SUSTAINABILITY ASSESSMENT

A RATING SYSTEM FRAMEWORK FOR BEST PRACTICES

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A Rating System Framework for Best Practices

With a theoretical application to the surface mining recovery process for the development and operation of oil sands projects

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INVESTOR IN PEOPLE

The force behind my inspiration and motivation, my family

A mis padres, mis éxitos son sus frutos; son el producto de una cosecha muy bien cuidada en tiempos de sequía, inundaciones, plagas, y días soleados

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PREFACE

Minimising the detrimental effects on the natural environment due to construction practices is an existing concern. Younger generations and society in general are becoming more aware of the different impacts intrinsically carried by organisations and projects in their operations, and the need for finding a more sustainable path; the increase in the levels of awareness helps explain the exponential increment in the development of sustainability assessment tools. Sustainability of current operations and possible future improvements to meet goals and objectives are the main target for the development of approaches, strategies, models, appraisals and methodologies for sustainability assessment; however, the development of efficient and reliable assessment methods and their respective tools is a challenge for both academia and the scientific community.

Sustainability is a multi-disciplinary area in permanent evolution; therefore, assessment tools evolve in parallel to meet new requirements and overcome existing and emerging limitations. Social, economic and environmental aspects require balanced and integrated approaches for implementation and measurement. While most current sustainability assessment tools focus on one aspect of sustainability, which often refers to the environmental pillar, very few present an integral approach that considers the interlinkages and dynamics of all three pillars of sustainability. In fact, the assessment of economic and social aspects has emerged to contribute to defining the progress towards sustainable development in developing countries; therefore, integrated assessment systems require not only the identification of dynamics among the social, economic and environmental parameters, but also the collection and analysis of much more detailed information.

Sustainability assessment tools gather information for decision-making; therefore, the systems can be designed to target a specific aspect or various aspects of sustainability. Sustainability assessment tools can be grouped in cumulative energy demand (CED) systems, which focus on energy consumption; life cycle analysis (LCA) systems, which focus on environmental aspects; and total quality assessment (TQA) systems, which evaluate ecological, economic and social aspects. The multi-criteria systems are the most common type of TQA systems, and aim to include the three pillars of sustainability. Multi-criteria systems compare the real performance of different parameters with predetermined baselines or thresholds. In environmental or sustainability rating systems, each criterion included in the multi-criteria system has a certain number of points, and the overall sustainability performance score of the organisation or project is calculated by summing the results of the assessed criteria. Although environmental or sustainability rating systems are widely used, the development and application of the tools have been concentrated in the building industry. In the 1990s, the building industry not only recognised the impact of its activities, but also the need for mitigating the environmental impact of the building sector driven by public policy and market demand for environmentally sound products and services. The different assessment tools for measuring sustainability in the building environment can be classified into assessment and rating tools. Assessment tools provide a qualitative understanding of the building performance, which is used for design purposes, while rating tools determine the building performance level with starts or points being awarded based on the criteria met within a specific certification process. Although each rating system and certification tool presents a specific structure, commonalities are found in categories of building design and life cycle performance: water, materials, energy, site and indoor environment.

The building research establishment environmental assessment method (BREEAM) was the first real attempt to develop a comprehensive building performance assessment method to meet the different needs of relevant interest groups. Currently, more than 600 sustainability assessment rating systems are available and used worldwide. If the success of environmental and sustainability rating systems (ESRS) is measured by the number of projects or square metres certified, then the number of square metres certified in the construction building industry ranges in the millions while the number of projects certified is in the thousands. While BREEAM has been recognised as the first rating system to assess sustainability in the construction building environment, Leadership in Energy & Environmental Design (LEED) is certainly competing to position / for positioning itself as the worldwide leader.

ESRS target different performance aspects of the building in different stages of the life cycle. The aim of the assessment tools is to promote sustainable practices in the building industry during design, construction, operation, maintenance, disassembly or deconstruction, and disposal while integrating social, economic and environmental needs and the concerns of the different stakeholders. Therefore, the purpose of sustainability assessment is to gather information to support decision-making during the project's life cycle. ESRS are easy to understand, and enable performance assessment of the building in several stages. Currently, rating systems strongly support the design process of a building, but there is a trend for covering the construction, operation and dismantling phases with a whole-life-perspective analysis; consequently, the evolution of any rating system must continue to cover the multi-dimensionality of sustainability while improving the triple bottom line of buildings.

