



Analysis of the relationship between management system standards (ISO 9001, ISO 14001, NBR 16001 and OHSAS 18001) and corporate sustainability

Análise da relação entre normas de sistema de gestão (ISO 9001, ISO 14001, NBR 16001 e OHSAS 18001) e a sustentabilidade empresarial

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Abstract: Sustainability may be inserted into the business context as a way to minimize the negative impacts caused by production processes. Organizations use management system standards to satisfy the stakeholders' aspirations. Therefore, this study aimed to analyze the relationship between management system standards (ISO 14001, ISO 9001, OHSAS 18001 and NBR 16001) and corporate sustainability. The goal was achieved with following steps. First, the corporate sustainability requirements were identified based on Corporate Sustainability Index, Ethos Indicators and Global Reporting Initiative. Next, the matrix that lists the sustainability and standards requirements was built. The matrix was completed by the researcher and six experts. The responses were consolidated generating the Consolidated Relation Matrix, which was then analyzed and interpreted. The correlations were classified as strong, moderate, weak or null. The research results show a weak relationship between corporate sustainability and the ISO 9001 and OHSAS 18001 standards; moderate relationship with ISO 14001 and a strong relationship with NBR 16001. The study concluded that these regulatory standards can help companies to introduce sustainability in their context, however, ISO 9001 and OHSAS 18001 are standards that approach only some elements of corporate sustainability. The NBR 16001 is the standard with more elements of sustainability in its scope. Thus, companies aiming to introduce sustainability into corporate environments could focus on the implementation of the NBR.

Keywords: ISO 14001; ISO 9001; OHSAS 18001; NBR 16001; Corporate sustainability.

Resumo: A sustentabilidade pode ser inserida no contexto empresarial como uma forma de minimizar impactos causados pelos processos produtivos. Organizações utilizam as normas dos sistemas de gestão para satisfazer os anseios das partes interessadas. Sendo assim, o objetivo do estudo foi analisar a relação entre normas de sistemas de gestão (ISO 14001, ISO 9001, OHSAS 18001 e NBR 16001) e a sustentabilidade empresarial. O objetivo foi alcançado seguindo as seguintes etapas: Primeiramente, os requisitos da sustentabilidade empresarial foram identificados, baseados em Índice de Sustentabilidade Empresarial, Indicadores Ethos e Global Reporting Initiative. Posteriormente, a matriz que relaciona os requisitos da sustentabilidade e os das normas foi construída. A matriz foi preenchida pela pesquisadora e por mais seis especialistas. As respostas foram consolidadas, gerando-se a Matriz de Relação Consolidada, a qual foi analisada e interpretada. As relações foram classificadas como forte, moderada, fraca ou nula. Os resultados da pesquisa apontam que ISO 9001 e OHSAS 18001 possuem relação fraca com a sustentabilidade empresarial. A ISO 14001 apresenta relação moderada e a NBR 16001, relação forte. A pesquisa concluiu que os padrões normativos podem auxiliar as empresas a introduzirem a sustentabilidade em seu contexto, no entanto, ISO 9001 e OHSAS 18001 são normas que abordam apenas alguns elementos da sustentabilidade empresarial. A NBR 16001 é a norma que mais apresenta elementos da sustentabilidade em seu escopo. Sendo assim, empresas que objetivam introduzir a sustentabilidade no ambiente corporativo poderiam focar na implementação da NBR 16001.

Palavras-chave: ISO 14001; ISO 9001; OHSAS 18001; NBR 16001; Sustentabilidade empresarial.

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1 Introduction

Environmental problems caused by human actions resulting from the improper use and exploitation of natural resources threaten the support capacity of the planet (Barbieri, 2011). In this context, sustainable development is seen as an alternative to help solve environmental, social and economic problems, which encompass global issues (e.g. climate change) and specific regional problems (e.g. access to basic sanitation) (Elkington, 2001).

According to Elkington (2001, p. 21), sustainability is “[...] the principle of ensuring that our actions today do not limit the range of economic, social and environmental options available to future generations”.

In the business context, sustainability is regarded as

[...] adopting business strategies and activities that meet the needs of the enterprise and its stakeholders, while protecting, maintaining and improving the natural resources that will be needed in the future. (IISD, 1992, p. 11).

With the accelerated industrialization process in the 1960s, entrepreneurs believed that environmental damage should be borne by society at large in support of economic development. The industrial pollutants were discharged as far as possible from the pollution source (Barbieri, 2011). In the 1970s a new relationship between the environment and economic development was sought, this was observed through government corrective and low efficiency actions. The pollution generated by companies was controlled and remedied at the end of the “end of the pipe” processes and regulatory compliance occurred only when required (Barbieri, 2011). After the Rio 92 the strategic approach to preventing pollution began (Barbieri, 2011).

In this context, influenced by growing discussions related to the environment, in 1993 the International Organization for Standardization (ISO) created the ISO/TC 207 Technical Committee to develop the ISO 14000, which determines the requirements for implementing an Environmental Management System (EMS) (Cerqueira, 2012). Prior to launching ISO 14001 the International Organization for Standardization released the ISO 9001 in 1987 for the standardization of Quality Management Systems (QMS) (ABNT, 2008a).

In 1999 the first version of OHSAS 18001 was launched, setting guidelines for the implementation of the Safety Management System and Occupational Health (HSMS) (BSI, 2007). In 2004 the ABNT launched the NBR ISO 16001 standard, for the implementation of the Management System of Social Responsibility.

Given this context, studies have shown that companies that adopt the standards ISO 9001, ISO 14001, NBR 16001 and OHSAS 18001 considering the triple bottom line (environmental, social and economic) will contribute directly to corporate sustainability (Rocha et al., 2007; Tsai & Chou, 2009). However, no studies that indicated the relationship between these management system standards and corporate sustainability were identified. Therefore, to fill this gap the objective of our study is to analyze the relationship between management system standards (ISO 9001, ISO 14001, NBR 16001 and OHSAS 18001) and corporate sustainability.

