

Engineering and the Essential Foundations of Sustainability in the 21st Century: A Theoretical Investigation

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SUMMARY

Environmental management has become an increasingly relevant topic for those looking to start a business or already running their own. This aspect poses an even greater challenge for companies, as consumers are more aware and often act as watchdogs, prioritizing brands that demonstrate environmental and social responsibility, in addition to being vigilant about compliance with current environmental legislation. In some cases, there are even severe penalties for organizations that violate these standards. Faced with this new reality, companies need to adapt, investing in sustainable production processes that have a lesser impact on the environment. In this context, the central objective of this article is to identify which actions can be implemented within organizations to promote environmental preservation. In other words, to investigate how companies can adopt practices that demonstrate their commitment to sustainability.

Keywords: environmental management, sustainability, socio-environmental responsibility

ABSTRACT

Environmental management has become an increasingly relevant topic for those intending to start a business or who already manage their own enterprise. This issue represents an even greater challenge for companies, as consumers are becoming more aware and often act as watchdogs, prioritizing brands that demonstrate environmental and social responsibility, while also paying close attention to compliance with current environmental legislation. In some cases, severe penalties are imposed on organizations that violate these regulations. Faced with this new reality, companies need to adapt by investing in sustainable production processes that minimize environmental impact. Within this context, the main objective of this article is to identify which actions can be implemented within organizations to promote environmental preservation. In other words, to investigate how a company can adopt practices that demonstrate its commitment to sustainability.

Keywords: environmental management, sustainability, socio-environmental responsibility

INTRODUCTION

Environmental management has become a recurring topic among those looking to start their own businesses, as well as among entrepreneurs already running their own. Environmental issues have increasingly taken up space in meetings and debates, particularly when it comes to preserving natural resources or reducing pollutant emissions. From a political perspective, a significant body of legislation has been created to preserve the environment.

For companies, in particular, dealing with this reality has proven to be a major challenge. This is due to the fact that consumers are increasingly aware, demanding products that are environmentally sustainable and socially responsible. Furthermore, the advancement of environmental law has brought stricter measures and severe sanctions against organizations that cause damage to the environment in which they operate. Faced with this scenario, companies are forced to invest in sustainable technologies and production processes as a way to adapt to the new reality.

This situation is further aggravated in the context of micro and small businesses, which, due to their financial and structural limitations, face greater difficulties in adapting to environmental requirements. The historical burden of challenges faced by this business profile, coupled with a lack of incentives and technical knowledge, makes the adaptation process even more complex.

Based on this overview, the overall objective of this study is to identify which actions can be implemented in the organizational environment with a focus on environmental preservation. In other words, the aim is to understand which practices and strategies can be developed by companies to become more sustainable and environmentally responsible.

The relevance of this work lies in the fact that it proposes a scientific approach to one of the most critical issues for the future of society: development combined with sustainability. It is believed that understanding and raising awareness of this topic are fundamental so that the population, once sensitized, can actively contribute to improving socio-environmental conditions.

It is therefore argued that the adoption of sustainable practices represents a viable alternative to minimize the impacts caused by industrial activities — especially in the construction industry. Furthermore, it is understood that the key to ensuring a good quality of life for future generations lies in raising awareness among current generations about the importance of sustainability. Only through a harmonious relationship between humans and nature can development reach its full potential.

1. METHODOLOGICAL ASPECTS

This literature review highlights environmental issues as a fundamental element for entrepreneurs to overcome the specific challenges of each phase or stage outlined in the Functional Model of Environmental Management. This model guides organizations wishing to implement an environmental management system, considering it a decisive factor in their operations and a competitive differentiator. In this way, companies adapt to the new requirements imposed not only by legislation but also by the demands of consumers and society in general.



The material used for this analysis consisted of books, periodicals and dissertations, available in printed and electronic formats.

2. THEORETICAL FRAMEWORK

2.1 Evolution of the concept of sustainability

One of the most evident aspects of organizations focused on environmental issues in recent years is the social responsibility of both individuals and institutions, encompassing the private, public and third sectors.

