264	Soil quality — Determination of herbicides — Method using HPLC with UV-detection	Sustainability and environment	3
ISO 11269	Soil quality — Determination of the effects of pollutants on soil flora — Part 1, 2	Sustainability and environment	8, 9
ISO 14001	Environmental management systems — Requirements with guidance for use	Sustainability and environment	11
ISO 14007	Environmental management — Guidelines for determining environmental costs and benefits	Sustainability and environment	9
ISO 14008	Monetary valuation of environmental impacts and related environmental aspects	Sustainability and environment	8
ISO 14020	Environmental labels and declarations — General principles	Sustainability and environment	9

ISO 14024	Environmental labels and declarations — Type I environmental labelling — Principles and procedures	Sustainability and environment	13
ISO 14026	Environmental labels and declarations — Principles, requirements and guidelines for communication of footprint information	Sustainability and environment	8
ISO 14031	Environmental management — Environmental performance evaluation — Guidelines	Sustainability and environment	13
ISO 14033	Environmental management — Quantitative environmental information — Guidelines and examples	Sustainability and environment	13
ISO 14040	Environmental management — Life cycle assessment — Principles and framework	Sustainability and environment	11, 12, 13
ISO 14044	Environmental management — Life cycle assessment — Requirements and guidelines	Sustainability and environment	9, 13
ISO 14044	Environmental management — Life cycle assessment — Requirements and guidelines — Amendment 1, 2	Sustainability and environment	3, 13, 14, 15
ISO 14046	Environmental management — Water footprint — Principles, requirements and guidelines	Sustainability and environment	3, 6, 11, 14, 15
ISO 14055	Environmental management — Guidelines for establishing good practices for combatting land degradation and desertification — Part 1: Good practices framework	Sustainability and environment	3
ISO 14064	Greenhouse gases — Part 1, 2, 3	Sustainability and environment	13
ISO 14067	Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification	Sustainability and environment	11, 13, 14, 15
ISO 14080	Greenhouse gas management and related activities — Framework and principles for methodologies on climate actions	Sustainability and environment	1, 8, 10, 12, 16
ISO 14090	Adaptation to climate change — Principles, requirements and guidelines	Sustainability and environment	1, 2
ISO 14442	Water Quality — Guidelines for algal growth inhibition tests with poorly soluble materials, volatile compounds, metals and wastewater	Sustainability and environment	12
ISO 15089	Water Quality — Guidelines for selective immunoassays for the determination of plant treatment and pesticide agents	Sustainability and environment	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
ISO 16000	Indoor air — Part 1, 9, 11, 42	Sustainability and environment	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
ISO 16000	Indoor air — Part 1, 42	Sustainability and environment	11, 12, 13, 15

ISO 16075	Guidelines for treated wastewater use for irrigation projects — Part 1, 2, 3, 4	Sustainability and environment	9, 10
ISO 16133	Soil quality — Guidance on the establishment and maintenance of monitoring programmes	Sustainability and environment	13
ISO 18400	Soil quality — Sampling: Part 104, 202, 203, 205	Sustainability and environment	8, 9, 11, 12, 13
ISO 18400	Soil quality — Sampling — Part 104, 202, 203, 204	Sustainability and environment	12, 13
ISO 18400	Soil quality — Sampling — Part 205: Guidance on the procedure for investigation of natural, near-natural and cultivated sites	Sustainability and environment	9, 12
ISO 20419	Treated wastewater reuse for irrigation — Guidelines for the adaptation of irrigation systems and practices to treated wastewater	Sustainability and environment	13, 15
ISO 20426	Guidelines for health risk assessment and management for non-potable water reuse	Sustainability and environment	9
ISO 20468	Guidelines for performance evaluation of treatment technologies for water reuse systems — Part 1, 2, 3, 4, 5, 6, 7	Sustainability and environment	9
ISO 20469	Guidelines for water quality grade classification for water reuse	Sustainability and environment	3, 6, 7, 9, 12, 13, 14, 15
ISO 20581	Workplace air — General requirements for the performance of procedures for the measurement of chemical agents	Sustainability and environment	8, 9
ISO 20670	Water reuse — Vocabulary	Sustainability and environment	13
ISO 20760	Water reuse in urban areas—Part 1, 2	Sustainability and environment	9, 11, 12, 14
ISO 20761	Water reuse in urban areas — Guidelines for water reuse safety evaluation — Assessment parameters and methods	Sustainability and environment	3, 8, 10, 11, 12, 13, 14, 15
ISO 20951	Soil Quality — Guidance on methods for measuring greenhouse gases (CO ₂ , N ₂ O, CH ₄) and ammonia (NH ₃) fluxes between soils and the atmosphere	Sustainability and environment	1, 2, 9, 12
ISO 25177	Soil quality — Field soil description	Sustainability and environment	9
ISO 37101	Sustainable development in communities — Management system for sustainable development — Requirements with guidance for use	Sustainability and environment	6, 7, 8, 9, 11, 12, 13
ISO 38200	Chain of custody of wood and wood-based products	Sustainability and environment	4, 8, 9, 12
ISO 5667	Water Quality — Sampling — Part 1, 3, 4, 5, 6, 10, 11, 12, 13, 14, 16, 21, 22, 23, 24, 25	Sustainability and environment	6, 14

ISO 8245	Water Quality — Guidelines for the determination of total organic carbon (TOC) and dissolved organic carbon (DOC)	Sustainability and environment	11, 12, 13
ISO/AWI 11268	Soil quality — Effects of pollutants on earthworms — Part 2: Determination of effects on reproduction of <i>Eisenia fetida</i> / <i>Eisenia andrei</i>	Sustainability and environment	8, 9, 11, 12, 13
ISO/AWI 14015	Environmental management — Environmental Due Diligence Assessment (revision of ISO 14015:2001)	Sustainability and environment	3, 10, 11
ISO/AWI 14017	Requirements and guidelines for validation and verification of water information and related reports	Sustainability and environment	1, 5, 6, 7, 8, 10, 12, 13
ISO/AWI 23880	Sludge recovery, recycling, treatment and disposal — Vocabulary	Sustainability and environment	9
ISO/CD 14030	Environmental performance evaluation — Green debt instruments — Part 1: Process for green bonds	Sustainability and environment	9
ISO/CD 14097	Framework and principles for assessing and reporting investments and financing activities related to climate change	Sustainability and environment	3
ISO/CD 22238	Water reuse — A guideline to wastewater disinfection and equivalent treatments	Sustainability and environment	9, 11, 13
ISO/CD TS 14092	GHG Management & related activities: requirement & guidance of adaptation planning for organizations including local governments and communities	Sustainability and environment	7, 9
ISO/DIS 14009	Environmental management systems — Guidelines for incorporating material circulation in design and development	Sustainability and environment	3
ISO/DIS 14016	Environmental management — Guidelines on assurance of environmental reports	Sustainability and environment	7
ISO/DIS 14053	Environmental management — Material flow cost accounting — Guidance for practical implementation in SMEs	Sustainability and environment	3, 7, 8, 9, 11, 12, 13, 15
ISO/DIS 14065	Greenhouse gases — Environmental information — Requirements for bodies validating and verifying environmental information	Sustainability and environment	6
ISO/DIS 14091	Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment	Sustainability and environment	1, 3, 9, 11
ISO/DIS 19698	Sludge recovery, recycling, treatment and disposal — Beneficial use of biosolids — Land applications	Sustainability and environment	4
ISO/DIS 20468	Guidelines for performance evaluation of treatment technologies for water reuse systems — Part 1, 2, 3, 4, 5, 6, 7, 8	Sustainability and environment	9
ISO/DIS 22449	Use of reclaimed water in industrial cooling systems — Part 1, 2	Sustainability and environment	3

ISO/DIS 23056	Water reuse in urban areas — Guidelines for decentralized/onsite water reuse system — Design principle of a decentralized/onsite system	Sustainability and environment	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17
ISO/DIS 23070	Water reuse in urban areas — Guidelines for reclaimed water treatment — Design principle of a RO desalination system of municipal wastewater	Sustainability and environment	11, 12, 13
ISO/FDIS 14006	Environmental management systems — Guidelines for incorporating ecodesign	Sustainability and environment	7, 9
ISO/NP 23992	Soil quality — Framework for detailed recording and monitoring of changes in dynamic soil properties	Sustainability and environment	11, 13
ISO/NP TS 14074	Environmental management — Life cycle assessment — Principles, requirements and guidelines for normalization, weighting and interpretation	Sustainability and environment	9
ISO/PRF 14063	Environmental management — Environmental communication — Guidelines and examples	Sustainability and environment	9, 11
ISO/WD 14002	Environmental management systems — Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area — Part 2: Water	Sustainability and environment	3, 9, 15
ISO/WD 14020	Environmental labels and declarations — General principles	Sustainability and environment	11, 13
ISO/WD 24416	Water reuse in urban areas – Guidelines for water reuse safety evaluation: Chemical stability evaluation of reclaimed water	Sustainability and environment	11
ISO/WD 32210	Framework for sustainable finance: Principles and guidance	Sustainability and environment	8, 9
ISO/WD TS 14029	Mutual recognition agreements between Type III Environmental Declaration (EPD) Programme Operators — Principles and procedures	Sustainability and environment	3

B.13. FSDS Targets Table

Table B-14 is FSDS’s targets list categorized as used by this research.

Table B-14. FSDS Targets Table

FSDS Sustainability Targets	Category	Subcategory
FSDS01—Effective Action in Climate Change	Environmental	Air Emission
FSDS02—Greening Government	Environmental; Environmental	Air Emission; Waste
FSDS03—Clean Growth	Environmental	Energy
FSDS04—Modern and Resilient Infrastructure	Environmental; Environmental; Environmental; Environmental; Environmental	Air Emission; Energy; Local Impact; Resource Consumption; Water
FSDS05—Clean Energy	Environmental	Energy
FSDS06—Healthy Coasts and Oceans	Environmental; Environmental	Soil; Water
FSDS07—Pristine Lakes and Rivers	Environmental	Water
FSDS08—Sustainably Managed Lands and Forests	Environmental; Environmental	Local Impact; Biodiversity
FSDS09—Healthy Wildlife populations	Environmental	Biodiversity
FSDS10—Clean Drinking Water	Environmental	Water
FSDS11—Sustainable Food	-	-
FSDS12—Connecting Canadians with Nature	Environmental; Environmental	Air Emission; Energy
FSDS13—Safe and Healthy Communities	Environmental; Environmental	Air Emission; Biodiversity

B.14. The 100 SDI : Meta-Analysis

The meta-analysis table demonstrates the list of all the studied indicators from the certifications and standards analyzed by this research. The table presents the category, subcategory, the sustainability targets, the description, the certification/standard, the sustainability indicators description, the sustainability indicators, and the assessment methodology of each analyzed indicator. It contains more than 1,300 rows, and it can be found in the following link:

<https://drive.google.com/file/d/1gd4eAHwhkSv4rTyj9BvhEUqiL4XYsN0w/view?usp=sharing>

B.15. The 100 SDI: Literature References for SDI/SDG

Table B-15 demonstrates the literature review used to identify and justify the connection between

Table B-15. SDI References—Literature Review to Identify the Connection Between the SDI and SDGs

Category	SDI	Reference	Type
Economic	SDI 1	(United Nations, 2015)	Official Website
		(Mohagheghi, Mousav, & Vahdani, 2017)	Journal Paper (Neural Computing and Applications)
Economic	SDI 2	(United Nations, 2015)	Official Website
		(British Columbia Government, 2019)	Official Website
		(Muthu, 2016)	Book (UBC Library)
Economic	SDI 3	(United Nations, 2015)	Official Website
		(A.Dias, R.Mattos, & A.P.Balestieri, 2004)	Journal Paper (Energy Policy)
Economic	SDI 4	(United Nations, 2015)	Official Website
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Economic	SDI 5	(United Nations, 2015)	Official Website
		(Midgley, 2008)	Journal Paper (ISW—International Social Work)
Economic	SDI 6	(United Nations, 2015)	Official Website
		(Gimenez, Greenberg, Markusen, Mayer, & Newton, 1978)	Book (UBC Library)
Economic	SDI 7	(United Nations, 2015)	Official Website
		(Jones, 2008)	Journal Paper (Chicago-Kent Law Review)
		(Gimenez, Greenberg, Markusen, Mayer, & Newton, 1978)	Book (UBC Library)
Economic	SDI 8	(United Nations, 2015)	Official Website
		(Huston & Baines, 2019)	Book (UBC Library)
Economic	SDI 9	(United Nations, 2015)	Official Website
		(Sharif, 2016)	Book (UBC Library)
Environmental	SDI 10	(United Nations, 2015)	Official Website
		(Fanger, 2006)	Journal Paper (Indoor Air—International Journal of Indoor Environment and Health)
Environmental	SDI 11	(United Nations, 2015)	Official Website
		(National Cancer Institute, 1999)	Book (UBC Library)
Environmental	SDI 12	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2019)	Official Website
Environmental	SDI 13	(United Nations, 2015)	Official Website

		(EPA - United States Environmental Protection Agency, 2019)	Official Website
Environmental	SDI 14	(United Nations, 2015)	Official Website
		(Fanger, 2006)	Journal Paper (Indoor Air— International Journal of Indoor Environment and Health)
Environmental	SDI 15	(United Nations, 2015)	Official Website
		(Fanger, 2006)	Journal Paper (Indoor Air— International Journal of Indoor Environment and Health)
		(EPA - United States Environmental Protection Agency, 2019)	Official Website
Environmental	SDI 16	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
Environmental	SDI 17	(United Nations, 2015)	Official Website
		(Government of Canada, 2013)	Official Website
Environmental	SDI 18	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
Environmental	SDI 19	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2018)	Official Website
Environmental	SDI 20	(United Nations, 2015)	Official Website
		(Capital Regional District - CRD, 2019)	Official Website
		(National Academy of Sciences, 1993)	Official Website
Environmental	SDI 21	(United Nations, 2015)	Official Website
		(City of Vancouver, 2015)	Official Website
Environmental	SDI 22	(United Nations, 2015)	Official Website
		(New Jersey Department of Environmental Protection, 2004)	Book (UBC Library)
		(EPA - United States Environmental Protection Agency, 1995)	Official Website
Environmental	SDI 23	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
Environmental	SDI 24	(United Nations, 2015)	Official Website
		(Hong, Hong, Kang, & Lee, 2019)	Conference Paper (10th International Conference on Applied Energy (ICAE 2018))
Environmental	SDI 25	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
Environmental	SDI 26	(United Nations, 2015)	Official Website

		(EPA - United States Environmental Protection Agency, 2019)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
Environmental	SDI 27	(United Nations, 2015)	Official Website
		(A.Dias, R.Mattos, & A.P.Balestieri, 2004)	Journal Paper (Energy Policy)
Environmental	SDI 28	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
Environmental	SDI 29	(United Nations, 2015)	Official Website
		(Attard, Shiftan, Ison, & Shaw, 2015)	Book (UBC Library)
		(Woldeamanuel, 2016)	Book (UBC Library)
Environmental	SDI 30	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
Environmental	SDI 31	(United Nations, 2015)	Official Website
		(Buyle, Braet, & Audenaert, 2013)	Journal Paper (Renewable and Sustainable Energy Reviews)
Environmental	SDI 32	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
Environmental	SDI 33	(United Nations, 2015)	Official Website
		(Esmailian, et al., 2018)	Journal Paper (Waste Management)
Environmental	SDI 34	(United Nations, 2015)	Official Website
		(Provincial Agricultural Land Commission BC, 2014)	Official Website
		(National Academy of Sciences, 1993)	Official Website
Environmental	SDI 35	(United Nations, 2015)	Official Website
		(City of Vancouver, 2018)	Official Website
Environmental	SDI 36	(United Nations, 2015)	Official Website
		(Meng, et al., 2019)	Journal Paper (Resources, Conservation and Recycling)
		(Esmailian, et al., 2018)	Journal Paper (Waste Management)
Environmental	SDI 37	(United Nations, 2015)	Official Website
Environmental	SDI 38	(United Nations, 2015)	Official Website
		(Cook & Ponsard, 2011)	Journal Paper (Climate Policy)
Environmental	SDI 39	(United Nations, 2015)	Official Website
		(Lavrusovich, Abene, & Lavrusovich, 2019)	Conference Paper (International Geotechnical Symposium “Geotechnical Construction of Civil Engineering & Transport Structures of the Asian-Pacific Region” (GCCETS 2018))

Environmental	SDI 40	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2019)	Official Website
Environmental	SDI 41	(United Nations, 2015)	Official Website
		(Woolley, 2013)	Book (UBC Library)
Environmental	SDI 42	(United Nations, 2015)	Official Website
		(New Jersey Department of Environmental Protection, 2004)	Book (UBC Library)
		(City of Nanaimo, 2005)	Official Website
		(Capital Regional District - CRD, 2019)	Official Website
		(Official Portal for Department of Irrigation and Drainage, 2017)	Official Website
		(National Geographic Headquarters, 2019)	Official Website
Environmental	SDI 43	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2019)	Official Website
Environmental	SDI 44	(United Nations, 2015)	Official Website
		(Capital Regional District - CRD, 2019)	Official Website
		(Official Portal for Department of Irrigation and Drainage, 2017)	Official Website
Environmental	SDI 45	(United Nations, 2015)	Official Website
		(United States Environmental Protection Agency, 1998)	Official Website
		(Capital Regional District - CRD, 2019)	Official Website
		(Official Portal for Department of Irrigation and Drainage, 2017)	Official Website
		(National Geographic Headquarters, 2019)	Official Website
Environmental	SDI 46	(United Nations, 2015)	Official Website
		(Li, 2015)	Book (UBC Library)
Environmental	SDI 47	(United Nations, 2015)	Official Website
		(Bahadori & Smith, 2016)	Book (UBC Library)
		(Spellman, 2013)	Book (UBC Library)
Environmental	SDI 48	(United Nations, 2015)	Official Website
		(Barbosa, Fernandes, & David, 2012)	Journal Paper (Water Research)
		(United States Environmental Protection Agency, 1998)	Official Website
Environmental	SDI 49	(United Nations, 2015)	Official Website
		(Caschetto, et al., 2014)	Journal Paper (Environmental Earth Sciences)
Environmental	SDI 50	(United Nations, 2015)	Official Website
		(Haddeland, et al., 2014)	Journal Paper (Proceedings of the National Academy of Sciences of the United States of America)

Environmental	SDI 51	(United Nations, 2015)	Official Website
		(Caschetto, et al., 2014)	Journal Paper (Environmental Earth Sciences)
Environmental	SDI 52	(United Nations, 2015)	Official Website
		(A.Dias, R.Mattos, & A.P.Balestieri, 2004)	Journal Paper (Energy Policy)
Governances	SDI 53	(United Nations, 2015)	Official Website
		(Zuo, Zillante, Wilson, Davidson, & Pullen, 2012)	Journal Paper (Renewable and Sustainable Energy Reviews)
		(Hong, Hong, Kang, & Lee, 2019)	Conference Paper (10th International Conference on Applied Energy (ICAE 2018))
		(Murray & Dainty, 2009)	Book (UBC Library)
Governances	SDI 54	(United Nations, 2015)	Official Website
		(Li, 2015)	Book (UBC Library)
Governances	SDI 55	(United Nations, 2015)	Official Website
		(Matsumoto, Masui, Fukushige, & Kondoh, 2017)	Book (UBC Library)
		(Sukkasi, 2016)	Book (UBC Library)
Governances	SDI 56	(United Nations, 2015)	Official Website
		(Matsumoto, Masui, Fukushige, & Kondoh, 2017)	Book (UBC Library)
		(Sukkasi, 2016)	Book (UBC Library)
Governances	SDI 57	(United Nations, 2015)	Official Website
		(Matsumoto, Masui, Fukushige, & Kondoh, 2017)	Book (UBC Library)
Governances	SDI 58	(United Nations, 2015)	Official Website
		(Bynum, Claridge, & Curtin, 2012)	Journal Paper (Energy and Buildings)
Governances	SDI 59	(United Nations, 2015)	Official Website
		(Nimlyat, 2018)	Journal Paper (Building and Environment)
		(Rubeis, et al., 2017)	Journal Paper (Energy and Buildings)
Governances	SDI 60	(United Nations, 2015)	Official Website
		(Bynum, Claridge, & Curtin, 2012)	Journal Paper (Energy and Buildings)
Governances	SDI 61	(United Nations, 2015)	Official Website
		(Hitchcock & Willard, 2009)	Book (UBC Library)
Governances	SDI 62	(United Nations, 2015)	Official Website
		(Hitchcock & Willard, 2009)	Book (UBC Library)
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Governances	SDI 63	(United Nations, 2015)	Official Website