2 Theoretical foundation

This subject will present the theoretical basis of the themes used in this study.

2.1 Management systems standards

The first version of the ISO 9001 standard was published in 1987 and was later revised in 1994, 2000, 2008 and 2015. The ISO 9001:2008 standard specifies quality management requirements based on a management system model (Carpinetti, 2012). The model is based on the principles of total quality management which includes: customer focus, leadership, involvement of individuals, process approach, systemic management approach, continuous improvement, decision-making based on facts and mutually beneficial supplier relationships (Vitoreli & Carpinetti, 2013).

In a survey carried out in New Zealand that included 300 quality auditors, the authors Terziovski et al. (2003) concluded that the members of ISO 9001 certified companies believed improved business performance could be achieved only if the quality culture were effectively disseminated in organizations. According to Qi et al. (2013) the standard ISO 9001 is seen as a cornerstone for a company’s sustainable economic growth.

The study by Zeng et al. (2005), conducted in China in 100 construction and civil engineering certified ISO 9001 companies, pointed out that the reasons these companies were motivated to implement this standard as a reference are related to: improving business reputation, satisfying customer requirements, respond to government appeals and improve the management of the organization. In addition, the study shows the key benefits associated with ISO 9001 certification, such as: increased efficiency, definition of responsibility, improvements in teamwork, improved internal management, increase customer confidence, increased market share, increase profits and decrease costs.

The ISO 14001 (ABNT, 2004) standard established in 1996 was influenced by the discussions raised in the Eco-92. This is an international standard that defines criteria for environmental management systems including requirements for organizational structure, practices, processes, resources, responsibilities and procedures in order to systematize the system in an organization (Bansal & Bogner, 2002).

In this context, Jiang & Bansal (2003) developed a study that identified the reasons why 16 pulp and paper Canadian companies obtained ISO 14001 certification. They concluded that the main factors these organizations adopted ISO 14001 standards are related to external (market demand and institutional pressures) and internal influences, which reflect the company's strategic choice on how to deal with environmental issues. The authors Heras-Saizarbitoria et al. (2011) analyzed 214 Spanish companies and conducted a study to analyze the motivations and the benefits obtained by ISO 14001 certified companies. They concluded that companies that adopt this certification, considering the internal factors, have greater benefits compared with those who seek certifications considering only external factors.

A study conducted in Japan, which estimated the effects of the ISO 14001 certification in supply chain management, pointed out that the ISO 14001 certified companies are 40% more likely to assess the environmental performance of its suppliers and 50% more likely to require its suppliers' commitment to adopt sustainable environmental practices. This survey interviewed 1499 Japanese respondents who worked in factories with over 50 employees and who were responsible for environmental activities in the organizations. The study concluded that the implementation of the ISO 14001 can affect the environmental actions of other organizations by promoting Green Supply Chain Management (GSCM) practices (Arimura et al., 2011).

An EMS that is correctly implemented can allow companies to achieve greater organizational efficiency and effectiveness, by reducing the costs and environmental impacts. Furthermore, companies that implement the ISO 14001 achieve competitive advantages and higher financial returns compared to those without this certification (Bansal & Bogner, 2002).

The NBR 16001 is a Brazilian standard subject to certification created by the Brazilian Association of Technical Standards in conjunction with other parts. Its first version was launched in 2004 and revised in 2012. This standard specifies requirements for the implementation of a Management System for Social Responsibility (SRMS) (ABNT, 2012a). The study by Soratto et al. (2006) points out that certification-related obstacles and compliance evaluation of ISO 16001

are related to the subjectivity of their requirements and the difficulty of quantifying objectives, goals and programs, according to the proposed issues.

The purpose of the 18001:2007 OHSAS is to establish a management system of Occupational Health and Safety (OHS) to eliminate or minimize risk to employees and other interested parties who could be exposed to OSH risks associated with its activities (BSI, 2007). The authors Fernández-Muñiz et al. (2009) developed a study to identify best safety management practices and analyze the results of these practices in a number of organizational performance indicators (e.g. personal injury, property damage, employee motivation, customer satisfaction, productivity, product quality, and others). The study sample consisted of 455 Spanish companies in which the model developed by the author was tested. Given this context, the authors concluded that the implementation of an occupational safety and health management system can reduce accidents and personal injury rates, improves working conditions, increases employee motivation, reduces absenteeism, improves image and business reputation, influences productivity and innovation and influences sales, profits and profitability.

2.2 Corporate sustainability

In 1983 the World Commission on Environment and Development (WCED) was created and it formulated and directed proposals to address the critical environmental issues. In 1987 this committee presented to the world the Brundtland Report, also known as "Our Common Future" which formalized the concept of sustainable development and is defined as "[...] development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (ONU, 2014, p. 9). The report presents three fundamental components of sustainable development which include environmental protection, economic growth and social equity.

Through these three components the concept developed by Elkington emerged, known as triple bottom line, which considers social, environmental and economic issues. The following are the pillars of triple bottom line (Elkington, 2001):

Social Pillar: The author states that the degree of trust between the organizations and their stakeholders is an important factor to achieve long-term sustainability. In addition, the social costs should be entered in the accounting. Social accountability "aims to assess the impacts an organization or company has on people (internal and external)". Issues such as training and education, relationship with the surrounding community, workplace and product safety, employment for minorities and philanthropy are being incorporated

into social costs. The concept behind the economic and social pillars brings forth issues such as business ethics, unemployment and rights of minorities;

Economic Pillar: The pillar of a business is profit. To calculate it the accountants include, record and analyze numerical data. In the context of sustainability there is a need for companies to develop an accounting model to enter the environmental and social accountability. For this it is necessary to understand that economic capital means the total value of its assets minus its liabilities. The capital of a company is composed of physical capital (e.g. machinery), financial capital, human capital and intellectual capital, and also the natural and social capital needs to be absorbed by the economic capital, where all externalities should be internalized.