Public responsibility toward the environment manifests itself through the adoption of practices that go beyond the basic legal obligations imposed on citizens and organizations. In other words, it involves going beyond what the law requires, adopting proactive measures. One of the main challenges for organizations is fully complying with these legal requirements while also pursuing their goals, ensuring environmental preservation for future generations.

One of the first widely introduced sustainability concepts, sustainable development, was created in the Brundtland Report. According to Andrade (2000, p. 4), the Brundtland Report is an article entitled "Our Common Future," prepared by the International Commission on Environment and Development, published in 1987, in which sustainable development is titled: "Development that satisfies current needs without compromising the ability of future generations to meet their needs."

Dias (2009, p.153) in his interpretation of the Brundtland report defined sustainability like this:

(...) is a transformation process in which the exploitation of resources, the direction of investments, the orientation of technological development and change institutional harmonize and reinforce present and future potential in order to meet human needs and aspirations.

As Braga (2005, p. 216) explains, there were several initiatives that addressed sustainable development, prior to Agenda 21, which reaffirm a critical view of the development model adopted by industrialized countries and reproduced by developing nations, and which highlight the risks of using uncontrolled use of natural resources without considering the real carrying capacity of ecosystems. The report points to a mismatch between sustainable development and the new patterns of production and consumption prevailing in today's society. better world for all generations without harming the environment is a social goal to be achieved, which makes it a common ideal across the planet. Barbieri & Cajazeira (2009, p.66) explain that:

The sustainable development movement is based on the perception that the earth's carrying capacity cannot be exceeded without major social and environmental catastrophes. Furthermore, there are already clear signs that in many cases acceptable limits have been exceeded, as evidenced by several very serious environmental problems, such as global warming, the destruction of the stratospheric ozone layer, the pollution of rivers and oceans, the accelerated extinction of living species, as well as serious social problems. According to Ferreira (1995, p. 619), sustainability refers to: "Sustainable, adj. That which can be sustained, capable of remaining more or less constant, or stable, for a long period".

According to this concept of sustainability proposed by Aurélio, it can be seen that a company that wants to remain in the market of the new millennium, needs to execute sustainable practices, that is, that the company can, through its actions, be able to keep on the market for a long time.

It is no longer just about meeting the requirements of a company with sustainable practices in the environment in which it operates; it has become a necessity in the current 21st century, since if the company wants a constant and long future, as the concept mentioned above says, it is precisely this path that it has to follow and fight for, as the World Commission already said in its report that was published in 1987, in which sustainable development is conceived as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Sustainability is, therefore, an unavoidable reality, and companies have sought to adapt to this new scenario marked by growing consumer demand for environmentally responsible products, in addition to stricter environmental legislation.

To maintain their competitiveness and serve an increasingly demanding public, organizations have been modifying their administrative structures and implementing innovative production practices.

The factors that make sustainability so relevant involve economic, social, and other aspects that contribute to building a more just and conscious society, with future generations in mind. Today, companies need to adapt to a different economic context. Although sustainability includes respect for human beings, the corporate perspective is largely focused on financial and economic results. In other words, organizations don't meet environmental requirements out of mere kindness, but rather out of a need to remain competitive in the market.