The framework for developing ESRS, already implemented in the building construction industry, can be extended and applied in other industry contexts. The different benefits carried in the development and implementation of ESRS has been studied to propose a framework of a rating system that can be adopted to other organisational and project contexts. The development of the framework considers the stakeholders as the main tool in the decision-making process while the rating system itself can be used by companies, stakeholders and policy makers to measure, in a consistent manner, the implementation of sustainable development strategies and overall sustainability of the organisation or project.

The development and operations of the Canadian oil sands have been highlighted in this book with the aim of demonstrating the need for developing and implementing ESRS in industry contexts carrying great social, economic, environmental, health and other impacts throughout the project life cycle. Canadian oil sands developments are of interest to oil producers because of the size of the proven reserves; but the scale of development and the perceived enduring impacts are of concern to different stakeholders. Currently, the oil and gas industry — which includes oil sands operations — does not possess standardised environmental or sustainability rating systems to measure and benchmark performance. Oil and gas industry projects are typically large and of long duration. Different aspects are to be considered in the development and implementation of a rating system to break into a new industrial context with effective engagement, participation and stakeholder management as primary areas of consideration.

The development of the structure of the Wa-Pa-Su project sustainability rating system considers three main aspects: areas or categories of excellence, each with a set of criteria; areas or sub-divisions of an oil sands or heavy oil project and management integration. In this particular adaptation of the assessment framework (i.e. The Wa-Pa-Su project sustainability rating system), the structure of the rating tool considers the complexity and size of oil sands projects, dividing them into 10 different areas or sub-divisions: project integration, provisional housing/buildings, permanent housing/buildings, roads, oil transportation & storage, mining process, in situ process, upgrading & refining, shutdown & reclamation and CO_2, SO_x & other greenhouse gases (GHG) capture and storage. The development of the Wa-Pa-Su project sustainability rating system offers a proactive approach, which aligns with sustainability principles, for oil sands projects throughout their life cycle phases, the project management processes (e.g. initiation, planning, execution, monitoring and control, and close-out), and the life cycle of sub-projects and processes. The resources involved in project development, expectations of stakeholders and potential environmental impact define the 10 areas or categories of excellence: project & environmental management excellence (PEME); site & soil resource excellence (SSRE); water resource excellence (WRE); atmosphere & air resource excellence (AARE); natural & artificial lighting excellence (NALE); energy resource excellence (ERE); resources & materials excellence (RME); innovation in design & operations excellence (IDOE); infrastructure & buildings excellence (IBE); and education, research & community excellence (ERCE).

As the structure of the rating system is defined, the focus turns to identify the different parameters to address the 'what' and the 'how' in sustainability assessment. What should be measured or included in the assessment (i.e. SDIs (sustainable development indicators)) and how to measure those parameters (e.g. metrics). SDIs can be found within currently existing approaches, strategies, models, appraisals and methodologies for environmental and sustainability assessment. Conceptually, the design and implementation of SDIs brings together different stakeholders towards finding the balance among economic, social and environmental development; however, questions surround SDIs for the assessment of sustainability of projects (e.g. surface mining operations) or industries (e.g. oil and gas) for which the development of SDIs still is in its infancy: (1) Do the SDIs properly align theory with practice? (2) Do the SDIs meet their intent? and (3) Can the stakeholders and project proponents afford the implementation of SDIs? Individual efforts have been made to establish a set of SDIs by companies developing projects; and regulatory systems (in some way predecessors of SDIs) require certain levels of investment to meet a minimum level of performance, particularly on environmental grounds.

But large industrial projects (such as oil sands projects, which include surface mining operations) do not have a comprehensive set of SDIs to benchmark sustainable performance and/or measure the advances made towards the implementation of sustainable development strategies. Questions remain regarding the rate at which extractive industry companies align with more sustainable practices, whether it is the applicability of SDIs, their degree of usefulness, or the cost of development and implementation of SDIs, or other factors.