The concepts between the economic and environmental pillars includes eco-efficiency, which takes into account goods and services that eliminate or minimize the environmental impacts in their production processes which contain quality and market competitiveness; and

Environment Pillar: In this pillar the author points out the need to take into account natural resources such as wood, water, soil, flora, fauna, biodiversity, greenhouse gas emissions such as carbon dioxide and methane in the atmosphere (from the consumption of non-renewable resources), use of renewable resources and other resources that sustain an ecosystem. In other words, organizations should ensure they are not exceeding the carrying capacity of the planet. A way to achieve this objective is by monitoring their environmental impacts and that of its suppliers, also in the entire production chain considering the product life-cycle management. The idea between the environmental and social pillars includes the issues related to environmental injustice, where people are disadvantaged due to environmental problems.

2.3 Putting into practice

Organizations are implementing tools to assist the insertion of sustainability in their contexts, as for example, the Ethos Indicators, the Corporate Sustainability Index and the Global Reporting Initiative (GRI).

The Ethos indicators for sustainable and responsible business are tools that help companies incorporate concepts related to corporate sustainability (Ethos, 2007). The tool consists of a questionnaire, where companies can perform management self-diagnosis and identify at which level the company is inserted, facilitating the incorporation of concepts that permeate corporate sustainability (Ethos, 2014). The indicators address seven major issues: values, transparency and governance, internal public, environment, suppliers,

consumers and customers, community, government and society (Ethos, 2007).

The Corporate Sustainability Index is

[...] a comparative analysis tool for the performance of companies listed on the BM&FBovespa under the corporate sustainability aspect, based on economic efficiency, environmental balance, social justice and corporate governance. (Bovespa, 2014).

Its mission is “[...] to induce companies to adopt corporate sustainability best practices and support investors in decision making of socially responsible investments” (Bovespa, 2014).

Another tool used by companies to demonstrate their sustainable performance is the Global Reporting Initiative (GRI). The GRI “[...] helps organizations to set goals, measure performance and manage changes in order to make their operations more sustainable”, by disseminating information of their economic, social and environmental impacts (GRI, 2013, p. 3). The goal of GRI is to

[...] help the reporters prepare relevant sustainability reports which include valuable information on the most critical sustainability issues for the organization and also make the process of sustainability reporting a standard practice. (GRI, 2013, p. 3).

This tool brings the concept of “materiality” which means that “[...] sustainability reports will focus on effective crucial issues to achieve their goals and manage their impacts on society”, making them more reliable and understandable (GRI, 2013, p. 3).

In this context, the Ethos Indicators, the Corporate Sustainability Index and the GRI indicate the key indicators that can be used by companies that want to achieve a higher level of maturity regarding sustainability. Therefore, these documents were the basis for identifying the key sustainability requirements that were listed in the relationship matrix.

2.4 Consolidating concepts

Companies are no longer considering only economic issues and have begun to align with social and environmental issues. These changes in ideas are directly related to the pressures imposed by the stakeholders. Therefore, some organizations are using standards of management systems such as ISO 14001, ISO 9001, OHSAS 18001 and NBR 16001 to help satisfy the aspirations of stakeholders and thereby become sustainable.

According to the literature review no studies that related these normative standards to corporate sustainability were identified. Therefore, the assumption was that the ISO 14001 standard represents the environmental pillar, the ISO 9001 standard

represents some elements of the economic pillar, the NBR 16001 represents the social pillar and the OHSAS 18001 represents some elements of the social pillar considering the “triple bottom line” model proposed by Elkington. Moreover, sustainability can be measured in organizations by using sustainability indicators such as those described in the Corporate Sustainability Index, the Ethos Indicators and the Global Reporting Initiative.

3 Methodology

This section will illustrate the steps taken to prepare the Relationship Matrix. This instrument helped identify the relationship between the management systems standards (ISO 9001, ISO 14001, OHSAS 18001 and NBR 16001) and corporate sustainability. The steps are as follows (Figure 1): exploratory literature review to identify the corporate sustainability requirements; reading and interpretation of the management system standards used; construction of the Theory Relationship Matrix; completion of the Theoretical Relationship Matrix; consultation with experts; compilation of the opinions of experts and creation of the Consolidated Relationship Matrix.

3.1 Step 1 – Selection of management system standards

The selection of management system standards used in the study followed the following criteria:

- i) Known management system standards ;
- ii) Management system standards that fit into the sustainability dimensions according to the Triple bottom line theory (environmental, social, economic and their interrelations);
- iii) Standards that are subject to certification.

3.2 Step 2 – Identification of corporate sustainability requirements

In this step the purpose was to identify the corporate sustainability requirements (Chart 1). Therefore an exploratory literature review was carried on the subject out and it identified that there is a range of studies that address the issue of corporate sustainability. The researchers considered three documents that point to the main sustainability indicators which can be used by companies striving to achieve a higher level of maturity regarding this matter. The requirements were based on the Corporate Sustainability Index (ISE), Ethos Indicators and the Global Reporting Initiative (GRI), considering the principle of “materiality”. As a result it was determined that these tools group the most important indicators of corporate sustainability.

The sustainability requirements were extracted by reading and interpreting these documents. Subsequently, the similar indicators were identified and then transformed into requirements. Therefore, the requirements were considered as: “[...] need or expectation that is stated generally implied or obligatory” (ABNT, 2005, p. 8). The requirements were listed and included in the lines of Theoretical Relationship Matrix. 89 requirements were identified as shown in Chart 1 (which presents the themes addressed by each corporate sustainability requirement).