		(Hitchcock & Willard, 2009)	Book (UBC Library)
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Governances	SDI 64	(United Nations, 2015)	Official Website
		(Hitchcock & Willard, 2009)	Book (UBC Library)
Governances	SDI 65	(United Nations, 2015)	Official Website
		(Hitchcock & Willard, 2009)	Book (UBC Library)
		(Wilson & Rezgui, 2013)	Journal Paper (Technological and Economic Development of Economy)
Governances	SDI 66	(United Nations, 2015)	Official Website
		(Sibery, Loughman, & Loughman, 2011)	Book (UBC Library)
Governances	SDI 67	(United Nations, 2015)	Official Website
		(Hitchcock & Willard, 2009)	Book (UBC Library)
Governances	SDI 68	(United Nations, 2015)	Official Website
		(Sexton, Barrett, & Lu, 2009)	Book (UBC Library)
Governances	SDI 69	(United Nations, 2015)	Official Website
		(A.Dias, R.Mattos, & A.P.Balestieri, 2004)	Journal Paper (Energy Policy)
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Governances	SDI 70	(United Nations, 2015)	Official Website
		(Sexton, Barrett, & Lu, 2009)	Book (UBC Library)
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Governances	SDI 71	(United Nations, 2015)	Official Website
		(Martin & Schouten, 2014)	Journal Paper (RAM—Recherche et Applications en Marketing)
Governances	SDI 72	(United Nations, 2015)	Official Website
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Social	SDI 73	(United Nations, 2015)	Official Website
		(Sexton, Barrett, & Lu, 2009)	Book (UBC Library)
Social	SDI 74	(United Nations, 2015)	Official Website
		(Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018)	Journal Paper (Public Works Management & Policy)
Social	SDI 75	(United Nations, 2015)	Official Website
		(Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018)	Journal Paper (Public Works Management & Policy)
Social	SDI 76	(United Nations, 2015)	Official Website
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Social	SDI 77	(United Nations, 2015)	Official Website

		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
		(Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018)	Journal Paper (Public Works Management & Policy)
Social	SDI 78	(United Nations, 2015)	Official Website
		(Murray & Dainty, 2009)	Book (UBC Library)
		(Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018)	Journal Paper (Public Works Management & Policy)
Social	SDI 79	(United Nations, 2015)	Official Website
		(Murray & Dainty, 2009)	Book (UBC Library)
		(Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018)	Journal Paper (Public Works Management & Policy)
Social	SDI 80	(United Nations, 2015)	Official Website
		(Murray & Dainty, 2009)	Book (UBC Library)
Social	SDI 81		
Social	SDI 82	(United Nations, 2015)	Official Website
		(Fenn, Li, Pleites, Zorigtbaatar, & Philips, 2018)	Journal Paper (Public Works Management & Policy)
Social	SDI 83	(United Nations, 2015)	Official Website
		(Murray & Dainty, 2009)	Book (UBC Library)
		(Symbol of the Government of Canada, 2019)	Official Website
Social	SDI 84	(United Nations, 2015)	Official Website
		(The International Bank for Reconstruction and Development / The World Bank, 2002)	Book (UBC Library)
Social	SDI 85	(United Nations, 2015)	Official Website
		(Sharif, 2016)	Book (UBC Library)
		(World Bank Group, 2015)	Book (UBC Library)
Social	SDI 86	(United Nations, 2015)	Official Website
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Social	SDI 87	(United Nations, 2015)	Official Website
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Social	SDI 88	(United Nations, 2015)	Official Website
		(Murray & Dainty, 2009)	Book (UBC Library)
Social	SDI 89	(United Nations, 2015)	Official Website
		(Murray & Dainty, 2009)	Book (UBC Library)
Social	SDI 90	(United Nations, 2015)	Official Website
		(Hubera, Sloof, & Praag, 2017)	Journal Paper (Labour Economics)
Social	SDI 91	(United Nations, 2015)	Official Website
		(Bugliarello, Barnes, Alexandre, & Wakstein, 1976)	Book (UBC Library)
Social	SDI 92	(United Nations, 2015)	Official Website

		(Wilson & Rezgui, 2013)	Journal (Technological and Economic Development of Economy)
Social	SDI 93	(United Nations, 2015)	Official Website
		(Murray & Dainty, 2009)	Book (UBC Library)
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Social	SDI 94	(United Nations, 2015)	Official Website
		(Murray & Dainty, 2009)	Book (UBC Library)
Social	SDI 95	(United Nations, 2015)	Official Website
		(A.Dias, R.Mattos, & A.P.Balestieri, 2004)	Journal Paper (Energy Policy)
Social	SDI 96	(United Nations, 2015)	Official Website
		(EPA - United States Environmental Protection Agency, 2017)	Official Website
		(New Jersey Department of Environmental Protection, 2004)	Book (UBC Library)
		(EPA - United States Environmental Protection Agency, 2019)	Official Website
		(Hong, Hong, Kang, & Lee, 2019)	Conference Paper (10th International Conference on Applied Energy (ICAE 2018))
Social	SDI 97	(United Nations, 2015)	Official Website
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
		(Murray & Dainty, 2009)	Book (UBC Library)
Social	SDI 98	(United Nations, 2015)	Official Website
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)
Social	SDI 99	(United Nations, 2015)	Official Website
		(Xia, Olanipekun, Chen, Xie, & Liu, 2018)	Journal Paper (Journal of Cleaner Production)

B.16. 100 SDI for Building Construction Industry Validation Report

The validator reports are as follow:

1. A.16 SDI Validation Reports _ Specialist 1
2. A.16 SDI Validation Reports _ Specialist 2
3. A.16 SDI Validation Reports _ Specialist 3
4. A.16 SDI Validation Reports _ Specialist 4

1. A.16 SDI Validation Reports _ Specialist 1

This report aims to consider your acceptance of the 100 SDI regarding three variables: perception of efficiency and effectiveness.

If you do not want to be identified, please enter only your expertise area/field.

1. Specialist Name (or expertise area/field)

Specialist 1

2. Bio

A 40 year veteran property investor and development business, leading organizations to incorporate ESG in the projects they deliver and the culture they foster.

3. Validation Questions

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the 100 SDI to the construction industry?

Yes, overall it aims to bundle the goals into action areas. In certain aspects, such as child labor and schooling, there may be little that the construction industry can directly influence, whereas in others, such as site management and sourcing sustainable materials, examples, references and indices would be valuable.

Q.2 - Do you believe the 100 SDI is consistent and address the main issues of sustainability management in the construction industry?

Yes, consistent in how it approaches the bundling, see comment above, for applicability to construction industry. In general, one impediment organizations have implementing the goals is determining which items are directly material to their business processes. As this framework illustrates, because the UNSDG's reflect governmental priorities, and are organized that way, bundling from a business perspective may make the SDG's more relevant for businesses.

Perceived Ease of Use

Q.3 - Did you find the 100 SDI easy to follow?

Yes, the dashboard approach made the format very easy to follow and visually pleasing.

Q. 4 - Did you find it would be easy to apply the 100 SDI in an organization?

Ultimately, I believe that the SDGs are comprised of broad value statements, and each organization needs to assess where it wants to take a stand. From there it can measure its effectiveness, determine where its opportunities lie, and from there develop goals and metrics, and timelines by which it will measure its progress against desired outcomes.

I view this dashboard as a straightforward mapping of outcomes to what the UN is looking to achieve against that goal.

Q. 5 - Did you find the 100 SDI easy to understand?

Very east to understand

Q. 6 - Did you find the information of the 100 SDI clear and easy to understand?

Yes, very clear as well.

Q. 7 - Overall, did you find the 100 SDI easy to use?

I think my initial reaction was boy, I agree the goals, as presented by the UN, are not that easy to pull into a coherent set of policies from a business perspective. One concern I hear from business executives, for example, is – is it really my duty to promote childhood education? When in this instance a construction company could decide to launch an apprentice program, that would address this need and promote a pipeline of well-trained workforce, another goal of most organizations. Some leaders are strategic, non-linear thinkers who might make this kind of a leap across goals, but many more are tactical and might fail to appreciate how the goals compliment one another.

Perceived Usefulness

Q.8 - Do you believe that the 100 SDI would reduce the effort required to understand and implement sustainable development management in the construction industry?

It could. One caution is it is pretty long, I looked at printing it and it ran 90 pages. There may be a way to digitally index the resource that would make it less intimidating to a newcomer, by presenting in layers based on engagement by the User.

Q.9 - Do you believe that using the 100 SDI would make it easier for users to implement sustainable development in the construction industry?

Potentially. Its first utility is to aid construction firms in understanding what the UNSDGs are and what they call for. This is an academic understanding of common principals the other participants in the supply chain reference and seek to advance. To implement sustainable development approaches requires a partnership be the architect, contractor, developer and if they are already identified, the end user. This answers the challenge of “what it is we are trying to achieve”, not the “how do we actually accomplish that?”

Q.10 - Do you believe the 100 SDI would make it easier for the construction industry to identify and manage sustainable development activities?

Yes, but as mentioned earlier each firm will need to 1) identify goals that speak to them, 2) determine what outcomes they want to achieve, 3) plans, 4) metrics and targets to measure success. 1 and 2 are the identify, 3 and 4 are the manage part.

Q.11 - Do you believe that using the 100 SDI would make it easier to maintain sustainable development practices in the construction industry?

Yes, common language/framework is 75% of the impediment, so yes. It might also provide a contractor with the framework for laying out the targets they are trying to achieve and form a foundational reference for the other stakeholders to articulate how they measure success.

Q.12 - Overall, do you believe that the 100 SDI provides an effective solution to sustainable development management in the construction industry?

It's a tool to build a roadmap. It isn't a solution on a standalone basis, nor can it be, since this is a journey each firm and each project team need to come together around.

Q.13 - Overall, do you believe the 100 SDI is an improvement to the sustainable development management practices in the construction industry?

I am not aware of any other tool to explain/translate the UN framework to the business outcomes people in the construction industry care about, so yes.

Q.14 - Do you believe that using the 100 SDI would make it easier to communicate the sustainability performance of an organization?

Yes. Absolutely. There are numerous sustainability reporting protocols, so it might be beneficial to reference them in the report.

Q. 15 - Overall, did you find the 100 SDI to be useful?

Yes, I enjoyed reviewing the mapping, and the layered approach, E, then G, then S, and how the individual SDG's support execution.

Intention to Use

Q.16 - Would you use the 100 SDI to manage sustainable development in a construction organization?

It would be useful for guiding the overall plan, articulating priorities and desired outcomes. These positives are important, but construction itself is heavy on logistics, personnel management, scheduling, budgeting – managing construction projects and organizations requires a lot of technical skills beyond knowledge of sustainability.

Q.17 - Would you intend to use the 100 SDI in preference to the standards the current sustainability management literature offers?

I might reference this resource in a white paper or speech talking about sustainable development. In terms of my organization's efforts, this resource could be one of several (reporting standards manuals, GRESB reporting, for example) prescribe what we report to clients, therefor are important resources to consider in development of management plans. This resource would not replace the existing protocols.

4. Additional Comments

Q.(Extra) - If necessary, please add a comment or your overall analysis of the 100 SDI.

Nice work, a great deal of thought and research went into development of this resource. Feel free to contact me if further elaboration of any of my answered is desired or required.

2020-09-27

Specialist 1 signature

2. A.16 SDI Validation Reports _ Specialist 2

A.16 100 SDI Validation Report

This report aims to consider your acceptance of the 100 SDI regarding three variables: perception of efficiency and effectiveness.

If you do not want to be identified, please enter only your expertise area/field.

1. Specialist Name (or expertise area/field)

~~Specialist Name~~

Specialist 2

Specialist 2 has more than 19 years of experience in the sustainability and environmental consulting industry. With a diverse range of sustainability accreditations, including Certified Passive House Designer, LEED, and WELL, Megan is able to provide a multidisciplinary perspective in sustainable design strategies for a wide array of building projects.

Specialist 2 works with Stantec's Sustainability & Building Performance team as a sustainability consultant specializing in LEED strategy and certification. Megan has worked on more than 25 projects that have achieved LEED certification. Her successful LEED projects have ranged in size and in building type, from small office renovations to large-scale hospital and institutional buildings. This showcases her in-depth experience in working with design teams and clients in planning and implementing strategies to meet LEED requirements at the building and site scale – she is skilled in helping project teams navigate the evolving LEED requirements and certification process.

Specialist 2 is the Team Lead of Stantec's LEED Canada Certification Review Team, which works on behalf of the Canada Green Building Council (CaGBC) to validate LEED projects from across the country across all building types. Megan is also a member of the CaGBC's Materials Technical Advisory Group.

3. Validation Questions

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the 100 SDI to the construction industry?

I perceive value in the 100 SKI to members of the construction industry that value sustainability. Unfortunately, my experience with the construction industry is that they are mostly focused on making money, not saving the world. Sustainability is often only thought about when it is a government or client requirement.

Q.2 - Do you believe the 100 SDI is consistent and address the main issues of sustainability management in the construction industry?

The categories, subcategories, and sustainability targets are very comprehensive and address all 17 SDGs. I cannot think of anything to add.

Perceived Ease of Use

Q.3 - Did you find the 100 SDI easy to follow?

It took me a bit of time looking at the table to figure out how it worked and how to read it. Once I figured it out it was easy to follow. The formatting and filters are helpful.

Q. 4 - Did you find it would be easy to apply the 100 SDI in an organization?

I think an organization could easily use the filters in the table to narrow the 100 SDI to the items that are most important or applicable to them.

Q. 5 - Did you find the 100 SDI easy to understand?

It took me a bit of time looking at the table to figure out how it worked and how to read it. Once I figured it out it was easy to understand.

Q. 6 - Did you find the information of the 100 SDI clear and easy to understand?

Yes.

Q. 7 - Overall, did you find the 100 SDI easy to use?

Once I figured it out, yes.

Perceived Usefulness

Q.8 - Do you believe that the 100 SDI would reduce the effort required to understand and implement sustainable development management in the construction industry?

Yes, lots of searchable information in one place.

Q.9 - Do you believe that using the 100 SDI would make it easier for users to implement sustainable development in the construction industry?

Yes, it outlines actions that users can implement to contribute towards the SDGs.

Q.10 - Do you believe the 100 SDI would make it easier for the construction industry to identify and manage sustainable development activities?

I think an organization could easily use the filters in the table to identify sustainable development activities they could investigate or narrow the 100 SDI to the items that are most important or applicable to them. Regarding management of sustainable development activities, it might be helpful to add a blank column for users to make notes for themselves.

Q.11 - Do you believe that using the 100 SDI would make it easier to maintain sustainable development practices in the construction industry?

I think the 100 SDI would be most applicable for organizations wanting to research or implement sustainable development practices rather than a tool used for maintaining.

Q.12 - Overall, do you believe that the 100 SDI provides an effective solution to sustainable development management in the construction industry?

Overall I believe that the 100 SDI is more of an education, research, and planning tool rather than a management tool.

Q.13 - Overall, do you believe the 100 SDI is an improvement to the sustainable development management practices in the construction industry?

If organizations were to implement the 100 SDI it would be a significant improvement to the sustainable development management practices in the construction industry.

Q.14 - Do you believe that using the 100 SDI would make it easier to communicate the sustainability performance of an organization?

Yes because it clearly shows organizations how their actions can contribute to the SDGs.

Q. 15 - Overall, did you find the 100 SDI to be useful?

I think the 100 SDI would be useful to organizations wanting to implement or improve their sustainability management practices.

Intention to Use

Q.16 - Would you use the 100 SDI to manage sustainable development in a construction organization?

In my roles I do not think I would personally use the 100 SDI, but I can see that it could be helpful to our Sustainability Practice Leader and/or our Corporate Sustainability Director. They could use the 100 SDI to look for ways our organization could further contribute towards the SDGs.

Q.17 - Would you intend to use the 100 SDI in preference to the standards the current sustainability management literature offers?

I do not have any experience with corporate sustainability management documentation.

4. **Additional Comments**

Q.(Extra) - If necessary, please add a comment or your overall analysis of the 100 SDI.

The 100 SDI is a comprehensive document that I hope the construction industry will be interested in using.

2020-09-12

Specialist 2 signature

3. A.16 SDI Validation Reports _ Specialist 3

1. Specialist Name

Specialist 3

2. Bio

Specialist 3 is a leader in sustainability education with experience in course design, program design, and institutional change. Her teaching achievements, which include the introduction of service learning into undergraduate programs, and the successful development of on-line and blended courses in sustainability and engineering, have been cited by engineering educators across North America for their excellence. She is a co-director of the [Masters of Engineering Leadership in Urban Systems](#).

3. Validation Comments

Is the 100 SDI considering enough range of sustainability indicators for Building Construction Industry?

My background relates is in interpreting sustainability within engineering practice in general. As such, I am impressed with the breadth of sustainability issues captured by the 100 SDI.

Are the indicators well connected with the presented SDG's?

Yes

Is the 100 SDI useful as a reference for sustainability indicators management for the construction industry?

The 100 SDI is a useful example of how to interpret and apply sustainability indicators within an industrial sector.

4. Additional Comments (is the 100 SDI valuable, how it would be used, etc.)

To date, the construction industry has not been able to improve its impact on climate change, bio-diversity loss, and other sustainability issues. Therefore the creation of the 100 SDI is a much needed intervention aimed at prompting needed change. It successfully links to the SDGs. Ideally, the 100 SDI documentation will include a discussion of how the 100 SDI framework can be used by the construction industry to support and reinforce both the "Envision" assessment protocol for infrastructure (<https://sustainableinfrastructure.org/envision/overview-of-envision/>) and the "City Resilience Index" (<https://www.cityresilienceindex.org/#/>). What are the similarities and differences between these indicator systems?

2020-05-18

Specialist signature

4. A.16 SDI Validation Reports _ Specialist 4

This report aims to consider your acceptance of the 100 SDI regarding three variables: perception of efficiency and effectiveness.

If you do not want to be identified, please enter only your expertise area/field.

1. Specialist Name (or expertise area/field)

Specialist 4, Architect AIBC, MRAIC, CPHD, LEED AP® BD+C (architecture)

2. Bio

Specialist 4 is a Principal in Vancouver studio of Diamond and Schmitt Architects. He has extensive experience with mixed-use, office, and academic facilities, working effectively with private and public-sector clients.

Specialist 4 background in urban planning is the foundation that informs his approach to architecture, which is defined by seeking a rewarding sense of place. Inspired by simplicity and functionality, Specialist 4 desire is to elevate the essential and basic building elements to be recognized as lasting and defining.

He has expertise in high-performance buildings, particularly passive house and timber techniques.

3. Validation Questions

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the 100 SDI to the construction industry?

The SDI goals are valuable generally, but relevance varies greatly across different markets. In highly developed western economies many of the indicators seem distant to local preoccupations, and potentially beyond the influence of individual organizations.

Q.2 - Do you believe the 100 SDI is consistent and address the main issues of sustainability management in the construction industry?

I think the themes capture the breadth of the issues in a general sense, however, to suit local conditions detailed tactics and responses must be formulated (based on the SDI)

Perceived Ease of Use

Q.3 - Did you find the 100 SDI easy to follow?

I found it useful to refresh my memory on the broad objectives first, then when engaging with the 100 SDI I found it easy to follow.

Q. 4 - Did you find it would be easy to apply the 100 SDI in an organization?

The 100 SDI makes themes more clear and easier to place in context. Given the order given to the material, I would expect it to be easy to align the values and initiatives of an organization to the 100 SDI.

Q. 5 - Did you find the 100 SDI easy to understand?

Yes, with some engagement.

Q. 6 - Did you find the information of the 100 SDI clear and easy to understand?

Descriptions were concise and easy to follow.

Q. 7 - Overall, did you find the 100 SDI easy to use?

Yes.

Perceived Usefulness

Q.8 - Do you believe that the 100 SDI would reduce the effort required to understand and implement sustainable development management in the construction industry?

