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Article

Criteria determining sustainability management in the construction sector

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Abstract: It is important for society to know the actions implemented by companies in the construction sector to reduce the environmental pollution generated by this industry and to contribute to the solution of economic and social problems in their environment; however, the variables that allow identifying their contributions and impacts are not known. Based on this problem, the study focuses on identifying the factors that influence sustainability management within the construction sector in Colombia. The research presents a predictive approach and uses a quantitative methodology, applying statistical modeling techniques. The sample corresponds to 84 Colombian companies. As a result, a system of equations of the form y = mx + b is presented to describe the deviation of the environmental, economic, social, compensation measures, management, indicators and sustainability reports. The analysis of the intersections constitutes a projective tool to evaluate the relationships and balance points between the dimensions analyzed, helping to identify strengths and opportunities for improvement.

Keywords: sustainable development; sustainability management; construction industry; sustainability reports

1. Introduction

The construction sector plays a preponderant role in the development of the regions, not only because of its social purpose but also because of the labor force it provides, the economic dynamism it generates and the environmental impact that also derives from this activity. For this reason, it is important that companies belonging to this industry assume a clear vision of the importance of sustainable development, know the impact of their activities and define the way in which they mitigate them and contribute to the achievement of the Sustainable Development Goals (SDGs) (Lima et al., 2021; Murtagh et al., 2020). There are different mechanisms that allow measuring the progress and results of companies regarding the 2030 Agenda and their contribution to the achievement of the SDGs, such as the Global Compact Guide, the Global Reporting Initiative (GRI), the SA 8000 Standard, the ISO 26,000 Standard, the Ethos Indicators of social responsibility, the AA 1000 Assurance Standards, among which, the universal measurement standard Global Reporting Initiative (GRI)—has been selected as a tool for this study, given its scope and application coverage (Hernández et al., 2020; Ürge-Vorsatz et al., 2020).

The Global Reporting Initiative (GRI) was created in 1997 by the UN as an independent institution with the purpose of defining the guidelines for the preparation of sustainability reports by companies that wish to evaluate their economic, environmental and social performance, and make it known to the public. These

standards are organized into three groups: GRI 101 related to the principles on which sustainability reports are based, GRI 102, which reflects the content of the sustainability report, and GRI 103, which describes how the sustainability report is managed (Acevedo and Piñeros, 2019). A key element in this area is the analysis of materiality; in this sense, materiality is understood as the relevant issues of the company that implies taking charge of its main impacts and risks. Therefore, materiality is going to be defined by those impacts and risks that may affect its normal development and sustainability over time; it consists then in pointing out those matters especially relevant for the sustainability of an organization, inasmuch as they reflect its most significant economic, environmental and social effects and/or substantially influence the assessments, decisions and perceptions of its stakeholders (Huerta and Gaete, 2017).

Materiality corresponds to social, environmental and economic aspects that are significant for the fulfillment of the organization's objectives, and that exert influence on the decision-making of the different stakeholders. It is important then to understand the meaning of materiality, why the issue is material, the coverage, i.e., where the impact occurs and the implication it represents for the entity (Moneva and Hernandez, 2009; Mio et al., 2020). To meet the requirements of the sustainability report for each material issue, the explanation of how the organization manages the issue, the statement of the purpose of the management approach and the aspects that include policies, commitments, objectives and goals, responsibilities, resources, formal mechanisms for complaints and grievances and specific actions such as process, projects, programs and initiatives must be made (Rubio-Rodriguez et al., 2021). Similarly, as a management approach for each material issue, aspects such as: type and location, expected result, expected time frame, binding nature of objectives, legislation and responsible for management should be considered (Beske et al., 2020; Menichini and Salierno, 2023).

Under this context it is relevant to make an analysis of stakeholders understood as the internal and external groups of a company that have their own objectives, shareholders, employees, managers, customers, suppliers and competitors, so that the achievement of these is linked to the performance of the company (Johnson-Cramer et al., 2022). The company's objectives are the result of a process of negotiation and adjustment between the different groups. The conflict of objectives between groups arises as a consequence of the incompatibility of achieving the expectations of all of them at the desired levels. Through negotiation, a balance is reached by setting an objective that tries to integrate everyone's objectives. It then assumes that all groups have equal decision-making power and freedom to participate; however, the group with greater power conditions the rest of the groups, imposing its objectives.

On the other hand, according to the GRI methodology, sustainability reports should include aspects such as general company information, production, infrastructure, air pollution, liquid discharge, solid waste, odors, debris and water use. This aspect is key in the sustainability management of companies in the construction sector, which also includes the environmental, economic, social dimension, compensation measures, management, provision of indicators and measurements and sustainability reports (Vargas, 2015), key aspects that contribute to sustainable development as presented in **Table 1**.

Table 1. Components reports GRI.