3.3 Step 3 – Completion of the Theoretical Relationship Matrix

After identifying the corporate sustainability requirements and the list of requirements for management system standards, the researchers completed the matrix by analyzing the relationships between each sustainability requirement with the standards requirements. The scale used in the relationships was

Steps to develop the Relationship Matrix



Figure 1. Development Method of Relationship Matrix. Prepared by the authors.

Chart 1. Issues addressed in corporate sustainability requirements.

	Social	Environmental	Economic	Socio-environmental	Socioeconomic	Enviro- econ.	Soc-enviro- econ.
<p>REQUISITOS DA SUSTENTABILIDADE EMPRESARIAL</p>	<p>1. Engagement and dialogue policies with stakeholders (Ethos, 2007) and (ISE, 2013). 2. Value diversity, equity and non-discrimination (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 3. Social Responsibility in the supply chain (Ethos, 2007) and (ISE, 2013). 4. Engagement of stakeholders (Ethos, 2007) and (ISE, 2013). 5. Participation of public policies (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 6. Sponsorship of programs and campaigns (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 7. Vulnerable groups (Ethos, 2007). 8. Ethical principles (Ethos, 2007). 9. Human Rights (GRI, 2013). 10. Career Planning of employees (Ethos, 2007). 11. Internal preparation of employees (Ethos, 2007). 12. Hiring local residents (Ethos, 2007) and (ISE, 2013). 13. Hiring people with disabilities (Ethos, 2007). 14. Occupational diseases and work accidents (GRI). 15. Agreement between companies and unions (GRI, 2013).</p>	<p>16. Permanent Preservation Areas (PPA) (ISE, 2013). 17. Legal Reserve (ISE, 2013). 18. Environmental License (ISE, 2013). 19. Climate change (ISE, 2013). 20. Environmental policy (Ethos, 2007) and (ISE, 2013). 21. Biodiversity Conservation (Ethos, 2007) and (ISE, 2013). 22. Area or committee responsible for the environment (Ethos, 2007). 23. Study of Environmental Impact (Ethos, 2007). 24. Emergency plan (Ethos, 2007). 25. Monitoring risks and environmental aspects (Ethos, 2007). 26. Action Plan (Ethos, 2007). 27. Greenhouse effect (Ethos, 2007). 28. Renewable resources (ISE, 2013).</p>	<p>29. Intangible assets (ISE, 2013). 30. Competition Defense (ISE, 2013). 31. Corporate risk management (ISE, 2013). 32. Derivative financial instruments (ISE, 2013). 33. Monitoring indirect economic impacts (ISE, 2013). 34. Management of intangible assets (ISE, 2013). 35. Performance Management (ISE, 2013). 36. Competition Defense (ISE, 2013). 37. Financial statements in constant currency (ISE, 2013). 38. Generating economic value (ISE, 2013). 39. Direct economic value (income) (GRI, 2013). 40. Benefit plan (GRI, 2013).</p>	<p>41. Commitment of senior management with social and environmental issues (Ethos, 2007). 42. Incorporation of socio-environmental criteria in the organization's strategy (Ethos, 2007). 43. Communicate socio-environmental aspects to stakeholders (Ethos, 2007). 44. Social responsibility in the production chain (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 45. Evaluation of suppliers (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 46. Prepare socio-environmental report (Ethos, 2007). 47. Training suppliers on socio-environmental issues (Ethos, 2007) and (ISE, 2013). 48. Participation of Local and/or regional committee/councils (Ethos, 2007). 49. Support educational projects (Ethos, 2007). 50. Technical Support (ISE, 2013). 51. Provide information (Ethos, 2007). 52. Disclosure of environmental aspects and impacts (ISE, 2013). 53. Complaints and Grievance Mechanisms Related to Environmental Impacts (ISE, 2013).</p>	<p>54. Occupational Health and Safety Policy (Ethos, 2007) and (ISE, 2013). 55. Preparation of labor, compensation, benefits and career policies (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 56. Policies related to customers (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 57. Working conditions (Ethos, 2007) and (ISE, 2013). 58. Dialogue with stakeholders (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 59. Inclusion of local suppliers (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 60. Mapping skills (Ethos, 2007). 61. Identify employees with high incidence rates or high risk of illnesses related to their occupation (GRI, 2013). 62. Competition Defense (ISE, 2013). 63. Gender Distinction (GRI, 2013).</p>	<p>64. Environmental Improvement (Ethos, 2007). 65. Waste Management (Ethos, 2007). 66. Monitoring timber inputs (Ethos, 2007). 67. Preventive policies (Ethos, 2007). 68. Environmental quality (Ethos, 2007). 69. Final destination of the product (Ethos, 2007). 70. Reduce consumption of natural resources (Ethos, 2007). 71. Environmental liabilities (ISE, 2013). 72. Environmental degradation (ISE, 2013). 73. Product life cycle (ISE, 2013). 74. Monitoring significant environmental aspects (Ethos, 2007) and (ISE, 2013). 75. Consumption of natural resources in the production chain (ISE, 2013). 76. "Ecodesign" or DfE (Desing for Environment) (ISE, 2013). 77. Product Planning (ISE, 2013).</p>	<p>78. Communication policy (Ethos, 2007). 79. Ethical stance (Ethos, 2007). 80. Identify stakeholders (Ethos, 2007) and (ISE, 2013). 81. Dialogue with stakeholders (Ethos, 2007), (ISE, 2013) and (GRI, 2013). 82. Monitor the impacts of surrounding communities (Ethos, 2007). 83. Person responsible for ensuring the internal and external ethics of the organization (Ethos, 2007) and (ISE, 2013). 84. No action for unfair competition (Ethos, 2007) and (GRI, 2013). 85. Compliance with laws (Ethos, 2007) and (ISE, 2013). 86. Commitment to sustainable development (ISE, 2013). 87. Definition of responsibility and authorities (ISE, 2013). 88. Corporate opportunity management (ISE, 2013). 89. Contingency Plan (ISE, 2013).</p>

Prepared by the authors.

adapted from the relationship matrix of the Quality Function Development (QFD) method, as follows:

- ❖ Strong relationship (9) – when the corporate sustainability requirements are **directly** related to the requirements of management system standards;
- ❖ Weak relationship (3) – when the corporate sustainability requirements are **indirectly** related to the requirements of management system standards;
- ❖ Null relationship (0) – when the corporate sustainability requirements **have no relationship** with the requirements of management system standards.