Yes, to the extent that there is enormous value in working toward common goals. The clear organization of the 100 SDI positions real issues in universal ways. Commonality across industries and nations is a benefit, and following it as a framework will bring focus more

quickly, will reinforce the themes in a consistent way, and will save the effort of ‘reinventing the wheel’.

Q.9 - Do you believe that using the 100 SDI would make it easier for users to implement sustainable development in the construction industry?

Yes, further to the previous answer, it would provide a template of a kind to for organizations to quickly step into.

Q.10 - Do you believe the 100 SDI would make it easier for the construction industry to identify and manage sustainable development activities?

Yes, considering the local imperatives – not all of the themes are practical to address universally – specific targets should be isolated to suit the market the organization works in.

Q.11 - Do you believe that using the 100 SDI would make it easier to maintain sustainable development practices in the construction industry?

Yes, but again, considering the local conditions as a way of prioritizing effort.

Q.12 - Overall, do you believe that the 100 SDI provides an effective solution to sustainable development management in the construction industry?

I’m not certain it is a solution, but it certainly can act as an important framework to shape effort and seek broad alignment of goals. In the end the issues we face are value-laden, and motivations vary.

Q.13 - Overall, do you believe the 100 SDI is an improvement to the sustainable development management practices in the construction industry?

Yes, the 100 SDI can be a part of improved management practices.

Q.14 - Do you believe that using the 100 SDI would make it easier to communicate the sustainability performance of an organization?

Absolutely. This is an important potential outcome. The framework gives a common language, sets the issues with a global perspective, and in a way makes a common purpose. The issues are complex, and reducing complexity through a clear roadmap is a benefit.

Q. 15 - Overall, did you find the 100 SDI to be useful?

Yes.

Intention to Use

Q.16 - Would you use the 100 SDI to manage sustainable development in a construction organization?

I think there are uses, again, the organization would need to prioritize the themes that resonate with the issues that they face, and those they can influence. A key use would be to align the values of the organization with the themes to create a tailored response that is focused and impactful.

Q.17 - Would you intend to use the 100 SDI in preference to the standards the current sustainability management literature offers?

Difficult to determine. I am not an expert on sustainability management, but I know that seeking internationally aligned frameworks instinctively is more efficient, and more likely to have widespread benefit.

4. Additional Comments

Q.(Extra) - If necessary, please add a comment or your overall analysis of the 100 SDI.

[Click here to enter text.](#)

Specialist 4 signature

Appendix C: The Sustainable Development Management Body of Knowledge (SDMBOK) for the Construction Industry

This appendix relates to the second objective of this research – the SDMBOK. The following pages contain the complete, standalone SDMBOK document.

Sustainable Development Management Body of Knowledge (SDMBOK)



@ Suzana C N L Espindola

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Glossary

This glossary includes important nomenclatures for a better understanding of the document:

100 Sustainable Development Indices (100 SDI) is a consolidated list of 99 sustainability targets based on the current literature review and focused on the building construction industry.

Framework is a broad overview, outline, or skeleton of interlinked items that supports a particular approach to a specific objective. It serves as a guide that can be modified as required by adding or deleting items (WebFinance Inc., 2018). For this research, it is the skeleton of the arrangement of the pattern that consists of the implementation of the management process based on the existing management models and practices, including the inputs, tools and techniques, output and templates.

Indicator is a measurable variable used as a representation of an associated target.

Indices are a group of sustainable targets.

Input is the information needed to determine the tools and techniques to implement a particular task (Project Management Institute, Inc., 2008).

Output is the results obtained by the procedures (Project Management Institute, Inc., 2008).

Recipients are those who will receive a message from the organization, such as with the promotion of the organization's strategy, either internal (employees) or external (external stakeholders).

SDMBOK—Sustainable Development Management Body of Knowledge is a supporting structure of sets and subsets of activities to assist the construction industry in initiating, planning, executing, controlling, monitoring, and reporting sustainable activities of its operations. The framework is a combination of two modules; *SOP—Sustainability Organizational Practices* and *SMP—Sustainability Management Processes*.

SMP—Sustainability Management Processes is conceptual modelling that specifies the requirements to implement a working system. The SMP assists the organization in identifying its sustainability working system, identifying the tasks and the methodology to implement, manage, control, and report the sustainability activities of the organization.

SOP—Sustainability Organizational Practices is conceptual modelling that involves investigating the requirements of the stakeholders, and developing a specification of the future system, the conceptual schema for the design process of the system modelling.

Target is a group of indicators that aims to identify the construction industry's impact on sustainable development.

Taxonomy is a science of orderly classification of items (related to one another in an actual or presumed manner) into distinct groups (WebFinance Inc., 2019). For this research, it is the base knowledge of the pattern that consists of the implementation of the management process, and is based on the literature review.

Template is a preset format used as a pattern for processes that serve as a model for others to copy (Oxford University Press, 2015). In this document, it is a collection of forms with methods or procedures based on the literature review and case studies to help the organization to implement SDM at the strategic level.

Tools and Techniques is a procedure for implementing/managing a particular task determining the steps needed to achieve the specific results, output (Project Management Institute, Inc., 2008).

1. Introduction

A framework is a supporting structure, a system of rules, recommendations, or advice that is utilized to plan and implement something (Cambridge University Press, 2018). Construction projects are very complex. They require the association of many stakeholders and contribute significantly to the environmental impacts (Project Management Institute, Inc., 2003). Therefore, to address the complexity of sustainability management in construction, it is fundamental to apply a framework that provides: comprehension of the duties' distribution, identification of the critical positions, identification of the hierarchical levels, and a definition of the relationship of the departments (Maurer, 1992).

The *Sustainable Development Management Body of Knowledge (SDMBOK)* is a framework to assist the construction industry in initiating, planning, executing, controlling, monitoring, and reporting sustainable activities of its operations. The framework is a combination of two layers: *Sustainability Organizational Practices (SOP)* and *Sustainability Management Processes (SMP)*, as demonstrated in Figure 1 (on page 420). The scope of sustainable development in the SDMBOK reference an index of sustainable development indicators—the 100 SDI—that is based on the United Nations Sustainable Development Goals (UN-SDGs) and is detailed in the Ph.D. research report titled “A Framework For Sustainable Development Management In The Construction Industry” by Suzana Carla Nunes Lins Espindola available on <https://open.library.ubc.ca/cIRcle/collections/ubctheses>.

The SDMBOK describes a range of project management principles and practices for the construction industry, focusing on sustainable development management. The SDMBOK is composed of definitions, procedures, and templates organized as follows:

- Definitions (Tasks and Processes)—based on the literature review considering business model (standards, certifications, etc.), project and construction management (e.g., PMBOK), and sustainability management.
- Procedures—a combination of methodologies based on literature review and case studies presented in the format of Input, Tools and Techniques, and Output.
- Template—a collection of forms with methods or procedures based on literature review and case studies to help the organization to implement sustainable development management at the organizational strategic level.

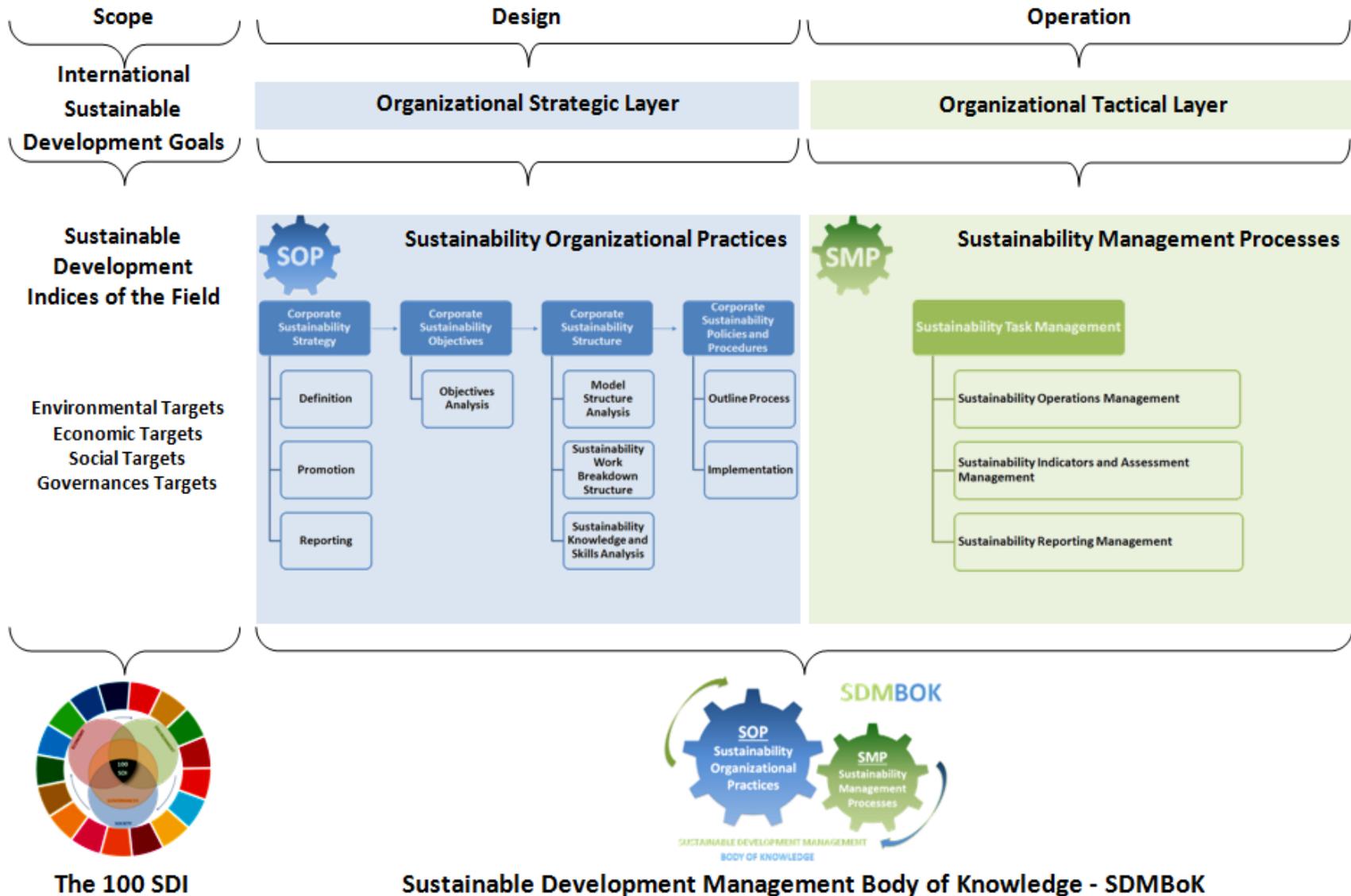


Figure 1 Roadmap of Sustainable Development Management Implementation

2. Purpose and Audience

Construction management activities can be organized into six hierarchical levels: organizational, project, activity, operation, process, and work task (Halpin & Woodhead, 1976).

There are many ways for a company to define its strategies, objectives, structure, and processes. However, it is crucial to create a framework that helps organizations achieve their objectives based on underlying patterns (Miles & Snow, 2003).

This framework intends to assist construction organizations to implement sustainable development management at two levels of project management: the level of organizational strategy—called Sustainability Organizational Practices, SOP—and the level of specific management practices—called Sustainability Management Processes, SMP. The SDMBOK assists in translating the broad sustainability goals into specific tasks.

The audience for this SDMBOK includes, but is not limited to:

- Construction managers and project managers
- Sustainability managers and coordinators
- Contractors
- Subcontractors
- Architects, designers, and engineers
- Chief Executive Officers (CEO)
- Construction consultants
- Construction industry trades and professionals

The SDMBOK includes the definitions and tools of each knowledge area in each layer of the framework. It also introduces templates for assisting organizations to implement the framework at the strategic level.

3. Sustainable Development Management—Body of Knowledge (SDMBOK) for the Construction Industry: Definitions, Tools, and Templates.

The objective of the SDMBOK is to provide the full range of information needed to successfully implement sustainable development management in organizations. The SDMBOK Framework is divided into two layers: SOP—Sustainability Organizational Practices, relating to the strategic level and SMP—Sustainability Management Processes, addressing the tactical level.

The SOP focuses on the corporate organizational structure, assisting the organization in identifying its sustainability goals, the human resources to execute the sustainability tasks, and the methodology of identifying and implementing the sustainability values and policies within the organization.

The SMP focuses on Corporate Sustainability Tasks, assisting the organization to identify its sustainability working system and identifying the tasks and the methodology to implement, manage, control, and report the sustainability activities of the organization.

4. Sustainability Organizational Practices (SOP)—Strategic Layer

Sustainability Organizational Practices (SOP) establish the organization's sustainability approach, identifying the human resources to execute the tasks and the methodologies for implementing the sustainability values and policies in the organization. The SOP is a conceptual model that involves investigating the requirements of the stakeholders and developing a management system that responds to these requirements. The SOP focuses on the organizational structure, bringing business concepts for implementing sustainability management processes into the organization.

The module is divided into four knowledge areas: Corporate Sustainability Strategy, Corporate Sustainability Objectives, Corporate Sustainability Structure, and Corporate Sustainability Policies and Procedures, as illustrated in Figure 2.

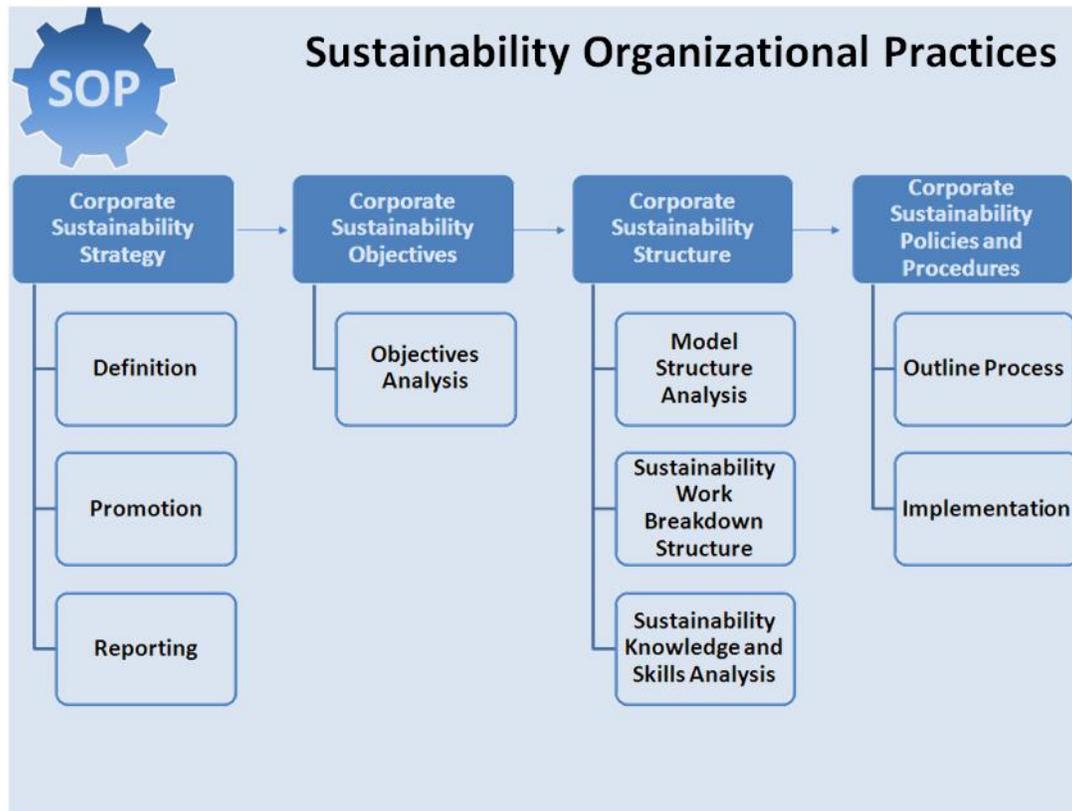


Figure 2 Sustainability Organizational Practices (SOP) Taxonomy

4.1.SOP: Corporate Sustainability Strategy

Corporate strategy is the overall scope and direction of an organization and the way that its various business operations work together to achieve particular goals (WebFinance Inc., 2020). Corporate Sustainability Strategy is the scope and direction of the sustainable goals of the organization.

The Corporate Sustainability Strategy is the process of documenting the actions necessary to identify, promote, and report the sustainability organization strategy and its general sustainable goals, considering its market, values, external regulations, external and internal initiatives, and its primary sustainability focus. The Corporate Sustainability Strategy becomes the primary source of direction for the sustainability activities plan.

To implement sustainability management in the organization’s daily activities, it is necessary initially to identify which issues the organization will address, identifying the values and commitment of the organization, how to promote those commitments, and how to report the organization's sustainability impact.

Figure 3 illustrates the SDMBOK three steps in implementing the Corporate Sustainability Strategy: definition, promotion, and reporting.

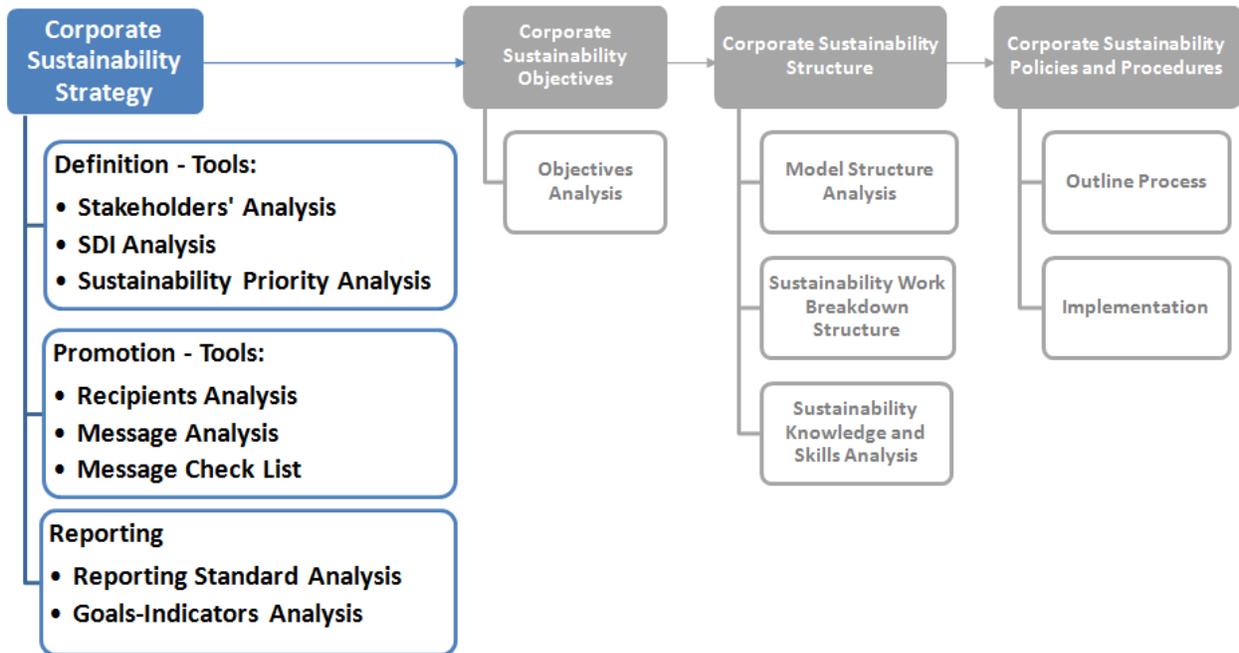


Figure 3 Corporate Sustainability Strategy Subsets

4.1.1. SOP: Corporate Sustainability Strategy—Definition

Corporate Sustainability Strategy—Definition is the process of identifying and documenting the sustainability goals that the organization will address, considering the organization's market, its values, external regulations, external and internal initiatives, and its primary sustainability focus.

Table 1 describes the elements of Corporate Sustainability Strategy Definition for defining the sustainability goals of the organization.