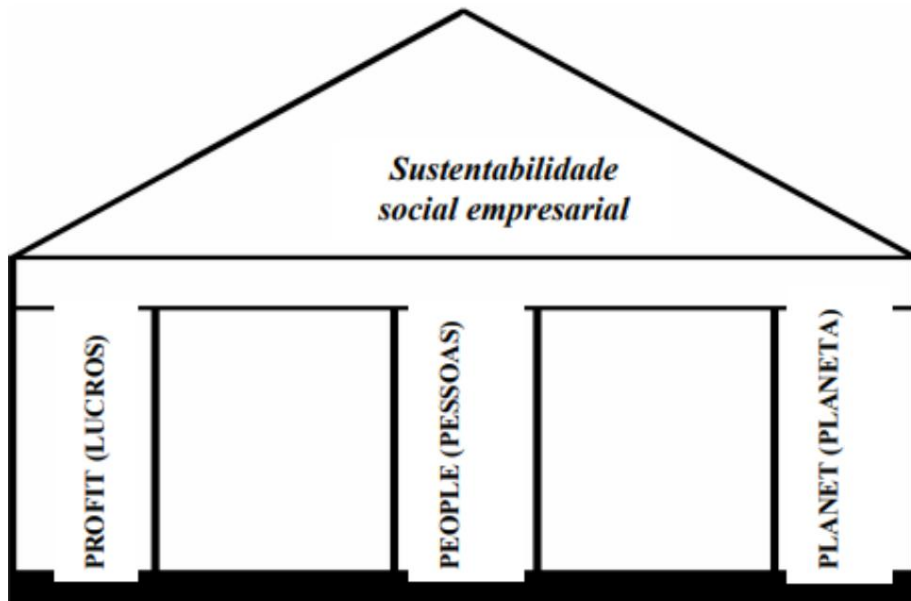
The lack of environmentally responsible strategies certainly reduces the competitiveness of companies that fail to prepare for this new 21st-century market niche. Therefore, to face this environment of increased competition, more discerning consumers, and restrictive legislation, organizations have been forced to make significant investments to align with this new reality.

According to Barbieri & Cajazeira (2009, p. 70), a sustainable company:

(...) is the one that seeks to incorporate the concepts and objectives related to sustainable development into its policies and practices in a consistent manner.
(...) for the company, the incorporation of these objectives means adopting business strategies and activities that meet the needs of companies and their stakeholders. current stakeholders, while protecting, sustaining and enhancing the human and natural resources that will be needed in the future.

As these authors also highlight, organizations must be based on the model of sustainable organization of the 3Ps, as highlighted in Figure 1 below:

Figure 01: The 3 Ps sustainable organization model.



Source: Barbieri & Cajazeira (2009, p. 79)

According to the authors, this model encompasses the three fundamental dimensions of organizational sustainability: economic (profit), social (people), and environmental (planet). A company will only achieve success and remain sustainable over time if it integrates these three pillars into its practices and strategies.

2.2 Social and environmental responsibility

Responsibility is a mutual expectation among people, and with the aim of encouraging businesspeople and entrepreneurs to adopt social and environmental responsibility, regulatory standards were established to guide companies that intend to implement conscious management of the resources they use.

According to Dieese (2006, p. 02):

The topic of corporate social responsibility (SR) has gained significant public visibility in recent years. It appears in advertising campaigns by large national and multinational companies, aiming to publicize the commitments and results of their social and environmental actions. While internally, employees are encouraged to join social volunteer programs, externally, companies begin to jointly develop or support projects with non-governmental organizations or even official programs. The social responsibility movement has many facets, one of which is the creation and adoption of voluntary social responsibility standards.

There are several initiatives in this regard. Many companies have unilaterally defined codes of conduct or ethics, which establish principles of conduct in relationships with employees, local communities, public institutions, consumers, the environment, and so on. In other cases, adopted codes

prepared by business organizations, non-governmental organizations or private associations. sectoral, or by organizations or private associations.

Ashley (2005, p. 08) in his concept of Social Responsibility explains that: “social responsibility corresponds to the activities that it carries out, the way in which its policies are practiced and the results derived from its actions, whether positive or negative, and the commitment to make this clear to its stakeholders”. Ashley also states that it is legitimate that: “these days, organizations need to be aware not only of their economic and legal responsibilities, but also of their ethical, moral and social responsibilities” (ASHLEY, 2005, p. 08).