3.4 Step 4 – Consultation with experts

This Step was to obtain a thorough analysis by experts in management system standards (ISO 9001, ISO 14001, OHSAS 18001 and NBR 16001) of the Theoretical Relationship Matrix to ensure greater reliability of the relationships.

3.4.1 Selection of experts

The selection criteria of experts were as follows:

- i) Have higher education;
- ii) Know in detail at least one of the management system standards (ISO 9001, ISO 14001, OHSAS 18001 and NBR 16001);
- iii) Have at least two years of practical experience using at least one of the management system standards studied in this research;
- iv) Recommended that participants have participated in specific courses related to management system standards.

3.4.2 Data collection procedure

The experts were first contacted via e-mail or phone to verify their interest in participating in the research. In addition, social network was used to publicize the research and find specialists interested in participating.

After their acceptance, the statement term containing the research objective, justification and confidentiality assurance of confidential information from the companies the experts worked at was sent via e-mail.

The data collection used a semi-structured questionnaire to guide the researcher during the interview. The interviews included presentations related to the research to help the experts understand the objective. Subsequently, the researchers explained to the experts the procedure to complete the Relationship Matrix.

When in-person interviews could not be conducted with the experts, the information was sent via e-mail and the Relationship Matrix was returned completed with their relevant relationships.

Approximately 55 experts in at least one of the standards analyzed in this study were invited. Six agreed to participate. Some justified their non-participation because of their time constraints and other specialists did not answer the e-mail.

Of the 6 experts, 3 completed the Relationship Matrix related to ISO 14001, 3 completed the Matrix related to ISO 9001, 1 completed the Relationship Matrix related to NBR 16001 and 1 completed the Relationship Matrix related to OHSAS 18001. Two experts completed the Relationship Matrices related to ISO 14001 and ISO 9001. The average period to return the completed relationship matrix was of approximately two months after initial contact with the experts. In addition, one of the researchers also completed all matrices, as an academic expert.

3.4.2.1 Profile of specialists

A Chart 2 describes the information and experience of the experts.

3.5 Step 5 – Data analysis and construction of Consolidated Relationship Matrix

Upon receipt of the matrices completed by the experts the Consolidated Relationship Matrix was prepared with the following steps: 1) the data from the matrices completed by specialists were transferred to a digital spreadsheet, and 2) the averages of the relationships assigned by experts and by the researcher were calculated according to each standard. Thus, the Consolidated Relationship Matrix represents the average values of the opinions (assuming that 0 = null relationship, 3 = weak relationship and 9 = strong relationship) of experts and of one of the researchers.

As the Consolidated Relationship Matrix is composed of averages (global, general and average value) the following analysis scale is now used to better understand and interpret the results as shown in Chart 3.

To understand the results it is important to know how the following averages were calculated:

- ❖ **Average value** = is the individual average of each relationship according to the answers given by the experts and by the researcher (value of each cell);

Chart 2. Information on the experience of experts.

Standard	Experts	Academic education	Years of experience	Concluded specific course
ISO 14001	1	Biology	3 years	Internal Auditor Course
	2	Postgraduate course in environmental management	4 years	Lead Auditor Course
	3	Production Engineering	5 years	Internal Auditor Course
ISO 9001	4	Materials Engineering	2 years	Lead Auditor Course
	2	Postgraduate course in environmental management	4 years	Lead Auditor Course
	3	Production Engineering	5 years	Internal Auditor Course
NBR 16001	5	Administration	8 years	No
OHSAS 18001	6	Postgraduate course in environmental studies	18 years	Lead Auditor Course

Prepared by the authors.

Chart 3. Data analysis scale.

0 = null Relationship
0 > and ≤ 1.5 = Weak Relationship
1.5 > and ≤ 3 = Moderate Relationship
3 > and ≤ 9 = Strong relationship

Prepared by the authors.

❖ **Overall average** = is the average relationship between each of the sustainability requirements with each requirement of the management system standards (averages of the lines or columns); and

❖ **Global average** = the average of all existing relationships considering each dimension.

The research method allows users to interpret the results in the following ways:

1. Considering the mean values (value of each cell). This allows the user to identify the relationship between each corporate sustainability requirement with each requirement of the management system standard used;
2. Analyzing and interpreting the global mean values (average of rows and columns). This allows the user to interpret the general relationship of each sustainability requirement with the various system management requirements (line) or of each requirement of a specific management system with various sustainability requirements (column);
3. Analyzing and interpreting the global mean values (average of all existing relationships considering each dimension). This allows the

user to identify the global relationship of all sustainability requirements with the management system standard analyzed.

In this study the researchers decided to use the number analysis 2 and 3, because the relationship between the sustainability requirements and the requirements of the management system standard were analyzed considering the general and global averages. This type of analysis was used because the researchers wanted to identify the relationships considering the standards as a whole and not analyze details such as Option 1. The authors believe that, although only one requirement of a management system may be responsible and sufficient for fulfilling one or more sustainability requirements, the support would be more effective if different requirements of the standards relate to various sustainability requirements.

Figure 2 shows the Consolidated Relationship Matrix showing the average values (4.5; 3.75; 2.25 and 0.75), the overall averages (3.46; 3.08; 1.73; 1.5 and 1.04) and the global average (2.06).