Table 1 Corporate Sustainability Strategy—Definition: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Market • Corporate Sustainability Mission Statement • Stakeholders Identification • Sustainability Issues • Corporate Sustainability Strategy—Reporting (feedback) • (SMP) Sustainability Reporting Management Guidelines 	<ul style="list-style-type: none"> • Stakeholders Analysis • SDI Model • Sustainability Issues Priorities 	<ul style="list-style-type: none"> • Corporate Sustainability Strategy—Goals

4.1.1.1. Corporate Sustainability Strategy—Definition: Inputs

- Market—identifying the market clarifies the value that the organization must create from the point of view of the customers, analyzing the product/service and geographical area in which the organization will operate. Moreover, the organization can operate with different products/services and in different geographic areas, making it necessary to analyze them individually. Therefore, the SDMBOK suggests a corporate sustainability strategy for each of the organization’s markets.
- Corporate Sustainability Mission Statement—the mission statement describes the company’s values, its overriding objectives, and its main areas of activities. It provides the primary direction to determine the values and guidelines for the organization’s activities.
- Stakeholders Identification—identifying the stakeholders is a process of analyzing all the stakeholders and their interests, involvement, interdependencies, influence, values and potential impact on the organization’s activities.
- Sustainability Issues—whatever approaches the organization adopts, it is essential to recognize that they will never be completed. To avoid reducing the analysis to the perspective of the organization only, SDMBOK suggests considering international review as well, considering standards and institutions that analyze the impact of the field and international goals. The SDI Model technique discussed in the next section can assist the organization to identify the sustainability issues relevant to its field.

- Corporate Sustainability Strategy—Reporting (Feedback)—sustainability is an evolving field that needs to be reviewed constantly. Analyzing the sustainability strategy of the organization through its results provides a feedback loop to improve the sustainability performance of the organization.
- Sustainability Reporting Management Guidelines (Feedback)—feedback from the sustainability performance of the organization’s concluded projects and activities.

4.1.1.2. Corporate Sustainability Strategy—Definition: Tools and Techniques

- Stakeholder’s Analysis—in a stakeholder’s analysis, two variables affect the organization more than others: the importance (interest) and influence (power). The stakeholder analysis assists an organization in identifying the stakeholders and their two characteristics—importance and influence—so that they can be prioritized and their values identified. A Stakeholders' Analysis Matrix (Figure 4) can help to prioritize the stakeholders.
 - High level of importance and high level of influence—manage closely. The stakeholders at this category are the top priorities, and the organization should manage them closely;
 - High level of importance and low level of influence—keep the stakeholders at this category informed;
 - High level of influence and low level of importance— the stakeholders at this category keep satisfied;
 - Low level of importance and influence—monitor the impact of the organization’s activities to the stakeholders at this category.

Once stakeholders have been identified and prioritized, their values should be identified to be considered when analyzing and identifying the sustainability goals for the organization.



Figure 4 Stakeholders' Analysis Matrix—Impact on the organization

- SDI Model—the analysis of the sustainability issues of the corporate activities should not focus on the understanding and perception of the organization only. SDI is the sustainable development indices

that assist the organization to identify the sustainability targets to be addressed and how they contribute to the current international sustainable goals. The 100 SDI is a list of sustainable development targets based on the United Nations Sustainable Development Goals (UN-SDGs) and is detailed in the Ph.D. research report titled “A Framework For Sustainable Development Management In The Construction Industry” by Suzana Carla Nunes Lins Espindola available on <https://open.library.ubc.ca/cIRcle/collections/ubctheses>. This information provides the scope for the organization to prioritize the sustainability issues to be addressed.

This SDMBOK also introduces templates to implement the SOP framework. The templates are a series of forms that support the application of the SDMBOK and can be found in the research report mentioned above. The SDMBOK templates can be automatically populated with the 100 SDI list, which is a list of 99 sustainability indicators focus on the building construction industry.

- Sustainability Issues Priorities— once the scope of the sustainability targets for the organization’s activities has been defined (considering the 100 SDI or another list elaborated by the organization), the organization should prioritize the targets so that it can focus on the targets to be addressed for the next steps of the sustainability management implementation.

The SDMBOK analyzes the target contribution according to four perspectives using a simple weighting method where the organization defines the value for each of those perspectives:

- Regulation implications—the external policies and governmental implications regarding a specific issue
- Corporate mission statement—the impact of the target on the corporate mission statement
- Stakeholders’ values— the effect of the target on the values of the stakeholders previously analyzed
- Financial implications— the financial significance of addressing or not addressing the target issue

The Green Economy Roadmap Framework from the ICC suggests defining at least ten clear goals to be approached for a better management process (International Chamber of Commerce, 2012) . Therefore, SDMBOK suggests prioritizing and identifying at least ten goals for each sustainability category—economic, environmental, social.

4.1.1.3. Corporate Sustainability Strategy—Definition: Outputs

- Corporate Sustainability Strategy—Goals—the corporate sustainability goals addressed by the organization.

4.1.2. SOP: Corporate Sustainability Strategy—Promotion

Corporate Sustainability Strategy Promotion is the process of identifying and documenting the internal communication plan that establishes a service orientation focusing on achieving effective internal exchanges between the organization and its employees. Promoting the organization's sustainability values influences employees' work attitude, awareness, and commitment to the Corporate Sustainability Strategy.

Table 2 describes the Corporate Sustainability Strategy Promotion tools for defining the sustainability goals of the organization.

Table 2 Corporate Sustainability Strategy—Promotion: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Mission Statement • Corporate Sustainability Strategy—Goals • Recipients and level of knowledge 	<ul style="list-style-type: none"> • Recipients Analysis • Message Analysis • Message Checklist 	Corporate Sustainability Strategy—Promotion Plan

4.1.2.1. Corporate Sustainability Strategy—Promotion: Inputs

- Corporate Sustainability Mission Statement—the mission statement describes the company's values, its overriding objectives and its main areas of activities. It provides the primary direction for determining the values and guidelines for the organization's activities.
- Corporate Sustainability Strategy—Goals—the organization's sustainability goals.
- Recipients and level of knowledge—understanding the recipients, the ones that will be receiving the message: internal (employees) and external (external stakeholders) and their levels of knowledge, assists the organization to prepare the appropriate message to promote its sustainability values and goals.

4.1.2.2. Corporate Sustainability Strategy—Promotion: Tools and Techniques

- Recipients Analysis—analyzing the recipients assists the organization to promote the sustainability values. Each sustainability target will affect different stakeholders and identify the ones that need to be informed or educated for each target, this will assist the organization to determine the most effective messaging. The SDMBOK Recipients Analysis considers information for internal communication, examining the following:

- Identify the department that will receive the message.
- Identify the level of knowledge and education the recipients have so that the message will be elaborated accordingly.
- Identify whether the message needs an additional format, such as visual representation.
- Identify whether the recipients have access to technology so that the message can be appropriately elaborated.
- Identify any barriers, such as cultural differences, that should be addressed while transmitting the message.
- Message Analysis—The message analysis identifies the specifics of each message. It will analyze each of the organization's sustainability goals and determine how they should be promoted. The SDMBOK Message Analysis considers information for internal communication, by examining the following:
 - Characteristics of the message:
 - Identify the type of message: informative, persuasive, entertaining.
 - Identify the dissemination format: formal, informal, electronic, hard copy, training, etc.
 - Identify the message content.
 - Message maintenance:
 - Identify who is responsible for promoting the message.
 - Identify the frequency of updating and repeating.
 - Feedback process:
 - Identify whether the message needs to be assessed.
 - Identify the way the message would be assessed if needed.
- Message Checklist—the checklist analysis assists the organization in evaluating whether the message achieves all the aspects formerly analyzed, such as the type of the message, the format, the feedback process, and the quality of the message.

4.1.2.3. Corporate Sustainability Strategy—Promotion: Outputs

- Corporate Sustainability Strategy—Promotion Plan—a strategic plan for promoting the corporate sustainability goals.

4.1.3. SOP: Corporate Sustainability Strategy—Reporting

Corporate Sustainability Strategy Reporting is the process of identifying and documenting the economic, environmental and social impacts caused by the organization’s activities—positive or negative. The report presents the Corporate Sustainability Strategy, the measured performance, and the results concerning sustainable development, increasing transparency about the effects of its operations on sustainability issues.

Table 3 describes the Corporate Sustainability Strategy Reporting tools for defining the way the organization will report its sustainability performance based on its sustainability goals.

Table 3 Corporate Sustainability Strategy—Reporting: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Mission Statement • Corporate Sustainability Strategy—Goals • Organizational Profile • SMP: Corporate Sustainability Tasks—Sustainability Reporting Management 	<ul style="list-style-type: none"> • Sustainability Reporting Standard Analysis • Sustainability Goals - Indicators Analysis 	<ul style="list-style-type: none"> • Corporate Sustainability Strategy—Reporting

4.1.3.1. Corporate Sustainability Strategy—Reporting: Inputs

- Corporate Sustainability Mission Statement—the mission statement describes the company’s values, its overriding objectives, and its main areas of activities. It provides the primary direction for determining the values and guidelines for the organization’s activities.
- Corporate Sustainability Strategy—Goals—the organization’s sustainability goals.
- Organizational Profile—the organization profile helps stakeholders to understand the nature of the organization and its economic, environmental and social impact. It provides an overview of the organization's size, geographic location, and activities.
- Corporate Sustainability Tasks—Sustainability Reporting Management—feedback from the sustainability performance of the organization’s concluded projects and activities.

4.1.3.2. Corporate Sustainability Strategy—Reporting: Tools and Techniques

- Sustainability Reporting Standard Analysis—the sustainability reporting standard analysis assists the organization to define the content of its sustainability report and to identify the format standard utilized by the organization. The SDMBOK considers information for internal and external communication, examining the following:
 - Identify the Reporting Standard to be used by the organization:
 - Identify the reporting standard that the organization will apply, if an external standard.
 - Identify whether the chosen format is an international or national standard.
 - Identify the Reporting Standard Profile:
 - Identify whether the stakeholders require the chosen format.
 - Identify whether any regulation requires the chosen format.
 - Identify whether the chosen format reports the economic, environmental, and social perspectives of the organization's performance.
 - Identify Reporting Execution:
 - Identify who is responsible for updating the report.
 - Identify the frequency of updating and publishing of the report.
- Sustainability Goals-Indicators Analysis—the sustainability goals-indicators analysis assists the organization to define the compiled data of sustainability goals to be reported. The SDMBOK assists in examining the following:
 - Identify the sustainability goals that will be reported and their assessment methodologies.
 - Identify the location where the sustainability goals will be reported in the chosen reporting format: identify whether the sustainability goal is a requirement from the selected reporting standard format and the location where it will be reported.

4.1.3.3. Corporate Sustainability Strategy—Reporting: Outputs

- Corporate Sustainability Strategy—Reporting—the process to define the format to report the organization's sustainability performance.

4.2.SOP: Corporate Sustainability Objectives

Objectives are more specific and more measurable than goals. Objectives underlie all planning and strategic activities to achieve within a time frame and with available resources. They serve as the basis for creating policy and evaluating performance (WebFinance Inc., 2018).

The Corporate Sustainability Objectives section of the SDMBOK describes the actions necessary to identify the sustainability objectives according to the organization’s sustainability strategy and to identify the strategic activities to achieve them. Figure 5 illustrates the SDMBOK analysis tools for implementing the Corporate Sustainability Objectives.

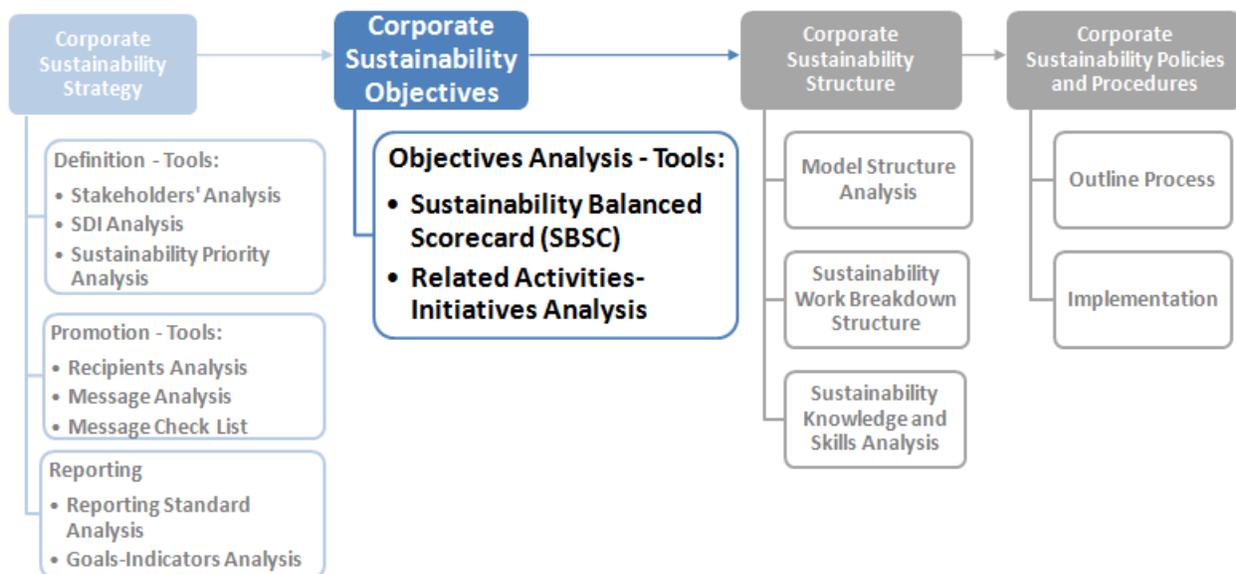


Figure 5 Corporate Sustainability Objectives Subset

4.2.1. SOP: Corporate Sustainability Objectives Analysis

Corporate Sustainability Objectives Analysis is the process of identifying and documenting the priority strategy goals of the organization in more detail, determining the initiatives of the organization to achieve the specific objectives and the activities to implement the sustainability goals. Table 4 describes the Corporate Sustainability Objectives tools for prioritizing its sustainability goals.

Table 4 Corporate Sustainability Objectives: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Strategy—Goals • Related Departments • Main Activities 	<ul style="list-style-type: none"> • Sustainability Balanced Scorecard (SBSC) • Related Activities-Initiatives Analysis 	<ul style="list-style-type: none"> • Corporate Sustainability Objectives

4.2.1.1. Corporate Sustainability Objectives Analysis: Inputs

- Corporate Sustainability Strategy—Goals—corporate sustainability goals addressed by the organization.
- Related Departments—the organizational units that will be affected by the relevant sustainability goals.
- Main Activities—the main activities involved in achieving the related sustainability goals.

4.2.1.2. Corporate Sustainability Objectives Analysis: Tools and Techniques

- Sustainability Balanced Scorecard (SBSC)—A Sustainability Balanced Scorecard assists the organization to identify the indicators and assessment methodology to manage the sustainability goals of each sustainability perspective and, based on the priority goals identified previously by the organization, to identify the organization’s initiatives for implementing and managing the goals.
 - Based on the information identified in the Corporate Sustainability Strategy (corporate sustainability goals, assessment methodology, and required performance), the organization identifies the initiatives, either a specific project or specific activity.
 - Related Activities-Initiatives Analysis—The related activities-initiatives analysis assists the organization to identify the main operational activities and the associated departments to structure the organization and assist in implementing and managing its sustainability goals.
- Related Department—Identify the organizational units where the initiatives (project or activity) will be implemented.
 - Main Activities—For the relevant departments, identify the main activities involved to achieve the established objectives.

4.2.1.3. Corporate Sustainability Objectives Analysis: Outputs

- Corporate Sustainability Objectives—the organizational sustainability goals and the main activities/projects for achieving them.

4.3.SOP: Corporate Sustainability Structure

An organizational structure depends on the organization's objectives and strategy. It identifies the way the roles and responsibilities are assigned and coordinated, and the way the information flows between the levels of management. The Corporate Sustainability Structure identifies the sustainability activities of the organization based on its sustainability strategies and objectives and the required knowledge, skills, and roles for managing its sustainability performance.

The Corporate Sustainability Structure section of the SDMBOK outlines the actions necessary to define the allocation, coordination and supervision of the activities for achieving the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The organizational structure focuses on the required sustainability knowledge, skills, training, certifications, roles, and department for managing sustainability practices. It assists the organization in adapting its organizational chart to be efficient and flexible to achieve sustainable competitive advantage. Figure 6 illustrates the three steps within the SDM -BoK relating to the Corporate Sustainability Structure.

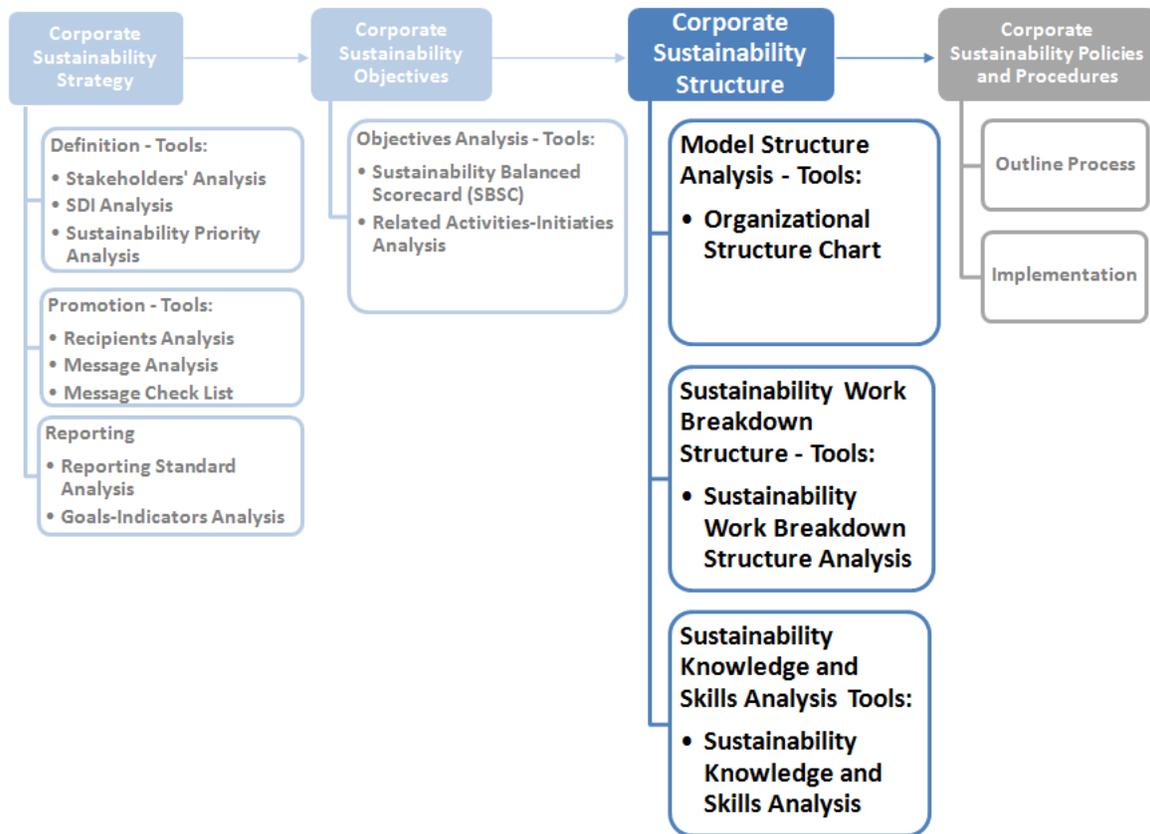


Figure 6 Corporate Sustainability Structure Subset

4.3.1. SOP: Corporate Sustainability Structure—Model Structure

The organizational structure assists an organization to execute its strategies and objectives, determine who is responsible for what and how they communicate with each other. The organizational structure should be defined, and the sustainability management activities should be located within this structure. Table 5 describes the Corporate Sustainability Structure—Model Structure tools for defining the organizational structure and positioning the sustainability management system within the organization structure.

Table 5 Corporate Sustainability Structure—Model Structure: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Characteristics of the organizational structure 	<ul style="list-style-type: none"> • Organizational Structure Chart 	<ul style="list-style-type: none"> • Corporate Organizational Chart

4.3.1.1. Corporate Sustainability Structure—Model Structure: Inputs

- Characteristics of the organizational structure—an organization can be structured according to the functional breakdown on the work, creating organizational units according to different functions.

Alternatively, an organization can be structured according to its various products or services, creating organizational units according to various products or services. Identifying the organization structure assists in determining and visualizing the organizational system and in positioning sustainability management within this organizational structure.