An assertive set of SDIs is not solely based on regulatory systems, as measuring sustainability cannot become a bureaucratic process, nor can any other SDI source single-handedly determine or mandate the final set of indicators, as the real objective is to assist decision makers (DMs) and effectively engage stakeholders. As the government and oil sands developers are turning towards increasing productivity with a more conscious sustainable development approach, a pre-selection of SDIs is required to assist further formal multi-criteria selection processes.

The structure design defines the organisation of the rating system while SDI selection and metrics design addresses the stakeholders' vision and needs, and the fundamentals, goals and objectives of sustainable development. Subsequently, the assessment methodology utilised in the rating system measures the relevance of the different criteria to present a numeric result of sustainability assessment or performance score. As a result, properly developed sustainability rating systems not only require the identification and design of metrics in the social, economic and environmental pillars of sustainability, but also weighting of the different criteria. The weighting process can be characterised by its subjectivity in certain areas of assessment; consequently, the stakeholder participation becomes critical from the credibility and validation standpoint. Current multi-criteria decision-making (MCDM) methods present valid alternatives for weighting the various criteria while allowing for the participation of different stakeholders. Among those, the analytic hierarchy process (AHP) structures the decision problem in a manner that is easy for the stakeholders to comprehend and analyse independent sub-problems by structuring the problem in a hierarchy and using pairwise comparisons. However, the relevance of criteria (e.g. weight) can be assessed through the application of other MCDM methods.

Measuring the weight is the initial step in the process of assigning a score to the different criteria; the criteria final score (CFS) may be impacted by other factors considered in the calculation of the overall performance of each criterion. The Wa-Pa-Su project sustainability rating system presents an integrated approach to sustainability assessment by incorporating three distinctive areas of knowledge: (1) sustainable development theory and fundamentals support the ultimate goal of the rating system of contributing to sustainability with the aim of finding a path to balance social, economic and environmental needs; (2) CPI becomes primordial due to the duration of the projects, thus it is critical to allow organisations or projects to improve performance over time and (3) multi-criteria decision analysis (MCDA) assists the assessment process through stakeholder engagement and participation, and the design and implementation of a criteria weighting system.

Previously, the discussion of sustainability and the application of ESRS led to: (1) concluding the need for the development of a rating system for industrial projects, with a particular application to oil sands projects; (2) defining the structure of the rating system; and (3) assisting in the pre-selection of SDIs for surface mining operations. Assessing the sustainability of projects at certain points in time required the application of a methodology selected by the interested groups and/or stakeholders; however, measuring the improvement of projects in sustainability performance over time (i.e. CPI) presents additional challenges.

Certain industries (i.e. oil & gas), projects (i.e. oil sands) or specific operations (i.e. surface mining) require a rating system with a particular level of flexibility, offering the opportunity for developers to improve the performance of operations and for stakeholders to understand the difficulties — and benefits — of implementing SDIs and reach the levels of sustainability performance expected by the various stakeholders.

Large-scale projects create a variety of social, economic, environmental and other impacts throughout their life cycles. Assessing sustainable development becomes a measurable factor, not only for the organisations directly involved in the development, construction and operation of projects, but also for a number of other stakeholders. In the oil sands operations, assessment turns into a periodic task, since the construction and operation phases of the projects can last for a considerable period of time.

The sustainability assessment tool must have the capability for the organisations and/or projects to evaluate and improve performance over time. To that end, the Wa-Pa-Su project sustainability rating system's design and characteristics meet the sustainability assessment needs of the oil sands operations; therefore, the development of its structure is based to support each area of operation (i.e. sub-divisions) and address the diverse impacts (i.e. areas of excellence) in each pillar of sustainability (i.e. social, economic and environmental). Though the different SDIs are incorporated with the aim of measuring the sustainability of the oil sands projects, the framework of assessment methodology can be implemented in a large range of projects and organisations due to its integrated approach, which allows the measurement of performance based on CPI with a high degree of stakeholder participation through the assessment process.