Barbieri and Cajazeiras (2009, p. 53) explain that there are four dimensions of issue of corporate social responsibility. According to these authors, these dimensions would be:

- a) Economic responsibility: refers to the fact that the company is profitable and produces goods and services that society desires;
- b) Legal responsibility: these are the laws that organizations are required to follow to operate in the market. Society expects them to comply with such rules and not to evade or circumvent them. “rules of the game”;
- c) Ethical responsibility: when organizations act to do what is right and fair, avoiding or minimizing impacts on people. It is doing beyond what is legal;
- d) Philanthropic responsibility: when in which the company carries out actions without any signaling from society.

The ways of understanding these responsibilities can be viewed from the Table below:

Table: Types of Social Responsibility

Tipo de Responsabilidade	O que deve cumprir
Responsabilidade econômica	Ser lucrativa – fornecer bens e serviços
Responsabilidade legal	Obedecer as leis
Responsabilidade ética	Fazer o certo e evitar danos
Responsabilidade filantrópica	Empresa cidadã

Source: Barbieri & Cajazeira (2009, p. 54) – Adapted by the author

Social and environmental responsibility, as discussed by the authors of this article, represents one of the greatest challenges facing society today. In this context, organizations have sought to adapt and create strategies that integrate social and environmental issues, as society is increasingly demanding and environmental legislation has become more stringent. Thus, specific environmental management techniques have emerged, which have been incorporated into organizational management models as a necessary approach to address the unsustainability crisis threatening the planet.

The focus on environmental issues gained prominence especially in the 1990s, when the negative effects of high consumption of industrialized products began to become apparent. Clear environmental impacts began to manifest, bringing to light serious problems such as environmental disasters, ozone depletion, melting polar ice caps, and other threats that are likely to worsen if protective measures are not adopted.

To contribute to environmental preservation and meet new market and legal demands, organizations have been compelled to implement environmental management systems. The objective of this chapter is to introduce the concept of environmental management.

environmental, as well as the mechanisms developed to protect the environment.

2.3 Theoretical and practical aspects of Environmental Management

Environmental Management is understood as the administrative and operational actions developed by organizations with the objective of generating positive effects on natural resources. In the words of Barbieri (2004, p. 19):

The political, economic, social, and cultural issues that underlie environmental problems delay or impede the adoption of solutions. All of these issues must be considered when addressing environmental problems, and this is broadly referred to as Environmental Management.

When a company thinks about environmental management at the beginning, the following questions arise: The following questions arise about how and where to start environmental management. This is the first step: asking yourself whether or not you already have environmental management methods in place, and if so, no, how and where should she start working to implement such methods.

For Donaire (1995, p. 63) the environmental management process within organizations must be developed based on the following steps:

Another approach that can be analyzed is one that, from an environmental perspective, involves identifying threats and opportunities by relating them to the organization's strengths and weaknesses. Identifying the situation that company is and the development of future scenarios is one of the aspects practical measures that the company can implement as a form of planning that will allow the company to take advantage of possible opportunities, prevent potential threats, maintain strengths and minimize or eliminate weaknesses.

In this sense, North (apud DONAIRE, 1995, p. 63) proposes an example of group dynamics among company executives who would discuss the following fundamental questions to verify the environmental issue within the organization. It is from these elements that the organization will have the possibility of developing efficient environmental management, and suggests the following question:

A) What are the strong points regarding environmental issues of the company and its employees? different functional departments? Carry out this analysis considering the following items: Environmentally friendly products; Production processes that save resources and do not pose environmental risks; Corporate image in relation to environmental causes; Commitment of management and staff to environmental protection; Research and Development capacity (R&D) for "clean" technologies and products. B) what are the weaknesses related to environmental issues? Consider the following in your assessment: Products that cannot be recycled; Non-recyclable packaging, containers, etc.; Polluting processes; hazardous effluents; Polluting image; personnel not engaged in environmental issues. C) What are the opportunities related to environmental issues? Consider this assessment, highlighting: Entry into new markets; The possibility of transforming traditional products into environmentally friendly ones; ensuring the company's survival by maintaining a good environmental image; increasing the performance of suppliers and employees by establishing new objectives for environmental protection; The possibility of saving resources, energy, and costs. D) What are the threats related to environmental issues? Consider the following in your analysis: Advancement of environmental legislation and the possibility of additional investments and decreased profits; Government intervention in current production activities; Actions by environmental groups; Competitors' performance regarding environmental issues.