4 Results and discussions

The analysis of the global averages in Chart 4 shows that the ISO 9001 had a weak relationship with business sustainability in all dimensions. All of the global averages showed values below 1 and some close to 0.

Regarding the OHSAS 18001, it is observed that the environmental – social – economic dimension had a null relationship with business sustainability. The other dimensions showed weak relationship as shown in Chart 4.

The analysis of the global averages in the matrix relating to ISO 14001 showed that this normative standard has a moderate relationship with business

Requirements of ISO 14001 Corporate Sustainability Requirements	4.1	4.2	(...)	4.6	Overall Average – Requirements of ISO 14001
	General Requirements	Environmental Policy	(...)	Administrative analysis	
16. Ensure preservation of Permanent Preservation Areas (PPA) (ISE, 2013).	2.25	3.75		2.25	3.08
(...)			(...)		
28. The management processes of the company should incorporate the sustainable use of renewable natural resources as a priority requirement (ISE, 2013).	0.75	4.5		2.25	1.5
Overall Requirement of ISO 14001	1.04	3.46		1.73	2.06

Figure 2. Consolidated Relationship Matrix. Prepared by the authors.

Chart 4. Overview of the relationships between management system standards and requirements of corporate sustainability considering the global averages.

Dimensions	Management system standards			
	NBR 16001	ISO 14001	ISO 9001	OHSAS 18001
Social	2.4 °	0.7 Δ	0.8 Δ	0.3 Δ
Environmental	3.1 *	2.1 °	0.2 Δ	0.1 Δ
Economic	1.1 Δ	0.2 Δ	0.1 Δ	0.1 Δ
Socio-environmental	2.8 °	1.6 °	0.1 Δ	0.1 Δ
Socioeconomic	3.3 *	0.4 Δ	0.6 Δ	0.5 Δ
Economic - Environmental	3.2 *	2.1 °	0.2 Δ	0.2 Δ
Social - environmental - economic	3.5 *	1.7 °	0.3 Δ	0 □

* = strong relationship. ° = Moderate relationship. Δ = Weak relationship. □ = null relationship. Prepared by the authors.

sustainability. The dimensions with the highest global average were economic–environmental (2.07), environmental (2.06) and the dimension with the lowest overall average was economic (0.22) as shown in Chart 4.

Regarding the NBR 16001 it is observed that this normative standard has a strong relationship with corporate sustainability, as of the 7 dimension analyzed 4 showed strong relationship, such as: social-environmental-economic (3.45), socioeconomic (3.31), economic-environmental (3.2) and environmental (3.04) as shown in Chart 4. These results are related to the fact that NBR 16001 addresses social, environmental and economic issues.

Chart 5 shows a mapping of the relationships between the management system standards NBR 16001, ISO 14001, ISO 9001 and OHSAS 18001 and the corporate sustainability requirements that were summarized in the themes as shown in Chart 1 (section 3.2). Chart 5 shows the sustainability dimensions analyzed (social, environmental, economic, socio-environmental, socioeconomic, economic–environmental and environmental – social and economic) and the relationships (strong, moderate, weak and null) between the corporate sustainability requirements and the management system standards.

The numbers in the Chart are related to the sustainability requirements shown in Chart 1. All discussions will now be based on Chart 5.

Chart 5. Mapping of the relationship between the management system standards and the 89 corporate sustainability requirements.

	Strong	Moderate	Weak	Nula Null	
NBR ISO 16001:2012	Social	2, 4, 9 and 14	1, 3, 5, 7, 8, 12, 13 and 15	6, 10 and 11	
	Environmental	16, 17, 18, 19, 21, 23, 24 and 25	20, 22, 27 and 28	26	
	Economic			29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 and 40	
	Socio-environmental	43, 47, 51 and 52	41, 42, 44, 45, 49, 50 and 53	46 and 48	
	Socioeconomic	54, 55, 56, 57, 61 and 63	58, 59, 60 and 62		
	Econ.- envi.	65, 67, 68, 69, 70, 74, 75, 76 and 77	71, 72 and 73	64 and 66	
	Envi. - Soc. - Econ.	78, 79, 80, 81, 82 and 89	83, 84, 85, 86, 87 and 88		
ISO 14001:2004	Social		9	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14 and 15	
	Environmental	16	17, 18, 19, 20, 21, 22, 23, 24 and 25	26, 27 and 28	
	Economic			29, 30, 31, 32, 33, 34, 35, 36, 37, 38 and 39	40
	Socio-environmental		41, 42, 43, 44, 45, 52 and 53	46, 47, 48, 49, 50 and 51	
	Socioeconomic			54, 55, 56, 57, 58, 59, 60, 61, 62 and 63	
	Econ. - envir.	65	64, 65, 66, 67, 68, 69, 70, 71, 74, 75 and 76	72, 73 and 77	
	Envir. - Soc. - Econ.		78, 79, 80, 82, 83, 86 and 89	81, 84, 85, 87 and 88	
ISO 9001:2008	Social		1	2, 3, 4, 6, 8, 9, 10, 11, 13, 14 and 15	5, 7 and 12
	Environmental			16, 17, 18, 20, 21, 22, 24, 25, 26, 27 and 28	19 and 23
	Economic			29, 35, 36, 39 and 40	30, 31, 32, 33, 34, 37 and 38
	Socio-environmental			41, 42, 43, 44, 45, 48, 49, 50, 51, 52 and 53	46 and 47
	Socioeconomic		56	54, 55, 57, 58, 59, 60, 61 and 62	63
	Econ.- envir.			64, 65, 66, 67, 69, 70, 71, 73, 74, 75, 76 and 77	68 and 72
	Envir. - Soc. - Econ.			78, 79, 80, 81, 82, 83, 84, 85, 86, 87 and 88	89

Prepared by the authors.

Chart 5. Continued...