MOTIVATION AND ABOUT THE ORGANISATION OF THIS BOOK

As world energy demands increase, so will the exploration and exploitation of alternative energy resources. The present level of energy generation cannot meet the needs of future generations if the pace of population growth and energy consumption continues at the current rate. While some unconventional energy sources are still in the research and development phase, others have been effectively implemented.

The impacts of different energy operations are still being debated, with respect to environmental, social, economic and health, among other effects. The definition of sustainable development adopted by the United Nations (UN) uses the expression 'meets the needs of the present' to indicate the required development by a current generation to maintain its standard of living while minimising environmental, economic and social impacts. Large industrial developments will affect a range of stakeholders and may entail cultural and political change. The level of impacts and their implications depends on many characteristics of the development such as its size, production rate, duration of exploitation, processes used (including treatment of waste streams) and regulatory standards. While local communities, businesses and surrounding areas are first expected to be impacted, certain developments can attract global attention.

Developing a new assessment tool in the area of sustainable development requires a strategic methodology for a cohesive and logical framework incorporating relevant theory and practical experience, building on a critical analysis of the state of the art. The assessment process implies the existence of tools, instruments, processes and methodologies to measure performance in a consistent manner with respect to pre-established standards, guidelines, factors or other criteria. Sustainability assessment scientists and practitioners have developed an increasing variety of tools with the aim of demonstrating progress towards the different facets of sustainable development.

Measures for assessing the environmental, social and economic impacts and long-term overall sustainability will become an increasingly important requirement in industrial project management. The concept of sustainability influences all aspects of a project throughout its life cycle. Considerations and expectations of stakeholders are at the forefront in each phase of the project life cycle, from the earliest phases in which the business case is presented for consideration by investors, followed by the design and construction of facilities and infrastructure, and continue during the operation of the industrial facility. Project management researchers and practitioners are working together to find effective and efficient methods and techniques to minimise environmental, social, economic, health and other potential impacts that projects inherently carry along each phase of their life cycle.

The rationale behind sustainable development indicates the balance of social, economic and environmental needs. For stakeholders, the rationalisation process of sustainability consists of quantifying the different impacts found in the operations and developments of companies and projects throughout their life cycle; however, as some areas are subjective in nature, the quantification process of the different impacts and assessment of sustainable development performance becomes an arduous task of development, validation, and application of scientific and empirical methods with the intrinsic objective of finding an agreement among the involved parties (i.e. stakeholders). Several environmental and sustainability assessment tools, instruments, processes and methodologies have been developed; ESRS have gained attention and credibility, demonstrated by the vast number of certified projects around the world and the widely-known usefulness and advantages of their application.

ESRS are structured decision-making tools in support of measuring environmental, social and economic performance throughout the project life cycle, not only complying with government and non-government regulations, but also meeting internal and external standards, procedures, processes and requirements. The majority, if not all, of ESRS created to date focus on buildings and residential housing construction, which demonstrates the need for gaining ground in the implementation of similar sustainability assessment methodologies in other industrial contexts. To that end, the motivation behind this book and its true aim is to introduce a methodology with a framework that can easily be applied to any type of project or organisation, putting the stakeholders at the centre of the decision-making process while making them accountable not only throughout the process but also for the end results.

The content of the book is organised in 14 chapters grouped in four parts: (1) sustainability assessment, (2) a new sustainability system, (3) the Canadian oil sands and (4) a step-by-step application: the surface mining process.

Chapter 1 discusses a range of fundamental and generic approaches and frameworks, as well as specific and integrated strategies for sustainability assessment, as the foundation of a framework for the methodology developed in a new rating system applicable to contexts other than the construction building industry. Assessment methods identified by different schemes are also presented along with a classification of the assessment tools.

Chapter 2 focuses on ESRS with emphasis on some of the most popular tools: LEED, BREEAM, comprehensive assessment systems for built environment efficiency (CASBEE), Green Star and SBTool. A description of the criteria weighting tool (CWT) used by each ESRS is described.

Chapter 3 presents the potential benefits of developing and implementing ESRS. While the valid argument that the benefits have been already proven in the construction building industry can be made, those described in this chapter are considered potential benefits as ESRS have not been implemented in other industry contexts; hence one of the motivations behind this book.