Donaire (1995, p. 64) further states that:

The discussion of these issues will allow the elaboration and establishment of a plan in which the company's environmental strategy will be progressively extended to all its sectors, so that in a short period of time, the planning, organization, management and control of the organization will consider with the same attention the economic, financial and environmental results.

In summary, as highlighted by Biazin & Godoy (sd, p. 01), environmental management can be understood as the process in which "(...) the parameters related to the environment are now taken into account in strategic planning, in the process productive, in the distribution and final disposal of the product". Therefore, the collection of such information indicated above allows the organization to carry out strategic develop a planning specifically regarding in relationship environmental issues, allowing it to understand the current stage of its actions related to the environment, as well as possible difficulties that you will face and have to find solutions to face them.

2.3.1 Measures to combat environmental impacts

Environmental impacts are a reality in our daily lives. Human activities have had an impact on every region of the planet, resulting in ecological disasters that compromise the present and restrict the possibility of a healthy life in the future.

According to Reis & Queiroz (2002, p. 05), before analyzing the environmental management model given by ISO 14000, it is essential to clearly understand the meaning of "environmental impact".

As these authors clarify, according to CONAMA Resolution 001/86 – National Environmental Council – environmental impact can be understood as:

(...) any change in the physical, chemical and biological properties of the environment environment, caused by any form of matter or energy resulting from human activities, which directly or indirectly affect: a) health; b) the safety and well-being of the population; c) social and economic activities; d) the biota; e) the aesthetic and sanitary conditions of the environment; f) the quality of environmental resources (REIS & QUEIROZ, 2002, p. 05).

Still following the explanations of these same authors, NBR ISO 14001, as it is more focused on implementing an environmental management model in organizations defines environmental impact as: "(...) any modification of the environment, whether adverse or beneficial, that results, in whole or in part, from the activities, products or services of an organization." (REIS & QUEIROZ, 2002, p. 05). Although less comprehensive than the first definition given by CONAMA, it can be seen that there are similarities in the concepts.

According to Reis & Queiroz (2002, p. 05), referring to NBR ISO 14001, they state that the introduction: "(...) environmental management standards aim to provide organizations with the elements of an effective environmental system, capable of integration with other elements of management in order to help them achieve their environmental and economic objectives."

The environmental impact assessment (EIA) process was provided for as one of the instruments in law 6,938 of August 31, 1981, but it was only effectively used

from CONAMA resolution 001 of 1986. According to Machado (apud REIS & QUEIROZ, 2002, p. 06) citing the Constitution of Brazil, point out that:

(...) to ensure the effectiveness of this right (to an ecologically balanced environment) it is incumbent upon the political power to: demand, in accordance with the law, the installation of work or activity potentially causing significant degradation of the environment, prior environmental impact study, which will be made public (art.225,1º, IV).

Thus, the environmental impact assessment process is:

(...) environmental policy instrument, formed by a set of procedures capable of ensuring, from the beginning of the process, that a systematic examination of the environmental impacts of a proposed action (project, program, plan or policy) and its alternatives is carried out, and that the results are presented in a manner appropriate to the public and decision-makers, and considered by them. Furthermore, the procedures must ensure the adoption of certain environmental protection measures in the event of a decision on project implementation (REIS & QUEIROZ, 2002, p. 6).

In short, environmental impact assessment is an environmental policy tool and, therefore, the responsibility of public entities. This process requires a comprehensive analysis from the origin of the impacts, in addition to requiring the participation of society, those responsible for the impacts, the licensing agency, and the Public Prosecutor's Office.