		Strong	Moderate	Weak	Nula Null
OHSAS 18001:2007	Social		4	1, 3, 8, 9, 10 and 14	2, 5, 6, 7, 11, 12, 13 and 15
	Environmental			24, 25 and 26	16, 17, 18, 19, 20, 21, 22, 23, 27 and 28
	Economic			29, 30 and 35	31, 32, 33, 34, 36, 37, 38, 39 and 40
	Socio-environmental			41, 44, 45, 46 and 47	42, 43, 48, 49, 50, 51, 52 and 53
	Socioeconomic			54, 55, 57, 58, 60 and 61	56, 59, 62 and 63
	Econ. - Envir.		67	65	64, 66, 68, 69, 70, 71, 72, 73, 74, 75, 76 and 77
	Envir. - Soc. - Econ.				78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88 and 89

Prepared by the authors.

4.1 ABNT NBR 16001:2012 – Social responsibility – Management system – Requirements

The social dimensions of the issues that had a strong relationship with the NBR 16001 were: stakeholder engagement, human rights and occupational diseases and accidents. These issues can be clearly identified in the NBR 16001 as they evidence the strong relationships between these issues.

One of the principles of social responsibility highlighted by the standard is ethical behavior (3.2. *Social Responsibility Policy*), however, this issue had a moderate relationship with the NBR 16001.

One of the central issues highlighted by the standard is related to community involvement and development, but this issue had a moderate relationship according to the results obtained in this work.

The prevention of pollution and compliance with legal requirements had strong relationships with the environmental dimension because the NBR 16001 takes these issues into consideration.

In the socio-environmental dimension the issue of communication with the stakeholders showed a strong relationship with NBR 16001. This relationship can be evidenced by the fact that the standard includes requirement 3.4.3 *Communication*, in which the organization should periodically disclose data related to social responsibility and maintain communication with the stakeholders.

Analyzing the socioeconomic dimension the issues that showed a strong relationship with the NBR 16001 were: occupational health and safety, customer relations and ensuring human rights. These issues can be inserted in the core subjects of social responsibility highlighted by NBR 16001, namely: labor practices, human rights and consumer issues (ABNT, 2012a). Weak and null relationships were not identified in this dimension.

4.2 ABNT NBR ISO 14001:2004 – Environmental management system: Requirements with guidelines

The social dimension that showed a moderate relationship with ISO 14001 is related to assuring human rights. The ISO 14001 does not have a specific requirement related to this issue, however, human rights must be guaranteed in every situation and context.

In the environmental dimension the preservation of Permanent Preservation Areas (PPA) had strong relationship with ISO 14001. The issues related to environmental licensing, climate change, environmental impact study, and others had moderate relationships. It is observed that all the issues listed above are related to compliance with legal requirements and the commitment that organizations establish when they implement an environmental management system based on ISO 14001. According to the study by Heras-Saizarbitoria et al. (2011) which identified the motivations that lead companies to adopt ISO 14001,

compliance with environmental laws and regulations was highlighted as one of the main reasons that companies implement this system.

The development of environmental policy had a strong relationship with ISO 14001. This issue is included in requirement 4.2 *Environmental Policy* which addresses the commitment of the company to maintain the environmental management system.

Analyzing the economic dimension, the issues showing a weak relationship with ISO 14001 were: corporate risk management, performance management, intangible assets management, direct economic value, among others. However, the authors Bansal & Bogner (2002) state that a properly adopted EMS allows a company to achieve greater organizational efficiency and effectiveness by reducing the costs and the environmental impacts. In addition, companies that have adopted ISO 14001 achieve competitive advantages and higher financial returns when compared to companies without certification. The maintenance and renewal of the environmental management system certificate (ISO 14001) should be sufficiently significant to justify the financial costs involved (Bansal & Bogner, 2002).

Regarding the socio-environmental dimension, the commitment of senior management to social and environmental issues showed a moderate relationship with the ISO 14001. According to the Brazilian Association of Technical Standards (ABNT, 2005) senior management should commit to implementing and maintaining the EMS by providing the necessary resources (financial and human). The disclosure of environmental aspects and impacts was an issue that showed a weak relationship with the ISO 14001 considering the overall average (2.42). However, this issue is included in requirement 4.3.1 *Environmental aspects*, in which the organizations must identify the significant environmental aspects and impacts. A meticulous analysis of the Consolidated Relationship Matrix showed a strong relationship (mean value = 6.75) between the corporate sustainability requirement that addresses this issue and the requirement 4.3.1 *Environmental aspects* of ISO 14001.

Analyzing the results obtained in the environmental-social-economic dimension the commitment to sustainable development showed a moderate relationship with ISO 14001. This result indicates that the ISO 14001 is only an instrument to assist sustainable development.

4.3 ABNT NBR ISO 9001:2008 – Quality management system – Requirements

The subject related to occupational health and safety had a weak relationship with ISO 9001. The study by Depexe & Paladini (2008) in the state of Santa

Catarina (BR), which included 14 companies in the civil construction sector, identified the perception of companies related to the benefits obtained by the implementation and certification of quality management system. The study showed that the main benefits related to employees are: improving occupational health and safety, increased job satisfaction, increased workers' suggestions, turnover reduction, reduced absenteeism and increased workers skills, associated with internal preparation. Thus, the study by Depexe & Paladini (2008) confirms the relationship identified in this study, showing that the ISO 9001 can help companies incorporate (indirectly) issues related to occupational health and safety.

The issues that had null relationships with ISO 9001 inserted in the economic dimension were: competition defense, corporate risk management, monitoring economic impacts, intangible assets management, economic profit, among others. However, according to the Brazilian Association of Technical Standards (ABNT, 2008b) the benefits associated with the implementation of a quality management system based on ISO 9001 are: increased profitability, higher revenues, improved budgetary performance, cost reduction, improved cash flow, increased return on investment, improved competitiveness, among others. Therefore, according to the Brazilian Association of Technical Standards (ABNT, 2008b) the ISO 9001 can help companies (indirectly) obtain economic benefits, confirming the relationship found in this study.