4.3.1.2. Corporate Sustainability Structure—Model Structure: Tools and Technique

- Organizational Structure Chart—The organizational chart assists an organization to visualize the organizational structure and its components, demonstrating the connection between departments and the relationships between them. It does not indicate the activities. However, it illustrates the flow of information within the organization.
 - The SDMBOK considers the analysis of two variables to determine the organizational structure model—the level of specialization and the level of the focus on product/service:
 - Low function and Low Product/ Service—Simple Organizational Chart
 - Low function and High Product/ Service—Divisional Organizational Chart
 - High function and Low Product/ Service—Functional Organizational Chart
 - High function and High Product/ Service—Matrix Organizational Chart

4.3.1.3. Corporate Sustainability Structure—Model Structure: Output

- Corporate Organizational Chart—an organizational chart, incorporating sustainability management into the organizational structure.

4.3.2. SOP: Corporate Sustainability Structure—Sustainability Work Breakdown Structure (SWBS)

Corporate Sustainability Structure—Sustainability Work Breakdown Structure is the process of identifying and documenting the sustainability work package from the general division to its smallest components, identifying and dividing the sustainability activities to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives. It assists the organization to identify the roles and responsibilities for managing the sustainability activities of the organization to accomplish the Corporate Sustainability Strategy and Corporate Sustainability Objectives.

Table 6 describes the Corporate Sustainability Structure—Sustainability Work Breakdown Structure (SWBS) tools for defining the work package of the organizational structure.

Table 6 Corporate Sustainability Structure—SWBS: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> Corporate Sustainability Objectives 	<ul style="list-style-type: none"> Sustainability Work Breakdown Structure (SWBS) Analysis 	<ul style="list-style-type: none"> Corporate Sustainability Work Breakdown Structure (SWBS)

4.3.2.1. Corporate Sustainability Structure—SWBS: Inputs

- Corporate Sustainability Objectives—the corporate sustainability goals and the main activities/projects to manage.

4.3.2.2. Corporate Sustainability Structure—SWBS: Tools and Techniques

- Sustainability Work Breakdown Structure (SWBS) Analysis—The SWBS analysis assists the organization to determine the work packages, dividing the organizational strategy and objectives into their components for coordination. It considers the organization’s goals, the main activities, the flow of information, the level of control of the entire procedure, and the responsibilities of individuals for every deliverable. To define the team assignment, the SDMBOK analyzes the activities as follows:
 - Internal Professional/Consultant—identify the internal professional (such as manager, analyst, or technical support) or a consultant who is responsible for executing/managing the activity.
 - Work category—once those responsible for the activity are identified, identify the work category such as planning the project, moderating working sessions, analyzing recommendations, managing results, executing the activity, etc.
 - Receive Information from—identify on whom the department depends (information or material) to execute the activity
 - Deliver Information to—identify which department depends on the information or material to continue the flow of the activity.
 - Deliverables—identify the deliverable for each activity with deadlines.

4.3.2.3. Corporate Sustainability Structure—SWBS: Output

- Corporate Sustainability Work Breakdown Structure (SWBS)—the organizational sustainability work packages.

4.3.3. SOP: Corporate Sustainability Structure—Sustainability Knowledge and Skills

Corporate Sustainability Structure—Sustainability Knowledge and Skills Analysis is the process of identifying and documenting the technical expertise and the required tools to enhance the sustainability performance determined by the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The Corporate Sustainability Structure—Sustainability Knowledge and Skills Analysis assists an organization to identify the sustainability skills, knowledge, and competencies for managing the Corporate Sustainability Strategy and Corporate Sustainability Objectives.

Table 7 describes the Corporate Sustainability Structure—Sustainability Knowledge and Skills tools for defining the sustainability skills, knowledge, and competencies needed for the work packages of the organizational structure.

Table 7 Corporate Sustainability Structure—Sustainability Knowledge and Skills: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Objectives • Sustainability Work Breakdown Structure (SWBS) 	<ul style="list-style-type: none"> • Sustainability Knowledge and Skills Analysis 	<ul style="list-style-type: none"> • Corporate Sustainability Structure—Sustainability Knowledge and Skills

4.3.3.1. Corporate Sustainability Structure—Sustainability Knowledge and Skills: Inputs

- Corporate Sustainability Objectives—the corporate sustainability goals and the main activities/projects to manage.
- Corporate Sustainability Work Breakdown Structure (SWBS)— the organizational sustainability work packages.

4.3.3.2. Corporate Sustainability Structure—Sustainability Knowledge and Skills: Tools and Techniques

- Sustainability Knowledge and Skills Analysis—the Sustainability Knowledge and Skills Analysis tool assists the organization to identify the essential skills and the additional tools, technologies, and standards needed to manage each of the corporate sustainability goals. This information will assist the organization in the hiring process or training of the current team:

- Essential Skills Development— identify the soft and technical knowledge that those responsible to execute any task need to accomplish the activities and to deliver the expected results.
- Additional Tools/Technology/Standards—identify any software, machinery, legal requirements needed to execute the activity.

4.3.3.3. Corporate Sustainability Structure—Sustainability Knowledge and Skills: Output

- Corporate Sustainability Structure—Sustainability Knowledge and Skills—the essential skills and additional tools, technologies, and standards needed to manage each of the corporate sustainability goals.

4.4.SOP: Corporate Sustainability Policies and Procedures

The corporate sustainability policies and procedures are a set of principles, rules, and guidelines designed to reach the Corporate Sustainability Strategy and Corporate Sustainability Objectives. It is a process of documenting the actions necessary to determine the corporate sustainability principles, rules, and guidelines for the organization based on the Corporate Sustainability Strategy—Goals and Corporate Sustainability Objectives.

Figure 7 illustrates the steps within the SDMBOK for elaborating and promoting the Corporate Sustainability Policies and Procedures.

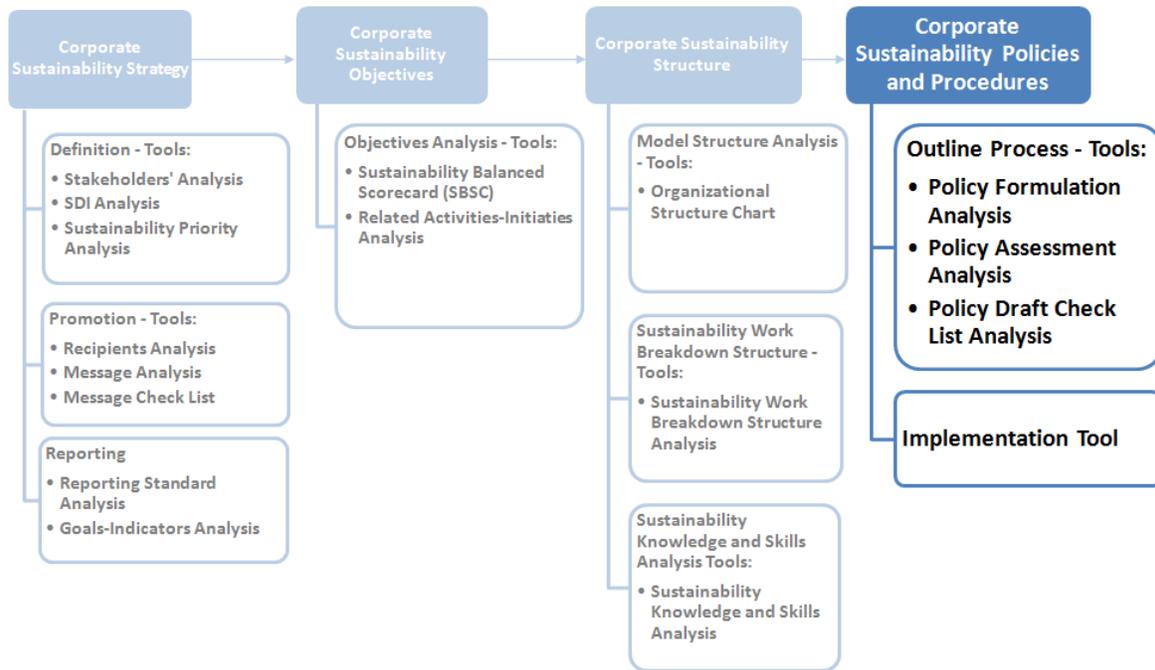


Figure 7 Corporate Sustainability Policies and Procedures Subset

4.4.1. SOP: Corporate Sustainability Policies and Procedures—Outline Process

The outline process is the process of identifying and documenting the set of principles, rules, and guidelines to reach its Corporate Sustainability Strategy and Corporate Sustainability Objectives. The Corporate Sustainability Policies and Procedures—Outline Process is a guide of how to define the rules and principles regarding the sustainability practices, the expected behaviour and responsibilities of managers and employees.

Table 8 describes the Corporate Sustainability Policies and Procedures—Outline Process tools for defining the process of formulating a policy.

Table 8 Corporate Sustainability Policies and Procedures—Outline Process: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Objectives • Corporate Sustainability Structure—Sustainability Knowledge and Skills 	<ul style="list-style-type: none"> • Policy Formulation Analysis • Policy Assessment Analysis • Policy Draft Check List Analysis 	<ul style="list-style-type: none"> • Corporate Sustainability Policy

4.4.1.1. Corporate Sustainability Policies and Procedures—Outline Process:

Inputs

- Corporate Sustainability Objectives—the corporate sustainability goals and the main activities/projects to manage.
- Corporate Sustainability Structure—Sustainability Knowledge and Skills—the essential skills and additional tools, technologies, and standards needed to manage each of the corporate sustainability goals.

4.4.1.2. Corporate Sustainability Policies and Procedures—Outline Process:

Tools and Techniques

- Policy Formulation Analysis—the policy formulation analysis assists the organization to identify the primary information to be considered to elaborate a policy. It will describe the sustainability structure to be analyzed, the values of the stakeholders being approached, and the skills and tools necessary to implement the policy, as in the following steps:
 - Identify corporate sustainability strategy: sustainability goals, related department, main activities and stakeholders' values.
 - Identify the corporate sustainability structure—skills and tools.
 - Identify main information for policy definition: legal requirements, terminologies and workflow.
 - Identify the internal registration of the new policy, such as the corporate code, title, version and status of the new policy.
- Policy Assessment Analysis—the policy assessment analysis assists the organization in assessing the impact of the policy in the three perspectives of sustainability, analyzing the overall effect on sustainable development. This analysis is based on the Organization for Economic Co-operation and Development (OECD) and the Sustainability Impact Assessment (SIA) to evaluate the impact of

policy, determining the assessment overall score and evaluation. The assessment evaluation analyzes whether the policy obstructs or promotes environmental, economic, and social impacts, weighing the consequences and calculating the overall effect (either whether the policy obstructs or promotes sustainable development), as illustrated in Figure 8.



Figure 8 Policy Assessment Graphic

- Policy Draft Check List Analysis—the policy draft checklist analysis assists the organization in verifying whether the elaborated policy considered essential steps before implementing it. The checklist assists the organization to verify the following steps:
 - 1st Draft Analysis:
 - 1st Draft Analysed by the main Stakeholders identified in the "Outline Process—a. Policy Formulation"?
 - Policy Proposal adjusted accordingly?
 - If not, why?
 - Policy Proposal Assessment:
 - Proposed Policy Assessed?
 - Proposed Policy Assessment Presented to the main Stakeholders?
 - Proposed Policy Impact Accepted?
 - Policy Approval:
 - Proposed Policy Approved?
 - Who Approved?
 - When should review take place?

**4.4.1.3. Corporate Sustainability Policies and Procedures—Outline Process:
Output**

- Corporate Sustainability Policy—Corporate Sustainability Policy is the guideline to define the policy for each corporate sustainability goal, considering the impact of the policy from the sustainable development perspective.

4.4.2. SOP: Corporate Sustainability Policies and Procedures—Implementation

The implementation tool assists the organization to identify the related department to implement the policy, how it should be implemented, who is responsible for the implementation, and when the policy should be reviewed.

Table 9 describes the Corporate Sustainability Policies and Procedures—Implementation tools for defining the essential information to be considered when planning to implement a policy.

Table 9 Corporate Sustainability Policies and Procedures—Implementation: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Objectives • Corporate Sustainability Policy 	<ul style="list-style-type: none"> • Corporate Sustainability Policies and Procedures—Implementation Tools 	<ul style="list-style-type: none"> • Corporate Sustainability Policies and Procedures Implementation Plan

**4.4.2.1. Corporate Sustainability Policies and Procedures—Implementation:
Inputs**

- Corporate Sustainability Objectives—the corporate sustainability goals and the main activities/projects to manage.
- Corporate Sustainability Policy—Corporate Sustainability Policy is the guideline to define the policy for each corporate sustainability goal, considering the impact of the policy from the sustainable development perspective.

4.4.2.2. Corporate Sustainability Policies and Procedures—Implementation: Tools and Techniques

- Corporate Sustainability Policies and Procedures—Implementation Tool—The implementation tool assists the organization to identify the type of implementation, who is responsible for it and when it should be implemented:
 - Type of implementation—identify the formats used to implement the policy, memorandum, training, etc.
 - Who is responsible for implementing—determine who is responsible for implementing the policy, e.g. the departmental manager, the HR department, the site coordinator, etc.
 - When should the implementation take place—determine the periodicity of the implementation, e.g. it should be implemented when hiring a new employee, or every six months, etc.

4.4.2.3. Corporate Sustainability Policies and Procedures—Implementation: Output

- Corporate Sustainability Policies and Procedures Implementation Plan—the implementation plan identifying the type of implementation, the responsible parties, and the timing for implementing the policy.

4.5. Summary of SOP

The Corporate Sustainability Policies and Procedures is the last step of the SOP layer. Based on the information analyzed and determined in this layer, the next step is to define the process to be implemented in specific projects and procedures at the tactical layer. The following chapter approaches the organizational tactical layer for implementing the Sustainable Development Management system.

5. Sustainability Management Processes (SMP)—Tactical Layer

Whereas the Sustainability Organizational Practices (SOP) layer provides a generic framework for an organization's overall sustainability strategy, the Sustainability Management Processes (SMP) provides a framework for managing an organization's sustainability initiatives and practices. Like the SOP, the SMP is also a generic framework that defines elements of a general management approach that can be applied to any specific sustainability activity—it does not address the task-specific details (e.g., of a waste-reduction program or a life cycle analysis activity). The SMP assists the organization to identify its sustainability

working system by identifying the tasks and the methodology to implement, manage, control, and report the sustainability activities of the organization.

The SDMBOK divides the SMP task management into three subareas: operations management, indicators and assessment management, and reporting management. Figure 9 illustrates the Sustainability Management Processes (SMP) Taxonomy approached by this framework.



Figure 9 Sustainability Management Processes (SMP) Taxonomy

5.1.SMP: Corporate Sustainability Tasks

A task is the smallest identifiable piece of work (WebFinance Inc., 2018) managed at the tactical level or project management level. The Corporate Sustainability Tasks section of the SMP defines the process of documenting the actions necessary to execute and manage the organization's activities, based on the Corporate Sustainability Strategy and the Corporate Sustainability Objectives.

Figure 10 illustrates the SDMBOK's three steps for implementing the Corporate Sustainability Task Management: sustainability operations management, sustainability indicators and assessment management, and sustainability reporting management.

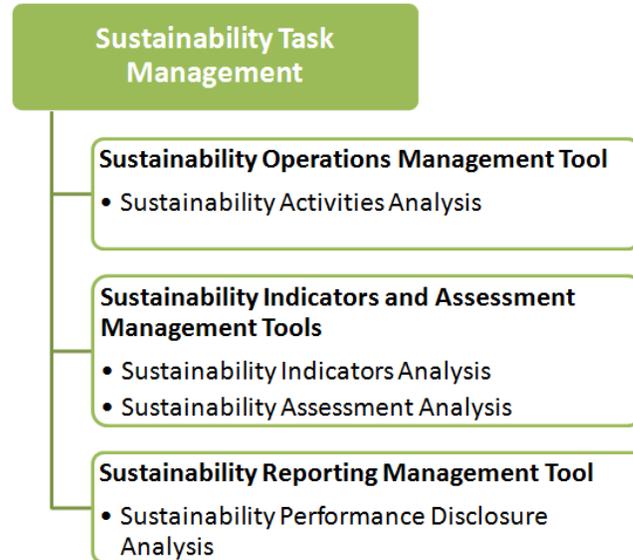


Figure 10 Sustainability Task Management Subsets

5.1.1. SMP: Sustainability Operations Management

Corporate Sustainability Tasks—Sustainability Operations Management is the process of identifying and documenting the work breakdown structure of the activities that provide sustainability management in the construction phase and assist the organization to achieve the Corporate Sustainability Strategy and Corporate Sustainability Objectives. The Corporate Sustainability Tasks—Sustainability Operations Management section of the SDMBOK provides a process for identifying specific sustainability activities and sustainability processes, assisting the organization to go from general or ethical goals to tangible and practical actions.

Table 10 describes the Corporate Sustainability Task Management—Operations Management tools, in a format of input, tools and techniques, and outputs.

Table 10 Corporate Sustainability Tasks—Sustainability Operations Management: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Objectives • Corporate Sustainability Policy • Predecessors tasks 	<ul style="list-style-type: none"> • Sustainability Operations Management Analysis 	<ul style="list-style-type: none"> • Sustainability Operations Management Guidelines

5.1.1.1. Corporate Sustainability Tasks—Sustainability Operations

Management: Inputs

- Corporate Sustainability Objectives—the organizational sustainability goals and the main activities/projects for achieving them.
- Corporate Sustainability Policy—Corporate Sustainability Policy is the guideline to define the policy for each corporate sustainability goal, considering the impact of the policy from the sustainable development perspective.
- Predecessor tasks—the tasks that must precede the activity as inputs to the work.

5.1.1.2. Corporate Sustainability Tasks—Sustainability Operations

Management: Tools and Techniques

Sustainability Operations Management Analysis—The Sustainability Activities Analysis assists the organization to subdivide project deliverables and project work in to smaller, specific and more manageable elements. The SDMBOK suggests using Work Breakdown Analysis, considering the sustainability goals, policies of the organization, and information described below and in Table 11.

- 1.1. A summary of the work to be accomplished
- 1.2. Inputs required from other project tasks (predecessors)
- 1.3. The manager and organizational unit responsible
- 1.4. Sustainability activity
- 1.5. Resource estimates for labour, material, equipment, and facilities
- 1.6. Total cost and budget
- 1.7. Work orders
- 1.8. Schedule dates and milestone events

Table 11 Sustainability Operations Management Analysis Table

Corporate Sustainab. Objectives	Corporate Sustainab. Policy	Activity	Department	Predecessors' Input	Sustainab. Activities	Weekly Labor Requirement (workers)	Time (Weeks)	Weekly Direct Cost (\$K)	Additional Sustainab. Materials/ Equip.	Additional Sustainab. Practice Costs	Total Cost (\$K)	
		H	Hi	H0		5	10	10	i	-	100	
		I	Ii	I0		4	8	8	ii	1	65	
		J	Ji	J0		8	6	16	iii	-2	94	
		K	Ki	K0		2	4	4	iv	-	16	
		L	Li	L0		6	2	18	v	-	36	
Total									56	-	-1	311

5.1.1.3. Corporate Sustainability Tasks—Sustainability Operations

Management: Output

- Sustainability Operations Management Guidelines—corporate sustainability work breakdown guideline.

5.1.2. SMP: Sustainability Indicators and Assessment Management

Corporate Sustainability Tasks—Sustainability Indicators and Assessment Management is the process of identifying and documenting a reliable mechanism to identify and manage the sustainability measures indicators. The Corporate Sustainability Tasks—Sustainability Indicators and Assessment Management section of the SDMBOK guides organizations to measure, monitor and control the performance of the organization's sustainability goals. Table 12 describes the inputs, tools and techniques, and outputs of the Corporate Sustainability Tasks—Indicators and Assessment Management tools.

Table 12 Corporate Sustainability Tasks—Indicators and Assessment Management: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Objectives • Corporate Sustainability Policy • Sustainability Operations Management Guidelines 	<ul style="list-style-type: none"> • Sustainability Indicators and Assessment Analysis 	<ul style="list-style-type: none"> • Sustainability Indicators and Assessment Management Guidelines

5.1.2.1. Corporate Sustainability Tasks—Indicators and Assessment

Management: Inputs

- Corporate Sustainability Objectives—the organizational sustainability goals and the main activities/projects for achieving them.
- Corporate Sustainability Policy—Corporate Sustainability Policy is the guideline to define the policy for each corporate sustainability goal, considering the impact of the policy from the sustainable development perspective.
- Sustainability Operations Management Guidelines—corporate sustainability work breakdown guideline.