By establishing the foundations for an environmental management system, NBR ISO 14001 seeks to implement a methodology within a company that allows it to manage its environment, considering both positive and negative environmental aspects and impacts. Therefore, the aforementioned standard emphasizes this comprehensive approach in its requirements, as per requirement 4.3.1:

The organization must establish and maintain procedure(s) to identify the environmental aspects of its activities, products, or services that it can control and over which it is presumed to have influence, in order to determine those that have or may have a significant impact on the environment. The organization must ensure that aspects related to these significant impacts are considered in defining its environmental objectives (REIS & QUEIROZ, 2002, p. 06).

DIAS (2009) demonstrates in the following table that the ISO 14000 standard represented by the Brazilian Association of Technical Standards (ABNT), also known by the Brazilian government as the National Standardization Forum, is a family of standards that seek to establish tools and systems for the environmental management of an organization, aiming at the standardization of some key analysis tools, such as environmental auditing and life cycle analysis.

NORMA	DESCRIÇÃO
ISO 14001	Sistema de gestão ambiental(SGA)-especificações para implantação e guia
ISO 14004	Sistema de gestão ambiental - Diretrizes Gerais
ISO 14010	Guias para auditoria ambiental - Diretrizes Gerais
ISO 14011	Diretrizes para auditoria ambiental e procedimentos para auditorias
ISO 14012	Diretrizes para auditoria Ambiental – critérios de qualificação
ISO 14020	Rotulagem ambiental – princípios básicos
ISO 14021	Rotulagem ambiental – termos e definições
ISO 14022	Rotulagem ambiental – simbologia para rótulos
ISO 14023	Rotulagem ambiental – testes e metodologia de verificação
ISO 14024	Rotulagem ambiental – guia para certificação com base em análise multicriterial
ISO 14031	Avaliação de Performance Ambiental
ISO 14032	Avaliação de Performance Ambiental dos sistemas de operadores
ISO 14040	Análise do ciclo de vida – princípios Gerais
ISO 14041	Análise do ciclo de vida – Inventário
ISO 14042	Análise do ciclo de vida – Análise dos impactos
ISO 14043	Análise do ciclo de vida – Migração dos Impactos

Source: Dias (2009, p. 92)

These standards have been widely adopted by organizations worldwide. seeking ISO 14000 certification proves that the organization is committed to reducing the impacts on the environment, that is, that it is environmentally responsible. According to information from Barbieri & Cajazeira (2009, p. 174), at the end of 2006, there were approximately 129,199 certified companies worldwide. In Brazil alone, in that same year, there were 2,447 certified companies.

It's clear, therefore, that environmental management practices have been a fundamental factor for companies to remain competitive in the market, given that consumers are increasingly demanding and laws are increasingly strict. It is with this in mind that organizations have sought to implement environmental management systems, meaning companies are aware of and concerned about the potential impacts they may have on the environment.

4 Final Considerations

These standards are widely recognized by organizations around the world. Pursuing ISO 14000 certification demonstrates companies' commitment to minimizing environmental impacts, that is, to acting with respect for the environment. According to Barbieri & Cajazeira (2009, p. 174), by the end of 2006, there were approximately 129,199 certified companies worldwide. In Brazil alone, that same year, 2,447 certifications were registered.

It is therefore clear that environmental management processes are a crucial factor, as companies continually compete in the market with increasingly demanding consumers.

demanding and more stringent environmental standards. For this reason, organizations have invested in implementing environmental management systems, demonstrating awareness and concern regarding their potential environmental impacts.

Given the need to highlight the relevance of environmental and sustainability issues in organizations, this article highlights the emergence of the concept of sustainability and its importance to businesses. It also seeks to emphasize the socio-environmental commitment of organizations that wish to remain competitive in the face of growing market demand.

Furthermore, the article presents theoretical and practical aspects of environmental management, offering initial guidance for companies wishing to begin this journey. Interestingly, good environmental management doesn't just begin with formal company registration (CNPJ), but rather with the awareness of directors and managers. When planned and organized from the outset, environmental management becomes easy to implement, contributing to the enhancement of the organization's image, its products, or services, by integrating the environmental management model into its strategic plans.

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