Considering the socio-economic dimension, the issue that presented a moderate relationship with the ISO 9001 is related to preparing customer policies. This issue is part of requirement 5.2 *Customer focus* of the standard. According to the Brazilian Association of Technical Standards (ABNT, 2008a), senior management must make a commitment to meet customer requirements. In addition, customer focus is one of the quality management principles, such as leadership, involvement of individuals, process approach, management system approach, continual improvement, factual approach to decision making and mutually beneficial relationships with suppliers.

4.4 OHSAS 18001:2007 – Occupational safety and health management system – Requirements

Considering the social dimension, the issues that showed weak relationships with the OHSAS 18001 were: types and rates of injuries, occupational diseases, lost days, absenteeism and number of work-related fatalities. However, the study by Fernández-Muñoz et al. (2009) identified best practices in safety management and analyzed the results of these practices in a set of organizational performance indicators (e.g. Personal

injury, property damage, employee motivation, customer satisfaction, productivity, product quality, among others). The study sample was composed of 455 Spanish companies, in which the model developed by the author was tested. In this context, the author points out that the implementation of occupational safety and health system management can reduce accident rates, personal injuries, improves working conditions, increases employee motivation, reduces absenteeism, among others. The analysis of the other dimensions showed that most relationships were null.

5 Conclusions

The analysis of the consolidated relationship matrix showed that NBR 16001 has a strong relationship with corporate sustainability. However, this is the standard that has lower acceptance by companies, perhaps because social responsibility is an issue that is beginning to be systematically inserted in organizations. The dimensions with global averages in strong relationships were the dimensions: environmental, socioeconomic, economic – environmental and social– environmental – economic. This normative standard showed a strong relationship with corporate sustainability for considering environmental, social and economic issues.

The ISO 14001 showed moderate relationship with corporate sustainability, because this standard does not directly consider economic and social issues. The environmental dimension had the highest overall average (2.02), declaring the assumption accepted in the beginning of the research that this normative standard represents the environmental pillar. Thus, it can be concluded that ISO 14001 is a tool that can be used to help businesses to be sustainable, however its use alone will not guarantee business sustainability.

The analysis of the relationship matrix enabled to conclude that ISO 9001 has a weak relationship with business sustainability. This was because ISO 9001 does not directly address economic, social and environmental issues. Thus, we conclude that ISO 9001 is a tool that can be used to help businesses be sustainable, however its use alone will not guarantee business sustainability.

The OHSAS 18001 showed a weak relationship with corporate sustainability. The corporate sustainability requirements inserted in the environmental – social – economic dimension showed all the null relationships with the requirements of this standard. This occurred because this standard does not directly consider economic and environmental issues. It can then be concluded that the OHSAS 18001 is a standard that can be used to help businesses to be sustainable, however, its use alone does not ensure corporate

sustainability, since it has only some characteristics in the social pillar.

It should be noted that the study has some limitations, namely:

- i) The results were interpreted considering the general and global averages, that is, we analyzed the standards as a whole as proposed by the method;
- ii) The number of experts consulted could have been higher;
- iii) Other standards could have been entered in the search scope, however, time was a limiting factor.

Suggestions for future work are:

- i) Increase the number of experts consulted to statistically analyze the data;
- ii) Insert other standards in the study that are part of the ABNT (2012b) selected for sustainability, such as ISO 14062:2004, ISO 14040:2009, ISO 14044:2009, ISO 9004:2008, ISO 10002:2010, ISO 10014:2008, ISO 31000:2009, ISO 50001:2011, NBR 18801:2010 and ISO 26000:2010; and
- iii) Update the research, considering that by the completion of this study (July/2015) there will be more current versions of the ISO 9001, ISO 14001 and OHSAS 18001 standards.

The following are recommendations for managers who want to implement these management systems in order to insert sustainability in their contexts:

- i) The ISO 9001 will probably not directly help to achieve this goal. However, the implementation of a quality management system based on this normative standard can ensure one of the elements that constitutes corporate sustainability and which is related to the delivery of quality products to customers. This standard alone does not represent the economic dimension. The economic benefits generated can be a consequence of the implementation of this system;
- ii) The OHSAS 18001 is a normative standard that encompasses only one element of corporate sustainability, which is related to ensuring the health and safety of employees and contractors in the workplace. Therefore this standard alone does not represent the social pillar. However, by implementing an occupational health and

safety system companies are moving towards sustainability, therefore it is recommended to implement this management system;

iii) According to this study, the ISO 14001 has a strong relationship with the issues related to compliance with applicable legal requirements, it introduces the issue of preventing pollution in its scope, it helps to identify significant environmental aspects and impacts, among other issues. Therefore, this normative standard represents the environmental dimension, that is, companies that have implemented environmental management system based on this standard can insert these issues in their contexts. In this context, the ISO 14001 used alone does not guarantee the inclusion of sustainability in corporate environments, as it does not address social and economic issues;

iv) Regarding the NBR 16001, this study points out that this normative standard was the one that best presented the elements of corporate sustainability. Therefore, it is recommended to use this normative standard as a means for companies to insert the social, environmental and economic issues in their contexts.

The following are recommendations to participants of review committees of the normative standards studied: The ISO 14001, ISO 9001 and OHSAS 18001 could include in their scope the need to identify the stakeholders, maintain dialogue and engagement with them, and also indicate the need for companies to monitor their impacts (environmental, social and economic) considering all stakeholders. With respect to NBR 16001, the inclusion of sustainable elements related to economic dimension is recommended (e.g. corporate risk management) and also the development of more detailed and clear requirements.

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