Chapter 4 introduces the origins and fundamentals of the Wa-Pa-Su project sustainability rating system, which was originally conceived for measuring, in a consistent manner, sustainability performance of the Canadian oil sands projects. However, the methodology evolved into a generic framework that can be adapted to any other project or organisation type.

Chapter 5 presents the integrated approach to sustainability assessment implemented in the Wa-Pa-Su project sustainability rating system. This chapter also highlights the reasoning behind the integration of three distinctive areas of knowledge for sustainability assessment: sustainable development theory and fundamentals, CPI and MCDA. The principles of the assessment methodology and the intersection between the different areas of knowledge are also described.

Chapter 6 provides the brief background of the Canadian oil sands and describes their life cycle. Each phase of the life cycle is explained and the two recovery processes (i.e. surface mining, in situ) are analysed in detail. Factual information about the development of the Canadian oil sands is presented and different facets of the projects are discussed.

Chapter 7 presents a discussion and analysis of the economic, social, environmental, health and other impacts of current operations in the Canadian oil sands that are of concern to different stakeholders, including some uncertainties in levels and persistence of impacts. An overview is provided of efforts undertaken by government and developers to minimise impacts; and comments are offered on possible future strategies.

Chapter 8 provides factual statistics in the area of sustainability performance of 10 of the developers and operators of the Canadian oil sands. Sustainability performance in each of the four main areas (land, water, air, and tailing ponds) of concern are discussed along with social, economic and organisational sustainability. Shortcomings in sustainability reporting are identified and suggestions for improving sustainability assessment performance and reporting are provided.

Chapter 9 introduces the Wa-Pa-Su project sustainability rating system structure in a step-by-step application to surface mining, one of the two recovery processes used in the Canadian oil sands projects. For this particular application of the assessment methodology, the areas of excellence and sub-divisions are identified and described in detail. Additionally, management interaction between project management processes groups, sub-projects' life cycle and process life cycle are analysed.

Chapter 10 presents an analysis of six different sources for pre-selecting SDIs, accompanied by a methodology to then finalise with a set of SDIs for the surface mining operations in oil sands projects. Each SDI description is later provided in Appendix C.

Chapter 11 analyses the development and implementation of SDIs in surface mining operations for oil sands projects, highlights the benefits of using SDIs, proposes an alternative framework for SDIs in the Canadian oil sands industry and offers recommendations for the use of SDIs to measure the sustainability of surface mining operations.

Chapter 12 presents the application of the AHP to weight the different criteria to measure the sustainability of surface mining operations. Prior to the application of the AHP method, the various criteria were pre-selected using a preliminary selection method consisting of the identification of criteria from six different sources as described in Chapter 10. The results of the weighting process assist scientists and practitioners not only by identifying those criteria that stakeholders consider relevant in the sustainability assessment process, but also by expressing the degree to which the criteria should be addressed in order to accomplish the project's and/or organisation's sustainability goals.

Chapter 13 introduces the performance improvement factor (PIF), which can be determined using three different methodologies: relevance factor or subjective stakeholder valuation, comparative assessment methods (CAMs) and links to metrics. Additionally, CPI indicator measurement is suggested and discussed for a pre-selected set of SDIs for surface mining operations in oil sands projects. Finally, a brief preamble discusses the proposed integrated approach for sustainability assessment and the part it plays in CPI, offering a foreword to upcoming manuscripts that discuss the other complementary parts of the integrated approach.

Chapter 14 highlights the flexibility and applicability of the rating system by presenting a simulated case study of implementation and sustainability assessment using the integrated approach adopted in the Wa-Pa-Su project sustainability rating system. The simulated implementation demonstrates how the assessment methodology can be utilised by the users of the rating system to determine progress towards sustainable development by comparing criteria performance against previously established baselines and thresholds, and allocating criteria and overall sustainability assessment scores. Since the Wa-Pa-Su project sustainability rating system is the first of its kind focusing on industrial projects with an emphasis on the Canadian oil sands, it must be understood that a variety of SDIs have not yet been measured, and the data required for this purpose have not been collected; therefore, the objective of the simulated case study of implementation and sustainability assessment using the developed integrated approach is to highlight the flexibility and applicability of the rating system.

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