GRI 101: Fundamentals	**GRI 102: General information**	**GRI 103: Management approach**
Principles for sustainability reporting The use of GRI standards for sustainability reporting Drafting statements related to the use of GRI standards	Name of the organization Business activity, products and services Location of headquarters and operations Ownership and legal form Markets and services Size of the organization Employee and labor information Supply chain Precautionary principle or approach External initiatives Membership in associations	Reports on the management approach to each material topic Contents 103–1 Explanation of the material topic and its coverage 103–2 The management approach and its components 103–3 Evaluation of the management approach
Thematic standards to provide specific information on each material topic		
Economic: GRI 200	Environmental: GRI 300	Social: GRI 400

Source: own elaboration with information from GRI.

In relation to the GRI reporting components, the environmental dimension focuses on reducing the ecological impact of construction activities. This includes practices such as efficient use of resources, waste management and minimization of carbon emissions. The implementation of renewable energy and sustainable materials are fundamental to protect the environment (Clark and Tilman, 2017). For its part, the economic dimension relates to promoting the long-term economic viability of companies in the sector; this is achieved through innovation, operational efficiency and contribution to local economic development without degrading natural resources (Gull et al., 2023). Meanwhile, the social dimension addresses the welfare of the community and employees, promoting fair labor practices and fostering social inclusion and equity; it also includes employment generation and contribution to community development (Garay et al., 2021). Finally, compensation measures comprise actions to mitigate negative impacts of construction operations, such as reforestation, habitat restoration and compensation to affected communities (Teodorovicz, 2014).

As for sustainability management, it involves incorporating sustainability into organizational strategy and corporate decisions (Nishant et al., 2020). This includes corporate governance, respect for human rights and commitment to ethical and transparent practices (Carroll and Brown, 2018). The provision of indicators and metrics are also fundamental to the monitoring and evaluation of sustainable practices; it includes the development and application of specific indicators to measure progress in environmental, economic and social dimensions (Willekes et al., 2022). From these elements it follows that sustainability reports and reports are vital documents to inform stakeholders about how companies manage and affect natural and social resources, facilitate transparency and help companies to be accountable for their sustainability practices (Hahn and Kühnen, 2013). In this context, the question arises: What are the fundamentals for assessing sustainability management in the construction sector?

2. Methodology

This research is conceived as a descriptive study because it seeks to characterize and describe the sustainability dimensions of the construction sector in Colombia. This

approach allows detailing current practices and policies without manipulating variables, providing a clear picture of the current situation of the sector in relation to sustainability (Smith, 2022). The scope of the research is conclusive, which implies that it was designed to provide accurate and reliable information that can be used to make informed decisions.

As part of the methodology, predictive study techniques are used, using modeling statistics to project results and understand future trends in sustainability management. This allows anticipating changes and adjusting intervention strategies in time, relying on advanced statistical software for robust and detailed analysis (Johnson and Onwuegbuzie, 2021; Lee, 2022). The study population comprises companies in the construction sector in Colombia, selected through non-probabilistic sampling. Given the indeterminate nature of the exact number of companies due to the informality of the sector, it was decided to include 84 companies of different sizes: micro, small, medium and large. This selection was based on the researchers' judgment and the accessibility of the companies to collect the required data (Gómez, 2023).

The sample selected for the study shows a predominance of construction companies (61.2%), followed by hardware stores (16.5%) and other types of businesses in the construction sector (22.4%). The economic activity of these companies is concentrated in the construction of residential buildings (34.1%), followed by specialized civil engineering (20.9%), highlighting the importance of infrastructure projects in this sector. Geographically, the companies under study are mainly located in Bogotá (46.2%) and Ibagué (34.1%), suggesting a high concentration in these Colombian cities. In terms of size, 45.1% of the firms are large, while microenterprises represent 37.4%, showing a polarization between large and small firms. The age of the companies reveals that 38.5% are less than 9 years old, indicating a dynamic sector with a high number of recent companies.

The software used by the research team is licensed for use; its application is the exclusive responsibility of the team, so SPSS Version 25 and Rstudio software were used for the respective quantitative analysis of the information (Bausela, 2005). Thus, the report begins with the theoretical conceptualization and progresses to the characterization of the information, providing the basis for the statistical analyses. During the preparation of the first report, information gaps were detected in several variables and companies, as detailed in the data characterization. These gaps were addressed by assigning scale 7, which is located outside the proposed scale and represents outliers in the data. This strategic approach ensures completeness and consistency in the analysis.

The reliability and consistency of a primary data collection instrument refers to the uniformity of the measurements, constituting a principle to ensure the accuracy of the results. In this sense, authors Quero (2010) and Walton et al. (2013), indicate that reliability refers to the consistency of an instrument and constitutes the relative absence of measurement errors in a measurement instrument. Consequently, it is considered reliable when the measurements made with the instrument produce consistent results at different times, scenarios and populations, provided that it is applied under similar conditions (Atmanspacher et al., 2014; Manterola et al., 2018; McHugh, 2012).