5.1.2.2. Corporate Sustainability Tasks—Indicators and Assessment Management: Tools and Techniques

1. Sustainability Indicators and Assessment Analysis—Sustainability Indicators and Assessment Analysis assists an organization to identify the activity's performance to be managed, develop clear definitions of the objectives, and identify the way that activities will be measured. The clarity of the goal, the measurement unit, and the frequency allow the organization to communicate its objective and analyze the performance without misinterpretation. The sustainability assessment analysis also assists an organization to identify and document the essential requirements and expectations, and provides a reliable mechanism to measure, monitor, and control the sustainability indicators, determining the assessment methodology of the sustainability activities and their indicators of performance.
 - Some requirement information assists an organization to define the indicator and assessment method to manage the performance of any activity, such as:
 - Identify the sustainability target to be addressed.
 - Identify the related department.
 - Identify the related activity.
 - Identify the person responsible for managing the indicator.
 - Identify the indicator of measurement to determine the performance of the activity.
 - Describe the indicator.
 - Describe the aim of the indicator.
 - Identify the measurement unit
 - Identify the measurement frequency.
 - Identify the expected performance of the indicator.
 - Identify whether there is any regulation or standard for measuring the specific indicator.
 - Identify the calculation or method used to assess the performance—the assessment criteria.
 - Identify the format of how the performance will be reported.

**5.1.2.3. Corporate Sustainability Tasks—Indicators and Assessment
Management: Output**

Sustainability Indicators and Assessment Management Guidelines—corporate sustainability indicators and assessment methodology guideline

5.1.3. SMP: Sustainability Reporting Management

Sustainability Reporting Management assists an organization to report and disseminate performance information relating to its sustainability activities. The reporting stage allows the organization to register the sustainability performance of the organization for future analysis, giving feedback for future updates. It also reports the performance of the organization's activity, recognizing the actions to address any performance issues as well as updating the stakeholders regarding the sustainability activities of the organization. Table 13 describes the Corporate Sustainability Tasks—Reporting Management tools.

Table 13 Corporate Sustainability Tasks—Sustainability Reporting Management: Inputs, Tools and Techniques, and Outputs

Inputs	Tools and Techniques	Outputs
<ul style="list-style-type: none"> • Corporate Sustainability Objectives • Corporate Sustainability Policy • Sustainability Operations Management Guidelines • Sustainability Indicators and Assessment Management Guidelines 	<ul style="list-style-type: none"> • Sustainability Performance Disclosure Analysis 	<ul style="list-style-type: none"> • Sustainability Reporting Management Guidelines

**5.1.3.1. Corporate Sustainability Tasks—Sustainability Reporting
Management: Inputs**

- Corporate Sustainability Objectives—the organizational sustainability goals and the main activities/projects for achieving them.
- Corporate Sustainability Policy—Corporate Sustainability Policy is the guideline to define the policy for each corporate sustainability goal, considering the impact of the policy from the sustainable development perspective.

- Sustainability Operations Management Guidelines—corporate sustainability work breakdown guideline.
- Sustainability Indicators and Assessment Management Guidelines—corporate sustainability indicators and assessment methodology guidelines.

5.1.3.2. Corporate Sustainability Tasks—Sustainability Reporting Management: Tools and Techniques

- Sustainability Performance Disclosure Analysis—The sustainability performance disclosure analysis assists an organization to decide what to report and how to communicate the results. Once the indicators and assessment methodologies are identified, the next step is to define the results reporting format. The materiality, completeness, and responsiveness for a comprehensive report needs some essential information such as:
 - Identify the indicator of performance.
 - Describe the objective and assessment methodology of the indicator.
 - Describe and explain terminology used, measurement unit, and illustrations.
 - Describe the frequency, the person responsible for managing and the performance of the indicator.
 - Describe concerns and interests regarding the results.
 - Describe future actions to respond to others’ concerns and interests.

5.1.3.3. Corporate Sustainability Tasks—Sustainability Reporting Management: Output

- Sustainability Reporting Management Guidelines—corporate sustainability reporting guidelines

5.2. Summary of SMP

Figure 11 illustrates the SDMBOK Roadmap, identifying the connection of each feature of the framework and linking the output of one subset to the input of another one.

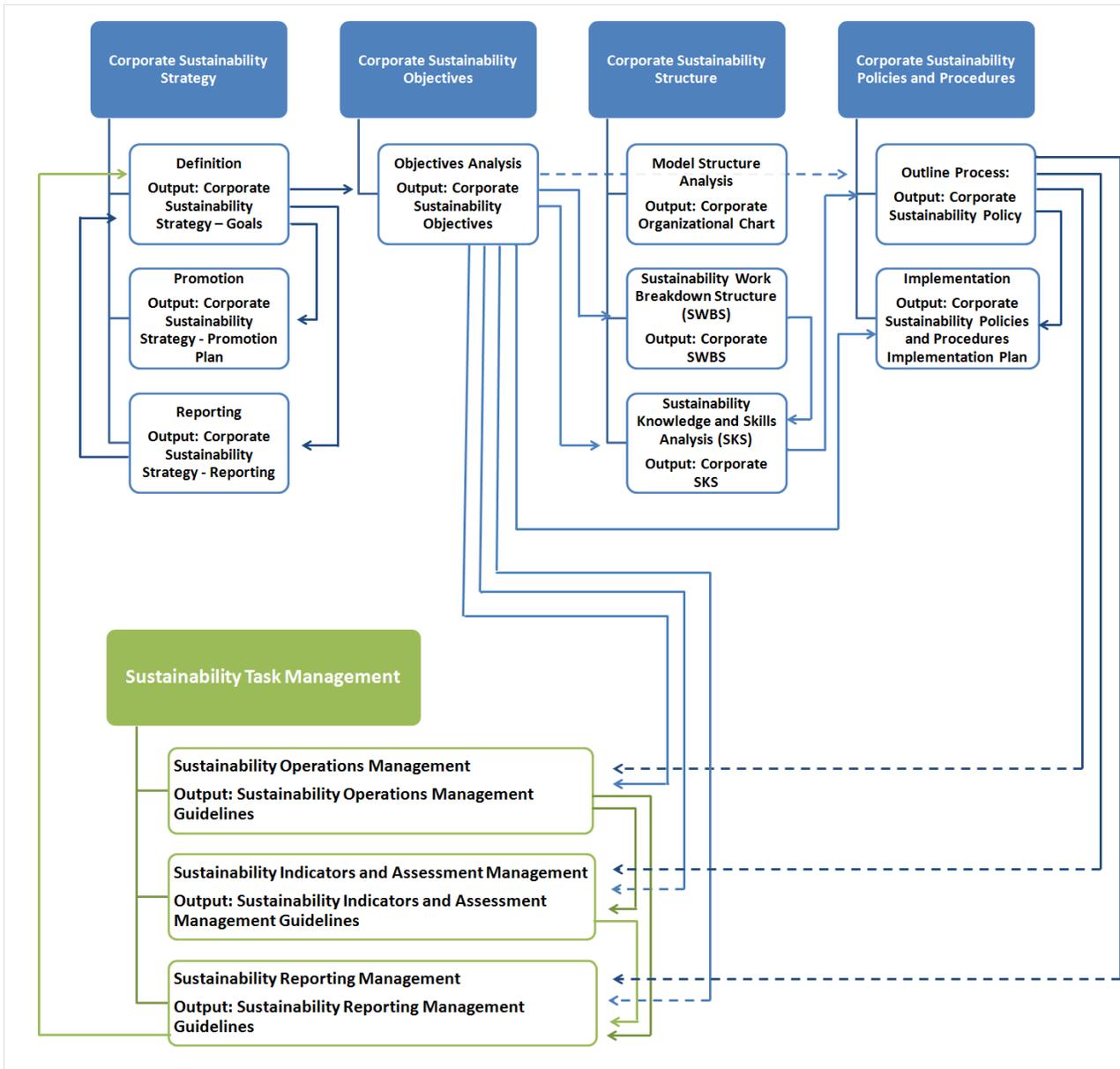


Figure 11 SDMBOK Roadmap (Output—Input)

Appendix D: The 100 Sustainable Development Indices (SDI)

This appendix contains documents that support the SDMBOK document.

D.1. Implemented Questionnaire

Table D-1 demonstrates the implemented questionnaire for the case studies of this research.

Table D-1. SDMBOK Case Studies - Implemented Questionnaire

PHASE 1 - Sustainability Organizational Practices - SOP - (FASE 1 - Práticas Organizacionais de Sustentabilidade)
<p>General Information (Informação geral)</p> <ul style="list-style-type: none"> • Organization (Empresa): Code (Case Study 1, 2, 3...) • Would you like to be identified in the final report (Thesis) in the acknowledgement part? (Você gostaria de ser identificado no relatório final (Tese) na parte de reconhecimento? () yes_sim () no_não) • The number of years in the construction market: (Número de anos no mercado de construção:) • The number of executed building projects: (Número de projetos de construção executados:) • The number of green building projects: (Número de projetos sustentáveis executados:) • When did the organization start to implement green activities? (Quando a organização começou a implementar atividades verdes?) • Which green building certification (s) does the organization focus on? (Qual (is) certificação (ões) sustentável a organização focaliza para executar seu projeto?) • Interviewee: (Entrevistado) • Position: (Cargo) • Years of experience in green building: (Anos de experiência em construção sustentável) • Do you have any green professional training or certification? (Você tem algum treinamento ou certificação sustentável?) () yes_sim () no_não • If yes, which one: (Se sim, qual(is)?) <p>The interview consists of statements that you will say if you have the practice or if you strongly agree, agree, do not have an opinion, disagree, or strongly disagree. Also, there are some specific questions which we appreciate if you are as detailed as possible (A entrevista consiste em declarações que você dirá se pratica ou se voce concorda plenamente, concorda, não tem uma opinião formada, discorda ou discorda plenamente. Além disso, há algumas perguntas específicas que agradecemos se você for o mais detalhado possível.)</p>
<p>Documents Request - Can you provide the following documents? (Solicitação de Documentos - Você pode fornecer os seguintes documentos?)</p> <ul style="list-style-type: none"> • Organizational Chart (Organograma da empresa) • Sustainability drivers and goals of the organization (definition, promotion and report) (Indicadores de sustentabilidade e objetivos da organização - definição, promoção e relatório) • Sustainability policies of the organization (both at the organizational level and the construction management level) (Políticas de sustentabilidade da organização tanto no nível organizacional quanto no de construção) • Sustainability report (Relatório de Sustentabilidade) • Sustainability Target list (Lista de alvos de sustentabilidade)
<p>Corporate Sustainability Strategy_Goals - Definition (Objetivos - definição)</p>

1. My organization has defined sustainability targets/ goals. (Minha organização tem metas de sustentabilidade definidas.) () yes_sim () no_não
2. To identify sustainability targets/ goals of the organization is very important for implementing sustainability practices. (Identificar as metas de sustentabilidade da organization é muito importante para a implementação de práticas de sustentabilidade.) () Strongly agree_Concordo plenamente () Agree_Concordo () Neutral_Neutro () Disagree_Discordo () Strongly Disagree_Discordo Plenamente
3. What does your organization consider to define the sustainability target/ goals? (O que sua organização considera para definir suas metas de sustentabilidade?)
4. Please describe how your organization define the sustainability target/ goals (who define the sustainability targets at the organizational and operational level?; does the organization follow any standard?). (Descreva como sua organização define as metas / metas de sustentabilidade: quem define as metas de sustentabilidade no nível organizacional e operacional ?; a organização segue algum padrão?.)
5. My organization has defined sustainability targets/ goals at the organizational level. (Minha organização tem metas de sustentabilidade definidas no nível organizacional.) () yes_sim () no_não
6. My organization has defined sustainability drivers/ goals at the operational level. (Minha organização tem metas de sustentabilidade definidas no nível operacional.) () yes_sim () no_não
7. Why does your organization define its sustainability target/ goals? Why is it important? (Por que sua organização define metas de sustentabilidade? Por que isso é importante?)
8. My organization follows a standard or guideline for defining the sustainability targets/goals. (Minha organização segue um padrão ou uma diretriz para definir as metas de sustentabilidade.) () yes_sim () no_não
9. Which standard or guideline does your organization follow to define the sustainability targets/ goals? (Qual padrão ou diretriz sua organização segue para definir as metas de sustentabilidade?)
10. My organization has the target market clearly defined (clients and type of projects). (Minha organização tem o mercado-alvo claramente definido (clientes e tipo de projetos). () yes_sim () no_não
11. My organization takes into consideration the sustainability values of our clients and community (stakeholders) for defining its sustainability goals. (Minha organização leva em consideração os valores de sustentabilidade de nossos clientes e comunidade (stakeholders) para definir nossas metas de sustentabilidade.) () yes_sim () no_não
12. Please describe how your organization identifies the sustainability values of your clients and community (stakeholders). (Por favor descreva como sua organização identifica os valores de sustentabilidade de seus clientes e comunidade (stakeholders).)
13. My organization identifies the impact of its activities according to the sustainability quartet bottom line (environment, economic, social and governances). (Minha organização identifica o impacto de suas atividades de acordo com a linha de fundo do quarteto de sustentabilidade (ambiental, econômica, social e regulamentação).)
14. Please describe how your organization identifies the impact of its activities. (Por favor, descreva como sua organização identifica o impacto de suas atividades.)
15. My organization identifies the External Regulations and Policies of the local market for defining its sustainability goals. (Minha organização identifica os Regulamentos e Políticas Externas do mercado local para definir nossas metas de sustentabilidade.) () yes_sim () no_não
16. Please describe how your organization implements External Regulations and Policies in its sustainability practices. (Por favor, descreva como sua organização implementa as Normas e Políticas Externas em suas práticas de sustentabilidade.)

17. My organization considers the UN-SDG (Sustainable Development Goals) for identifying its sustainability goals (Minha organização considera os objetivos da ONU-SDG (Sustainable Development Goals) para identificar nossos objetivos de sustentabilidade) (yes_sim (no_não
18. My organization defines an acceptable performance for each sustainability target. (Minha organização define uma meta de desempenho aceitável para cada meta de sustentabilidade.) (yes_sim (no_não
19. Please describe how your organization defines the performance for each sustainability target. (Por favor, descreva como sua organização define a meta de desempenho para cada meta de sustentabilidade.)

Corporate Sustainability Strategy_Goals - Promotion (Objetivos - Divulgação)

20. My organization has a strategic plan to promote its sustainability values to all departments/ employees. (Minha organização tem um plano estratégico para promover nossos valores de sustentabilidade para todos os departamentos / funcionários.) (yes_sim (no_não
21. To elaborate a strategic plan to promote the sustainability values and goals of the organization is very important for implementing sustainability practices. (Elaborar um plano de divulgação dos valores e objetivos sustentáveis da organization é muito importante para a implementação de práticas de sustentabilidade.) (Strongly agree_Concordo plenamente (Agree_Concordo (Neutral_Neutro (Disagree_Discordo (Strongly Disagree_Discordo Plenamente
22. What does your organization consider to define the strategic plan to promote the sustainability values and goals of the organization? (O que sua organização considera para definir o plano estratégico de implementação dos valores e objetivos sustentáveis da organização?)
23. Please describe how your organization implements its strategic plan to promote its sustainability values to all departments/ employees (who defines the communication tool?; what mechanism the organization use to promote it - internal policy, periodic training, etc.). (Descreva como sua organização implementa seu plano estratégico para promover seus valores de sustentabilidade a todos os departamentos / funcionários; quem define a ferramenta de comunicação ?; que mecanismo a organização usa para promovê-la - política interna, treinamento periódico, etc..)
24. Why does your organization elaborate a strategic plan to promote the sustainability values and goals of the organization? Why is it important? (Por que sua organização elabora um plano estratégico para divulgação dos valores e objetivos sustentáveis da organização? Por que isso é importante?)
25. My organization evaluates the different level of knowledge and skills of the recipients to define the promotion of its sustainability values. (Minha organização avalia os diferentes níveis de conhecimento e habilidades dos destinatários para definir a como divulgar nossos valores de sustentabilidade.) (yes_sim (no_não
26. Please describe how your organization implements the sustainability promotion to a different level of departments. (Por favor, descreva como sua organização implementa a promoção da sustentabilidade para os diferentes níveis/ departamentos.)

Corporate Sustainability Strategy_Goals - Reporting (Objetivos - Relatórios)

27. My organization reports the sustainability performance of its activities. (Minha organização relata o desempenho de sustentabilidade de nossas atividades.) (yes_sim (no_não
28. To report the sustainability performance of the organization is very important for the success of implementing sustainability practices. (Apresentar o desempenho de sustentabilidade da organização é muito importante para o sucesso da implementação de práticas de sustentabilidade.) (Strongly agree_Concordo plenamente (Agree_Concordo (Neutral_Neutro (Disagree_Discordo (Strongly Disagree_Discordo Plenamente

29. What does your organization consider to define the strategic plan to promote the sustainability values and goals of the organization? (O que sua organização considera para definir o plano estratégico de implementação dos valores e objetivos sustentáveis da organização?)
30. Please describe how your organization reports the sustainability performance of its activities (1. Who is responsible for reporting it?; 2. to whom the organization report it?; 3. what is the primary motivation - internal policy, certification requirement, law enforcement?; 4. does the organization use any standard?; 5. if yes which one?; 6. what information is published?; 7. what is the frequency of reporting it?) (Descreva como sua organização relata o desempenho de sustentabilidade de suas atividades (1. Quem é responsável por reportar? 2. a quem a organização apresenta os resultados?; 3. qual é a principal motivação - política interna, requisito de certificação, aplicação da lei? 4. a organização usa algum padrão ?; 5. se sim qual? 6. qual informação é divulgada?); 7. qual é a frequência para reportar?))
31. Why does your organization report sustainability performance? Why is it important? (Por que sua organização reporta seu desempenho sustentável? Por que isso é importante?)
32. My organization identifies the assessment methodology in its sustainability report. (Minha organização identifica a metodologia de avaliação usada em nosso relatório de sustentabilidade.) () yes_sim () no_não
33. How does your organization determine the assessment methodology of the sustainability indicators? Does it use any standard? If yes, which one? (Como sua organização escolhe a metodologia de avaliação dos seus indicadores de sustentabilidade? Voce utiliza algum padrão: Se sim, qual?)

Corporate Sustainability Objectives - Stakeholders' Identification (Identificação dos Stakeholders)

34. My organization identifies all its stakeholders and prioritize them. (Minha organização identifica todos os nossos stakeholders e os prioriza.) () yes_sim () no_não
35. To identify all the organization's stakeholders and prioritize them is very important for the success of implementing sustainability practices. (Identificar todos os stakeholders e priorizá-los é muito importante para o sucesso da implementação de práticas de sustentabilidade.) () Strongly agree_Concordo plenamente () Agree_Concordo () Neutral_Neutro () Disagree_Discordo () Strongly Disagree_Discordo Plenamente
36. What does your organization consider to identify all the organization's stakeholders and prioritize them? (For example, do you categorize, consider the market approach, Stakeholder Matrix...?) (O que sua organização considera para identificar seus stakeholders e priorizá-los?)
37. Please describe how your organization identify all its stakeholders and prioritize them (1. Who is responsible for it?; 2. does the organization use any standard or methodology?; 3. if yes which one?; 7. what is the frequency of reviewing it?) (Descreva como sua organização identifica seus stakeholders e priorizá-os (1. Quem é responsável por isso? 2. a organização usa algum padrão ou metodologia?; 3. se sim qual? 6. qual é a frequência para revisar?))
38. Why does your organization identify its stakeholders and prioritize them ? Why is it important? (Por que sua organização identifica e prioriza seus stakeholders? Por que isso é importante?)
39. My organization identifies the potential strategies and opportunities to approach the stakeholders and prioritize its targets. (Minha organização identifica as estratégias e oportunidades para abordar as partes interessadas e priorizar nossas metas.) () yes_sim () no_não
40. My organization takes into consideration the stakeholders' priorities to prioritize its sustainability targets. (Minha organização leva em consideração as prioridades das partes interessadas para priorizar nossas metas de sustentabilidade) () yes_sim () no_não

41. Please describe how the organization identifies and prioritize its stakeholders (e.g. Stakeholder Matrix?)
(Por favor, descreva como a organização identifica e prioriza suas partes interessadas (por exemplo, a matriz das partes interessadas?.)
-

Corporate Sustainability Objectives - Stakeholders Management Strategy (Abordagem dos Stakeholders)

42. My organization elaborate a strategic plan to approach its stakeholders. (Minha organização possui um plano estratégico para abordar os objetivos dos nossos stakeholders.) () yes_sim () no_não
43. To elaborate a strategic plan to approach its stakeholders is very important for the success of implementing sustainability practices. (Possuir um plano estratégico para abordar os objetivos dos nossos stakeholders é muito importante para o sucesso da implementação de práticas de sustentabilidade.) () Strongly agree_Concordo plenamente () Agree_Concordo () Neutral_Neutro () Disagree_Discordo () Strongly Disagree_Discordo Plenamente
44. What does your organization consider to elaborate a strategic plan to approach its stakeholders? (For example, a list of stakeholder's priorities) (O que sua organização considera para elaborar um plano estratégico para abordar os objetivos dos nossos stakeholders?)
45. Please describe how your organization elaborate a strategic plan to approach its stakeholders (1. Who is responsible for it?; 2. does the organization use any standard or methodology?; 3. if yes which one?; 7. what is the frequency of reviewing it?) (Descreva como sua organização elabora o plano estratégico para abordar os objetivos dos seus stakeholders (1. Quem é responsável por isso? 2. a organização usa algum padrão ou metodologia?; 3. se sim qual? 6. qual é a frequência para revisar?)
46. Why does your organization elaborate a strategic plan to approach its stakeholders? Why is it important? (Por que sua organização possui um plano estratégico para abordar os objetivos dos seus stakeholders? Por que isso é importante?)
-

Corporate Sustainability Objectives - Priorities (Metas - Objetivos)

47. My organization identifies a specific indicator for each sustainability target. (Minha organização identifica um indicador de desempenho para cada meta de sustentabilidade) () yes_sim () no_não
48. To identify the sustainability indicators is very important for implementing sustainability practices. (Identificar os indicadores de sustentabilidade é muito importante para implementar práticas de sustentabilidade.) () Strongly agree_Concordo plenamente () Agree_Concordo () Neutral_Neutro () Disagree_Discordo () Strongly Disagree_Discordo Plenamente
49. What does your organization consider to define the sustainability target/goals of the organization? (O que sua organização considera para definir as metas e objetivos sustentáveis da organização?)
50. Please describe how the organization identifies the sustainability target/goals of the organization (in which level is determined?; who determine?; with which frequency is reviewed?). (Por favor descreva como a organização identifica os indicadores para cada alvo - em que level é determinado?; quem determina?; com que frequência é revisado?)
51. Why does your organization identify the sustainability target/goals? Why is it important? (Por que sua organização determina as metas e objetivos sustentáveis da organização? Por que isso é importante?)
52. My organization prioritizes stakeholders and their objectives to determine its sustainability targets. (Minha organização prioriza stakeholders e seus objetivos para determinar as metas e objetivos sustentáveis da organização.) () yes_sim () no_não
53. Please describe how the organization prioritizes stakeholders and their objectives to determine its sustainability targets. (Descreva como a organização prioriza stakeholders e seus objetivos para determinar as metas e objetivos sustentáveis da organização.)
54. My organization defines the deadline to achieve each target. (Minha organização define um prazo para atingir cada meta) () yes_sim () no_não

55. Please describe how the organization identifies the deadline for each target. (Descreva como a organização identifica o prazo para atingir cada meta.)
56. My organization reviews the sustainability targets and deadline periodically. (Minha organização analisa as metas de sustentabilidade e seus prazos periodicamente.) () yes_sim () no_não
57. Please describe how the organization review the sustainability targets and deadline. (Descreva como a organização revisa as metas e objetivos sustentáveis e o prazo para atingir cada meta.)

Corporate Sustainability Structure - Knowledge and Skills Analysis (Equipe - Conhecimento e Análise de Competências)

58. My organization evaluates the required sustainability knowledge and skills to determine its organizational structure. (Minha organização analisa o conhecimento e habilidade sustentáveis necessários para determinar nossa estrutura organizacional - organograma.) () yes_sim () no_não
59. To evaluate the required sustainability knowledge and skills is very important for determining the organizational structure. (Analisar o conhecimento e habilidade sustentáveis necessários é muito importante para determinar a estrutura organizacional - organograma.) () Strongly agree_Concordo plenamente () Agree_Concordo () Neutral_Neutro () Disagree_Discordo () Strongly Disagree_Discordo Plenamente
60. What does your organization consider to define the required sustainability knowledge and skills of its employees? (O que sua organização considera para definir o conhecimento e habilidades sustentáveis dos seus colaboradores?)
61. Please describe how the organization identifies those required sustainability knowledge and skills (in which level is determined?; who determine?; with which frequency is reviewed? do you evaluate the organization's activities impacts?...). (Por favor descreva como a organização identifica o conhecimento e habilidades sustentáveis dos seus colaboradores? (em que level é analisado?; quem determina?; com que frequência é revisado? você analisa o impact das atividades se sua organização?...)
62. Please describe the required knowledge, training or certification your organization require for the employees at different levels. (Por favor, descreva o conhecimento necessário, treinamento ou certificação que sua organização exige dos seus funcionários em diferentes funções.)
63. Why does your organization identify the required sustainability knowledge and skills? Why is it important? (Por que sua organização determina o conhecimento e habilidades sustentáveis dos seus colaboradores? Por que isso é importante?)

Corporate Sustainability Structure - Sustainability Work Breakdown Structure (SWBS) (Equipe - Análise de funções)

64. My organization has a clear definition of the roles in the organization to manage sustainability activities. (Minha organização tem uma definição clara das funções na organização para gerenciar atividades de sustentabilidade) () yes_sim () no_não
65. To determine a clear definition of the roles in the organization to manage sustainability activities is very important for managing sustainability performance in the organization. (Determinar uma definição clara dos papéis na organização para gerenciar atividades de sustentabilidade é muito importante para gerenciar o desempenho de sustentabilidade na organização.) () Strongly agree_Concordo plenamente () Agree_Concordo () Neutral_Neutro () Disagree_Discordo () Strongly Disagree_Discordo Plenamente
66. What does your organization consider to define the roles in the organization to manage sustainability activities? (O que sua organização considera para definir os papéis na organização para gerenciar atividades de sustentabilidade?)

67. Please describe how the organization determine the sustainability roles in the organization (in which level is determined?; who determine?; with which frequency is reviewed? do you evaluate the organization's activities impacts?...). (Descreva como a organização determina as funções de sustentabilidade na organização (em que nível é determinado? Quem se identifica? Com que frequência é revisada? Você avalia os impactos das atividades da organização?...)
68. Why does your organization identify the sustainability roles in the organization? Why is it important? (Por que sua organização determina o conhecimento e habilidades sustentáveis dos seus colaboradores? Por que isso é importante?)

Corporate Sustainability Structure - Organization Sustainability Analysis Table (OSAT) (Equipe - Estrutura Organizacional - Organograma)

69. My organization has a clear organizational structure to manage sustainability activities. (Minha organização possui um organograma gerencial para controlar as atividades de sustentabilidade) (yes_sim (no_não
70. To have a clear organizational structure to manage sustainability activities is very important for managing sustainability performance in the organization. (Possuir um organograma gerencial para controlar atividades de sustentabilidade é muito importante para gerenciar o desempenho de sustentabilidade na organização.) (Strongly agree_Concordo plenamente (Agree_Concordo (Neutral_Neutro (Disagree_Discordo (Strongly Disagree_Discordo Plenamente
71. What did your organization consider to determine its organizational structure? (O que sua organização considera para definir os papéis na organização para gerenciar atividades de sustentabilidade?)
72. Please describe the organizational structure of your organization to manage sustainability practices. (Por favor, descreva a estrutura organizacional de sua organização para gerenciar práticas de sustentabilidade.)
73. Any additional information? (Alguma informação adicional?)

Corporate Sustainability Policies and Procedures - Definition (Padrões Internos - definição)

74. My organization has a sustainability policy for its activities. (Minha organização tem um padrão de sustentabilidade para nossas atividades.) (yes_sim (no_não
75. To define internal sustainability policy is very important for implementing sustainability practices. (Definir a padrão interno de sustentabilidade é muito importante para implementar práticas de sustentabilidade.) (Strongly agree_Concordo plenamente (Agree_Concordo (Neutral_Neutro (Disagree_Discordo (Strongly Disagree_Discordo Plenamente
76. What does your organization consider to define the internal sustainability policies of the organization? (O que sua organização considera para as políticas internas de sustentabilidade?)
77. Please describe how the organization defines its sustainability policies (who defines the policies?; Does each department have a sustainability policy?; does the organization follow any standard?). (Descreva como a organização define seus padrões de sustentabilidade (quem define as políticas? Cada departamento possui uma política de sustentabilidade ?; a organização segue algum padrão?)
78. Why does it important to implement internal sustainability policies into the organization? (Por que é importante implementar padrões interno de sustentabilidade na organização?)
79. My organization identifies significant conflicts across economic, environmental and social dimensions warranting sustainability impact assessment. (Minha organização identifica conflitos significativos nas dimensões econômica, ambiental e social que garantem a avaliação do impacto da sustentabilidade.) (yes_sim (no_não
80. My organization involves all stakeholders to define the sustainability policies. (Minha organização envolve todas as partes interessadas para definir os padrões de sustentabilidade.) (yes_sim (no_não

81. If yes, how do you involve the stakeholders? (Se sim, como você envolve os stakeholders?)
82. My organization evaluates potential economic, environmental and social impacts of the policy. (Minha organização avalia potenciais impactos econômicos, ambientais e sociais padrão estabelecido.) () yes_sim () no_não
83. If yes, how do you evaluate the impacts? (Se sim, como você analisa os impactos?)
84. My organization considers "Expected Behaviors and Responsibilities" in its policies. (Minha organização considera "Comportamentos esperados e responsabilidades" em nossos padrões estabelecidos.)
85. If yes, which "Expected Behaviors and Responsibilities" do you consider? (Se sim, como você analisa os impactos and como mitigá-los?)

Corporate Sustainability Policies and Procedures - Promotion (Padrões Internos - divulgação)

86. My organization promotes its sustainability policies at all levels of the organization. (Minha organização promove nossas políticas de sustentabilidade em todos os níveis da organização.) () yes_sim () no_não
87. To promote the sustainability policies of the organization is very important for implementing sustainability practices. (Promover as políticas de sustentabilidade da organização é muito importante para a implementação de práticas de sustentabilidade.) () Strongly agree_Concordo plenamente () Agree_Concordo () Neutral_Neutro () Disagree_Discordo () Strongly Disagree_Discordo Plenamente
88. What does your organization consider to determine the way the sustainability policies will be promoting into the organization departments? (O que sua organização considera para definir o meio de promover suas políticas sustentáveis?)
89. Please describe how the organization promotes its sustainability policies (communication mechanism such as online training). (Descreva como a organização promove suas políticas de sustentabilidade (mecanismo de comunicação, como por exemplo treinamento on-line).)
90. Why does it important to promote internal sustainability policies in the organization? (Por que é importante divulgar padrões interno de sustentabilidade na organização?)

Corporate Sustainability Policies and Procedures - Validation (Padrões Internos - Validação)

91. My organization determines the assessment method of checking the knowledge of each stakeholder about the policy (survey, test, suggestion box, etc.). (Minha organização determina o método de avaliação para verificar o conhecimento de cada parte interessada sobre o padrão interno estabelecido (pesquisa, teste, caixa de sugestões, etc.).) () yes_sim () no_não
92. To check the policy implementation is very important for implementing sustainability practices. (Verificar a implementação do padrão interno estabelecido é muito importante para implementar práticas de sustentabilidade.) () Strongly agree_Concordo plenamente () Agree_Concordo () Neutral_Neutro () Disagree_Discordo () Strongly Disagree_Discordo Plenamente
93. What does your organization consider to determine the way the sustainability policies will be validate? (O que sua organização considera para definir o meio de validar a implementação suas políticas sustentáveis?)
94. Please describe how the organization evaluates the policy implementation. (Por favor, descreva como a organização avalia a implementação do padrão interno estabelecido.)
95. Why does it important to validate the implementation of the internal sustainability policies in the organization? (Por que é importante validar a implementação dos padrões internos de sustentabilidade na organização?)

D.2. The SDMBOK - Meta-Analysis Table

The meta-analysis table demonstrates the data analysed to build the taxonomy of the SDMBOK considering the literature review and the case studies for the SOP level. The table presents an enormous amount of information and can be found in the following link:

https://drive.google.com/file/d/1mFxQqouNT59lTlalJG8RAnr6_ynDRPiT/view?usp=sharing

D.3. The SDMBOK Validation Reports

The validator reports are as follow:

1. B.19 SDMBOK Validation Reports _ Specialist 1
2. B.19 SDMBOK Validation Reports _ Specialist 2
3. B.19 SDMBOK Validation Reports _ Specialist 3
4. B.19 SDMBOK Validation Reports _ Specialist 4
5. B.19 SDMBOK Validation Reports _ Specialist 5
6. B.19 SDMBOK Validation Reports _ Specialist 6

1. B.19 SDMBOK Validation Reports _ Specialist 1

This report aims to consider your acceptance of the proposed framework (SDM-BoK) regarding three variables: perception of efficiency and effectiveness, the adoption of the framework - if the framework is practical, and your acceptance in using it.

If you do not want to be identified, please enter only your expertise area/field.

1. Specialist Name (or expertise area/field)

Specialist 1

2. Bio

Specialist 1 MAsc, P.Eng.

Specialist 1 is the President of *Green Sky Sustainability Consulting Inc.* (www.greensky.ca). He has advised corporations and governments on strategies for improving their sustainability related to environment, health, and safety performance. He directed Climate Change Sustainability teams at two leading consulting firms since 2004 before establishing his own firm, Green Sky Sustainability, in 2015. He has 30+ years of professional auditing and risk assessment experience in a variety of industrial sectors across the globe. For the last 14 years, Nelson has focused on providing climate action services, primarily in GHG mitigation as a GHG verifier. Since 2016, he has turned his attention to applying his ISO 14001 emergency preparedness and response assessment experience towards developing climate risk assessment approaches suited to small and medium-sized enterprises (SMEs). These approaches can also be used as screening-level risk assessments for larger and/or more complex risk assessments. One of his approaches forms part of the soon to be published ISO 14091 – Climate change adaptation – Guidelines on vulnerability, impacts and risk assessments.

Specialist 1 is a member of the CSA Technical Committee (TC 207) on the Environment which is also a harmonized mirror committee that represents Canada's interest in the development of international standards through the ISO Technical Committee 207 / Subcommittee 7 on GHG Management and Related Activities. The committee also develops new standards and adopts existing international standards at the Canadian national level. Particularly, he is a working group expert on the following standards: ISO 14064 – related to climate change mitigation – published 2019; ISO 14091 – related to climate change risk assessment and ISO 14097 – related to disclosure and risk assessments by financiers.

Specialist 1 has a B.Sc. in Chemical Engineering from the University of Alberta, and a MAsc in Environmental Engineering from the University of British Columbia. He has 12 years of experience with climate change markets in BC, Alberta, Saskatchewan, Ontario and California. He has been a member of EGBC and APEGA since 1982 and now APEGS. He was Chair of the Sustainability Committee and is an Executive Member of the Energy Efficiency and Renewable Energy Division and Environmental Professionals Division of Engineers and Geoscientists BC.

3. Validation Questions

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the SDMBoK to the construction industry?

The value lies with higher levels of construction management (or any management for that matter) such as universities or large construction groups with specialist knowledge and skills to understand and implement the SDMBoK. Those involved in the planning and design of many large, complex projects might benefit. Also, the construction industry is diverse – buildings (office, residential, commercial/institutional). Assuming that highways, bridges and overpasses, power projects, factories, mines are not included specifically here. I think the smaller, less sophisticated forms might shy away, having other priorities.

Note 1: Projects and many organizations share the same characteristics described for construction management.

Note 2: I find it hard to imagine that most contractors, subcontractors, consultants and trades and professionals (often smaller entities) would or could apply this – unless forced to do so.

Note 3: section 3 suggest it is for organizations – which I agree. Similarly in section 4

Q.2 - Do you believe the SDMBoK is consistent and address the main issues of sustainability management in the construction industry?

Thinking of buildings, typically sustainability issues are broad and diverse, including energy efficiency, low carbon emissions, low embodied carbon, local materials, using sustainable materials, resilience, etc. The SDMBoK is higher level than these and does not get into the

specifics. I wonder if construction is omitted in the scope, would this be a better description of the SDMBoK? (see comments above).

Perceived Ease of Use

Q.3 - Did you find the procedure of the SDMBoK easy to follow?

Once I got through a few sections I could see a pattern that was followed, then I found it easier to understand. I have the sense of layers of detail and I can imagine an html version going from ToC to the full detail in 3-5 layers being helpful.

Having the SDMBoK Figure 1 before me was helpful. Your repeating of Figure 2 was helpful. Second reading helps. Of course, this is not something to memorize, but something to have as a reference, almost a recipe guide.

Q. 4 - Did you find it would be easy to apply the SDMBoK in an organization?-

It is logically laid-out and has a structure that is consistent and can be learned and applied in an organization. When thinking of EnVision or other frameworks, I would say the SDMBoK is no more difficult to apply.

Q. 5 - Did you find the SDMBoK easy to learn/understand?

I would say a reasonable level of effort is required.

Q. 6 - Did you find the information/instructions of the SDMBoK clear and easy to understand?

The language is clear and concise which is helpful. On occasion I might have desired more information or an example to illustrate what was described, but this is better than the alternative of having twice the amount of text to wade through.

Q. 7 - Overall, did you find the SDMBoK easy to use?

I did not have an occasion to use it.

Perceived Usefulness

Q.8 - Do you believe that the SDMBoK would reduce the effort required to understand and implement sustainable development management in the construction industry?

Reduce the effort in the sense of helping to understand what is needed in one place. I see the construction industry as having levels of sophistication. At the highest levels SDMBoK might be useful to reduce the level of effort, however for smaller and/or less sophisticated firms, I think they might be better served with some examples or case studies they can try to copy. I do not see how SDMBoK is particularly focused on the construction industry.

Q.9 - Do you believe that using the SDMBoK would make it easier for users to implement sustainable development in the construction industry?

There are many ways to implement sustainable management practices. SDMBoK is one useful means. I am not sure making it easier is one measure. Making it more effective, more efficient, perhaps.

Q.10 - Do you believe the SDMBoK would make it easier for the construction industry to identify and manage sustainable development activities?

SDMBoK is one useful means – not sure it makes things easier – see my comments in Q9.

Q.11 - Do you believe that using the SDMBoK would make it easier to maintain sustainable development practices in the construction industry?

SDMBoK is one useful means. Might be more useful in maintaining than identifying.

Q.12 - Overall, do you believe that the SDMBoK provides an effective solution to sustainable development management in the construction industry?

SDMBoK is one useful means. See comments above Q9 to 11.

Q.13 - Overall, do you believe the SDMBoK is an improvement to the sustainable development management practices in the construction industry?

SDMBoK is helpful and that is always an improvement. Again, I do not see this as particularly focused on construction management.

Q.14 - Do you believe that using the SDMBoK would make it easier to communicate the sustainability performance of an organization?

SDMBoK would level the playing field if everyone followed it. It organizes information and approaches that would then make it easier to communicate.

Q. 15 - Overall, did you find the SDMBoK to be useful?

SDMBoK is useful.

Intention to Use

Q.16 - Would you use the SDMBoK to manage sustainable development in a construction organization?

In a large, sophisticated organization that wanted to demonstrate a systematic approach and communicate performance, then yes SDMBoK would be a tool I would consider as a consultant. It would be for a large scale project.

Q.17 - Would you intend to use the SDMBoK in preference to the standards the current sustainability management literature offers?

Not sure. I follow a number of ISO standards. They lack the detail of SDMBoK, but they are familiar to me and perhaps to some parts of industry.

4. Additional Comments

Q.(Extra) - If necessary, please add a comment or your overall analysis of the SDMBoK.

I see SDMBoK applying to a broader industry group than just construction management.

I think those who specifically work in the construction management subset might be able to give you a more focused assessment. I work at a broader level where I see SDMBoK as being applicable. If you have the time, I would be willing to reach out to people I know who focus on building construction sustainability management.

2020-09-07

Specialist 1 signature

2. B.19 SDMBOK Validation Reports _ Specialist 2

**A FRAMEWORK FOR SUSTAINABLE DEVELOPMENT MANAGEMENT
IN THE CONSTRUCTION INDUSTRY**

**Suzana Espindola, Ph.D. Candidate at UBC Civil Engineering - Project
and Construction Management**

September 14, 2020

A.3 SDM-BoK Validation Report

This report aims to consider your acceptance of the proposed framework (SDM-BoK) regarding three variables: perception of efficiency and effectiveness, the adoption of the framework - if the framework is practical, and your acceptance in using it.

If you do not want to be identified, please enter only your expertise area/field.

1. Specialist Name (or expertise area/field)

Specialist 2

, Chartered Professional Accountant – Chartered Accountant – Chief Financial Officer - Cold Water Ranch (2011) Ltd. , Director: Sema'th Xo' Tsa Developments Ltd. and Kilgard Business Park Ltd. and Kilgard Business Park Limited Partnership. Economic Development and Real Estate Development including Construction

2. Bio Please see page 2 to 3.

CAREER HIGHLIGHTS

CHIEF FINANCIAL OFFICER
Cold Water Ranch (2011) Ltd.

February 2019 – Present

We are currently in negotiations with the Ministry of Indigenous Relations and Reconciliation to have an 80 acre site designated, pursuant to the provisions of the Heritage Conservation Act.

VICE PRESIDENT FINANCE AND MARKETING
2019

February 2018 - February

FSH Design Inc. (Vancouver, B.C.)

FSH Design Inc. is a full-service agency focused on branding, web design and digital marketing and I, along with others, facilitated the launch and marketing of a human resource portal with video functionality.

CHIEF FINANCIAL OFFICER

January 2013 – January 2018

Corpus Management Group (Abbotsford, B.C.)

Corpus Management Group manages the operation of thirty plus companies and subsidiaries in the agricultural, aggregates and property development sector. I successfully managed major restructuring of aggregate business and real estate development with First Nations.

FINANCIAL CONSULTANT (Vancouver, B.C.)
2012

August 2012 – December

CHIEF FINANCIAL OFFICER

September 2007 – July 2012

Treegroup Developments Corp. (Vancouver, B.C.)

Treegroup is a development and construction company which owns over 700 developable acres in the GVRD with over 40 commercial and housing projects completed or underway:

- Led financial, taxation and compliance matters for over 100 Treegroup entities including complex corporate restructuring
- Directly involved in the \$55 million Ponderosa Project including prospectus

GREER SHIPPING LTD. (Vancouver, B.C.)

1996 - 2007

This company has trust and corporate expenditures of approximately \$120 million and is the agent for numerous shipping firms. It was established in 1920 and is ISO 9001 2000 certified.

- Developed and implemented a robust and complex financial reporting system
- Negotiated a major reorganization resulting in \$500 thousand savings to the company

PARTNER

KPMG PEAT MARWICK THORNE

1984 – 1992

This partnership is the Canadian member firm of KPMG International, the coordinating entity for a global network of professional services firms, providing audit, tax, and advisory services.

Ottawa, Ontario

(1990 - 1992)

Developed and delivered KPMG contribution audit services to the federal public sector.

Toronto, Ontario

National Director, Public Sector Services - Provincial

(1986 - 1990)

- Skillfully marketed the firm's professional services to the Province of Ontario as well as to Provincial Governments across Canada, resulting in \$5.4 million of fees in two years.

New Westminster, B.C.

(1984 - 1986)

- Delivered professional services to medium sized and public corporations

ARTICLING STUDENT AND MANAGER (Vancouver, B.C.)

1969 –1984

EDUCATION AND PROFESSIONAL DEVELOPMENT AND OTHER INVOLVEMENTS

- Admitted to the Institute of Chartered Accountants of British Columbia in 1978
- University of British Columbia – Faculty of Commerce
- Significant national public policy experience with over 30 years as a former Director of the Federal Liberal Agency of Canada, Chief Agent of the Liberal Party of Canada
- Presently a mentor to a Ph.D. Candidate at UBC - Project & Construction Management relating to Sustainable Development Management in the Construction Industry
- Presently Director of Sumas First Nation Economic Development Corporation

3. Validation Questions

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the SDM-BoK to the construction industry?

Yes.

Q.2 - Do you believe the SDM-BoK is consistent and address the main issues of sustainability management in the construction industry?

Yes

Perceived Ease of Use

Q.3 - Did you find the procedure of the SDM-BoK easy to follow?

Yes.

Q. 4 - Did you find it would be easy to apply the SDM-BoK in an organization?-

Yes

Q. 5 - Did you find the SDM-BoK easy to learn/understand?

Yes

Q. 6 - Did you find the information/instructions of the SDM-BoK clear and easy to understand?

Yes

Q. 7 - Overall, did you find the SDM-BoK easy to use?

Yes

Perceived Usefulness

Q.8 - Do you believe that the SDM-BoK would reduce the effort required to understand and implement sustainable development management in the construction industry?

Yes, the SDM-BoK framework detailed herein provides a efficient and effective methodology to assist any organization to implement it through a body of knowledge approaching both the strategic and tactical levels

Q.9 - Do you believe that using the SDM-BoK would make it easier for users to implement sustainable development in the construction industry?

Yes.

Q.10 - Do you believe the SDM-BoK would make it easier for the construction industry to identify and manage sustainable development activities?

Yes

Q.11 - Do you believe that using the SDM-BoK would make it easier to maintain sustainable development practices in the construction industry?

Yes

Q.12 - Overall, do you believe that the SDM-BoK provides an effective solution to sustainable development management in the construction industry?

Yes

Q.13 - Overall, do you believe the SDM-BoK is an improvement to the sustainable development management practices in the construction industry?

Yes, I have reviewed in detail the current documentation in the Construction Extension to the PMBOK Guide and the Project Management Body of Knowledge – 6th Edition. I believe the SDM BoK is a significant improvement over existing Bok guides due to their efficient and effective methodology that assists an organization to implement this framework through a body of knowledge approaching both the strategic and tactical levels.

Q.14 - Do you believe that using the SDMBoK would make it easier to communicate the sustainability performance of an organization?

Yes. It clearly articulates and links objectives to outcomes. In particular, I noted that Figure 11 SDM – BoK Roadmap (Output-Input) provides clarity in detailing the connection of each feature of the framework and links the output of one subset to the input of another one. Excellent!

Q. 15 - Overall, did you find the SDMBoK to be useful?

Extremely.

Intention to Use

Q.16 - Would you use the SDM-BoK to manage sustainable development in a construction organization?

Yes, we are currently in the feasibility phase of a \$300 million data centre and greenhouse in Abbotsford, B.C. We will be selecting the construction organization in the next year to complete this significant project. We have already discussed that one of the key criteria we will use to evaluate the bidders is the framework they have in place at both the strategic and tactical levels to achieve their sustainable development goals.

Q.17 – Would you intend to use the SDMBoK in preference to the standards the current sustainability management literature offers?

Yes, as noted above, I believe SDM BoK is a significant improvement in terms of efficiency and effectiveness as compared to the Construction Extension to the PMBOK Guide and the Project Management Body of Knowledge – 6th Edition.

4. Additional Comments

Q.(Extra) - If necessary, please add a comment or your overall analysis of the SDMBoK.
In summary, in light of the serious issues arising from climate change and the critical need for the construction industry to contribute to the UN Sustainable Development Goals, we are facing an existential issue. I am of the view that SDM-BoK is a very significant, positive and practical contribution to achieve sustainable development goals in Canada and worldwide.

Specialist 2 Signature



3. B.19 SDMBOK Validation Reports _ Specialist 3

B.3 SDM-BoK Validation Report

This report aims to consider your acceptance of the proposed framework (SDM-BoK) regarding three variables: perception of efficiency and effectiveness, the adoption of the framework - if the framework is practical, and your acceptance in using it.

If you do not want to be identified, please enter only your expertise area/field.

1. **Quality management (expertise area/field)**

Quality management/ Operations Management

2. **Bio**

[Click here to enter text.](#)

3. **Validation Questions**

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the SDMBoK to the construction industry?

Yes.

Q.2 - Do you believe the SDMBoK is consistent and address the main issues of sustainability management in the construction industry?

Yes.

Perceived Ease of Use

Q.3 - Did you find the procedure of the SDMBoK easy to follow?

Yes.

Q.4 - Did you find it would be easy to apply the SDMBoK in an organization?-

Yes. But also it will depend on whether the organization has a real and strong interest in sustainability.

Q. 5 - Did you find the SDMBoK easy to learn/understand?

Yes.

Q. 6 - Did you find the information/instructions of the SDMBoK clear and easy to understand?

Yes.

Q. 7 - Overall, did you find the SDMBoK easy to use?

Yes.

Perceived Usefulness

Q.8 - Do you believe that the SDMBoK would reduce the effort required to understand and implement sustainable development management in the construction industry?

Yes.

Q.9 - Do you believe that using the SDMBoK would make it easier for users to implement sustainable development in the construction industry?

Yes.

Q.10 - Do you believe the SDMBoK would make it easier for the construction industry to identify and manage sustainable development activities?

Yes.

Q.11 - Do you believe that using the SDMBoK would make it easier to maintain sustainable development practices in the construction industry?

Yes.

Q.12 - Overall, do you believe that the SDMBoK provides an effective solution to sustainable development management in the construction industry?

Yes. The SDMBoK is a solution.

Q.13 - Overall, do you believe the SDMBoK is an improvement to the sustainable development management practices in the construction industry?

Yes.

Q.14 - Do you believe that using the SDMBoK would make it easier to communicate the sustainability performance of an organization?

Yes.

Q. 15 - Overall, did you find the SDMBoK to be useful?

Yes.

Intention to Use

Q.16 - Would you use the SDMBoK to manage sustainable development in a construction organization?

Unfortunately not, because I don't work for a construction company.

Q.17 - Would you intend to use the SDMBoK in preference to the standards the current sustainability management literature offers?

Unfortunately not, because I don't work for a construction company.

4. Additional Comments

Q.(Extra) - If necessary, please add a comment or your overall analysis of the SDMBoK.

[Click here to enter text.](#)

[Click here to enter a date.](#)

I prefer to keep anonymous.

4. B.19 SDMBOK Validation Reports _ Specialist 4

B.3 SDM-BoK Validation Report

This report aims to consider your acceptance of the proposed framework (SDM-BoK) regarding three variables: perception of efficiency and effectiveness, the adoption of the framework - if the framework is practical, and your acceptance in using it.

If you do not want to be identified, please enter only your expertise area/field.

1. **Specialist Name (or expertise area/field)**

Specialist 4

2. **Bio**

Assistant Professor in the Management Engineering Department at Federal University of Pernambuco (UFPE). Research interest - Includes topics such as: Operational Research, MCDM/A (Multicriteria Decision Making and Aid), Risk, Reliability, Maintenance and Safety.

3. **Validation Questions**

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the SDMBoK to the construction industry?

Yes

Q.2 - Do you believe the SDMBoK is consistent and address the main issues of sustainability management in the construction industry?

Yes

Perceived Ease of Use

Q.3 - Did you find the procedure of the SDMBoK easy to follow?

Yes

Q. 4 - Did you find it would be easy to apply the SDMBoK in an organization?-

Not easy, but possible.

Q. 5 - Did you find the SDMBoK easy to learn/understand?

Yes, if people have a basic knowledge of sustainability.

Q. 6 - Did you find the information/instructions of the SDMBoK clear and easy to understand?

Yes, if people have a basic knowledge of sustainability.

Q. 7 - Overall, did you find the SDMBoK easy to use?

Yes, if people have a basic knowledge of sustainability.

Perceived Usefulness

Q.8 - Do you believe that the SDMBoK would reduce the effort required to understand and implement sustainable development management in the construction industry?

Yes

Q.9 - Do you believe that using the SDMBoK would make it easier for users to implement sustainable development in the construction industry?

Yes

Q.10 - Do you believe the SDMBoK would make it easier for the construction industry to identify and manage sustainable development activities?

Yes, if people present at least an essential sustainability background

Q.11 - Do you believe that using the SDMBoK would make it easier to maintain sustainable development practices in the construction industry?

Yes, if people present at least an essential sustainability background

Q.12 - Overall, do you believe that the SDMBoK provides an effective solution to sustainable development management in the construction industry?

In my opinion, SDMBoK does not provide an effective solution but a structured process to better sustainable development management

Q.13 - Overall, do you believe the SDMBoK is an improvement to the sustainable development management practices in the construction industry?

Yes

Q.14 - Do you believe that using the SDMBoK would make it easier to communicate the sustainability performance of an organization?

Yes

Q. 15 - Overall, did you find the SDMBoK to be useful?

Yes

Intention to Use

Q.16 - Would you use the SDMBoK to manage sustainable development in a construction organization?

Yes

Q.17 - Would you intend to use the SDMBoK in preference to the standards the current sustainability management literature offers?

4. If I were a civil construction manager, I would use the SDMBok and other standards and documents to better sustainability management.

5. **Additional Comments**

Q.(Extra) - If necessary, please add a comment or your overall analysis of the SDMBoK.

[Click here to enter text.](#)

2020-09-29

Specialist 4 signature

5. B.19 SDMBOK Validation Reports _ Specialist 5

B.3 SDM-BoK Validation Report

This report aims to consider your acceptance of the proposed framework (SDM-BoK) regarding three variables: perception of efficiency and effectiveness, the adoption of the framework - if the framework is practical, and your acceptance in using it.

If you do not want to be identified, please enter only your expertise area/field.

1. Specialist Name (or expertise area/field)

Specialist 5

2. Bio

Specialist 5

is an Associate professor of Universidade Federal de Pernambuco, Brazil, at the Management Engineering Department. She holds a Ph.D. in Management Engineering and graduation in Civil Engineering. Her works focus on Project management, mainly in the procurement and sustainability fields. She is a vice-coordinator of PMD – Project Management and Development Research Group.

3. Validation Questions

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the SDMBok to the construction industry?

Yes

Q.2 - Do you believe the SDMBok is consistent and address the main issues of sustainability management in the construction industry?

Yes

Perceived Ease of Use

Q.3 - Did you find the procedure of the SDMBok easy to follow?

1

It is easy to understand, but not necessarily easy to apply in the organizations.

Q. 4 - Did you find it would be easy to apply the SDMBoK in an organization?-

As it is a "Bok," it gives what is required (inputs), the tools and techniques, and the outputs.

Nevertheless, the manager needs to know how to use the tools and which ones are necessary for the target purpose, besides getting all the required information. Then, I did not find it easy to apply, but it is applicable and can get good results.

Q. 5 - Did you find the SDMBoK easy to learn/understand?

Yes, it is easy to learn and understand.

Q. 6 - Did you find the information/instructions of the SDMBoK clear and easy to understand?

Yes

Q. 7 - Overall, did you find the SDMBoK easy to use?

As I already stated, It is easy to understand, but not necessarily easy to apply in the organizations. It depends on several factors.

Perceived Usefulness

Q.8 - Do you believe that the SDMBoK would reduce the effort required to understand and implement sustainable development management in the construction industry?

Yes, as it provides and describes the processes, it facilitates the understanding and implementing. Nevertheless, other tools and techniques are available and can be used during the implementation of sustainability, depending on the required purpose and stage of the project life cycle. As it was not pointed out that "other tools" can also be used, it seems the suggested is(/are) the only that can be used.

Q.9 - Do you believe that using the SDMBoK would make it easier for users to implement sustainable development in the construction industry?

Yes

Q.10 - Do you believe the SDMBoK would make it easier for the construction industry to identify and manage sustainable development activities?

Yes, it gives the directions in a general way, not necessarily to make easier.

Q.11 - Do you believe that using the SDMBoK would make it easier to maintain sustainable development practices in the construction industry?

It depends on how each organization structure their processes and defines their indicators.

Q.12 - Overall, do you believe that the SDMBoK provides an effective solution to sustainable development management in the construction industry?

I have no evidence to state that it provides an effective solution to sustainable development management in the construction industry.

Q.13 - Overall, do you believe the SDMBoK is an improvement to the sustainable development management practices in the construction industry?

Yes, it is.

Q.14 - Do you believe that using the SDMBoK would make it easier to communicate the sustainability performance of an organization?

No, I don't.

Q. 15 - Overall, did you find the SDMBoK to be useful?

Yes, I find it useful.

Intention to Use

Q.16 - Would you use the SDMBoK to manage sustainable development in a construction organization?

Yes

Q.17 - Would you intend to use the SDMBoK in preference to the standards the current sustainability management literature offers?

Yes, together with complementary material.

4. **Additional Comments**

Q.(Extra) - If necessary, please add a comment or your overall analysis of the SDMBoK.

[Click here to enter text.](#)

2020-09-30

/s/

Specialist 5 signature

6. B.19 SDMBOK Validation Reports _ Specialist 6

This report aims to consider your acceptance of the proposed framework (SDM-BoK) regarding three variables: perception of efficiency and effectiveness, the adoption of the framework - if the framework is practical, and your acceptance in using it.

If you do not want to be identified, please enter only your expertise area/field.

5. Specialist Name (or expertise area/field) Project Management and Operations Research

Specialist 6

6. Bio

Assistant Professor in Engineering Management

7. **Validation Questions**

Perception of the Documentation Efficiency

Q.1 - Do you perceive value in the SDMBoK to the construction industry?

YES

Q.2 - Do you believe the SDMBoK is consistent and address the main issues of sustainability management in the construction industry?

YES

Perceived Ease of Use

Q.3 - Did you find the procedure of the SDMBoK easy to follow?

YES

Q. 4 - Did you find it would be easy to apply the SDMBoK in an organization?-

YES

Q. 5 - Did you find the SDMBoK easy to learn/understand?

YES

Q. 6 - Did you find the information/instructions of the SDMBoK clear and easy to understand?

YES

Q. 7 - Overall, did you find the SDMBoK easy to use?

YES

Perceived Usefulness

Q.8 - Do you believe that the SDMBoK would reduce the effort required to understand and implement sustainable development management in the construction industry?

YES

Q.9 - Do you believe that using the SDMBoK would make it easier for users to implement sustainable development in the construction industry?

YES

Q.10 - Do you believe the SDMBoK would make it easier for the construction industry to identify and manage sustainable development activities?

YES

Q.11 - Do you believe that using the SDMBoK would make it easier to maintain sustainable development practices in the construction industry?

YES

Q.12 - Overall, do you believe that the SDMBoK provides an effective solution to sustainable development management in the construction industry?

YES

Q.13 - Overall, do you believe the SDMBoK is an improvement to the sustainable development management practices in the construction industry?

YES

Q.14 - Do you believe that using the SDMBoK would make it easier to communicate the sustainability performance of an organization?

YES

Q. 15 - Overall, did you find the SDMBoK to be useful?

YES

Intention to Use

Q.16 - Would you use the SDMBoK to manage sustainable development in a construction organization?

YES

Q.17 - Would you intend to use the SDMBoK in preference to the standards the current sustainability management literature offers?

Its complement the literature

8. Additional Comments

Q.(Extra) - If necessary, please add a comment or your overall analysis of the SDMBoK.

I think it is necessary to describe the tools and techniques, for example, SBSC, we have a definition, but it is necessary to know how to apply it.

2020-10-05

Specialist 6 signature

D.4. The SDMBOK Templates

This research presents a series of templates to assist in implementing the SDMBOK on the SOP level. The templates are presented in excel files and can be found as following:

1. B.20. The SDMBOK Templates_1. Corporate Sustainability Strategy

https://drive.google.com/file/d/1jRxG9hmO7kLMULS4qmzN_ckP43f6DjI7/view?usp=sharing

2. B.20. The SDMBOK Templates_2. Corporate Sustainability Objectives

<https://drive.google.com/file/d/1IQIq8tKykXsyqCeskNvw44NZLqrHEmow/view?usp=sharing>

3. B.20. The SDMBOK Templates_3. Corporate Sustainability Structure

<https://drive.google.com/file/d/1NvY3tUN281AcnGIK8eIEd-OpqwjFnN4L/view?usp=sharing>

4. B.20. The SDMBOK Templates_4. Corporate Sustainability Policies and Procedures

<https://drive.google.com/file/d/1VOkCHWLM1iCIn861VMnqEUZcvTzZxe3V/view?usp=sharing>