Therefore, the reliability index for the statistical analysis is determined by means of Cronbach's Alpha coefficient, which is a measure of internal consistency that allows us to evaluate the extent to which the items of the instrument are correlated, offering an estimate of the reliability of the scale; that is, the value is calculated as the average of all the correlation coefficients. From another perspective, Cronbach's coefficient can be conceived as the average of all the correlations resulting from the possible divisions by halves (Zigler et al., 2023). In this research Cronbach's alpha is 0.98 (close to 1), which shows a high consistency of the variables that are correlated with each other and measure the same sustainability construct.

To perform an accurate analysis of position and dispersion statistics and identify the behavior of the variables that determine sustainability in the construction sector, it is essential to use reliable metrics. The mean provides an overview of the data, but can be affected by extreme values, while the median, which is positioned in the center of the ordered data set, provides a central value that is less susceptible to such extremes. The mode reflects the most frequently occurring value, useful for identifying common trends within the data set (Altman and Bland, 1995; Runkler, 2020). In turn, the dispersion statistics allow measuring the variability of the data and the variance facilitates observing the amplitude between each value and the mean; for its part, the standard deviation represents a measure of dispersion in the same units as the data, and the coefficient of variation compares data sets with different scales and measures the variability of the data (Runkler, 2020; Rodríguez, 2010).

On the other hand, for the development of the study, a statistical analysis was carried out with 66 variables distributed in seven components of corporate sustainability integrated in the previously validated instrument that was administered to 84 companies. These components are broken down into specific dimensions, including 11 environmental variables, 7 economic variables, 3 social variables, 10 variables related to compensation measures, 15 variables focused on management, 7 variables associated with the provision of indicators, and finally 3 variables dedicated to sustainability reports and memories. These variables make it possible to advance an integral evaluation that addresses various aspects to ensure a comprehensive understanding of corporate sustainability as detailed in **Table 2**.

Table 2. Dictionary of variables.

Code	Environmental Dimension
S.1.1	Energy efficiency or use of clean energies: Solar or geothermal energy
S.1.2	Solid waste management
S.1.3	Use of sustainable materials
S.1.4	Verification of provenance and management of the use of sustainable materials
S.1.5	Responsible water consumption and conservation measures
S.1.6	Quantification and control of greenhouse gas emissions
S.1.7	Identification and control of liquid discharges
S.1.8	Air pollution management
S.1.9	Construction noise control
S.1.10	Biodiversity protection through specific programs and actions.
S.1.11	Commitment and adoption of measures to reduce the carbon footprint.

Table 2. (*Continued*).

Cód.	**Economic Dimension**
S.2.1	Promotion of local development
S.2.2	Construction of sustainable infrastructure
S.2.3	Circular economy promotion and practices
S.2.4	Sustainable urban mobility solutions
S.2.5	Commitment and actions to promote urban sustainability
S.2.6	Promotion of sustainable innovation
S.2.7	Sustainable and smart roads
Cód.	**Social Dimension**
S.3.1	Generation of local employment
S.3.2	Social responsibility actions
S.3.3	Overt social equity actions
S.3.4	Measures for the protection of human rights
S.3.5	Social inclusion and diversity
S.3.6	Occupational health and safety
S.3.7	Decent working conditions for all workers
S.3.8	Construction of schools, hospitals and community centers
S.3.9	Measurement and promotion of employee well-being
S.3.10	Promotion of education and sports
S.3.11	Housing with access for vulnerable communities
S.3.12	Support for training
S.3.13	Projects with social impact such as wind and solar farms, among others
Code	**Compensation measures**
S.4.1	Reforestation, creation or preservation of green spaces
S.4.2	Support for the provision of health services
S.4.3	Landscape management, aesthetic and ecological improvement
S.4.4	Support for educational programs
S.4.5	Donations to non-profit entities
S.4.6	Housing plans and programs
S.4.7	Development of community projects
S.4.8	Employee family benefit plan
S.4.9	Scholarships for employees' families
S.4.10	Additional compensation measures implemented
Cód.	**Management**
S.5.2	Supplier selection based on sustainability criteria
S.5.3	Respect for human rights
S.5.4	Research in sustainable development
S.5.5	Governance/Corporate governance
S.5.6	Taxation and control
S.5.7	Risk control and management
S.5.8	Equal pay regardless of gender

Table 2. (*Continued*).

Cód.	Management
S.5.9	Occupational health and safety measures
S.5.10	Two-way communication with stakeholders
S.5.11	User satisfaction evaluation and management
S.5.12	Standardization of internal practices with partners
S.5.13	Inclusion of sustainability in quality management system
S.5.14	Integration of sustainability in the strategic plan
S.5.15	Accountability
Cód.	**Provision of indicators and measurements**
S.6.1	Environmental indicators and environmental impact measurement
S.6.2	Economic indicators and measurement of economic impact
S.6.3	Social indicators and social impact measurement
S.6.4	Cultural indicators and measurement of cultural impact
S.6.5	Inclusion of results in management reports
S.6.6	SDG indicators and measurement
S.6.7	Management of improvement plans
Cód.	**Sustainability reports**
S.7.1	Prepares and shares sustainability reports
S.7.2	Produces and shares sustainability reports
S.7.3	Publishes sustainability reports on the web

3. Results

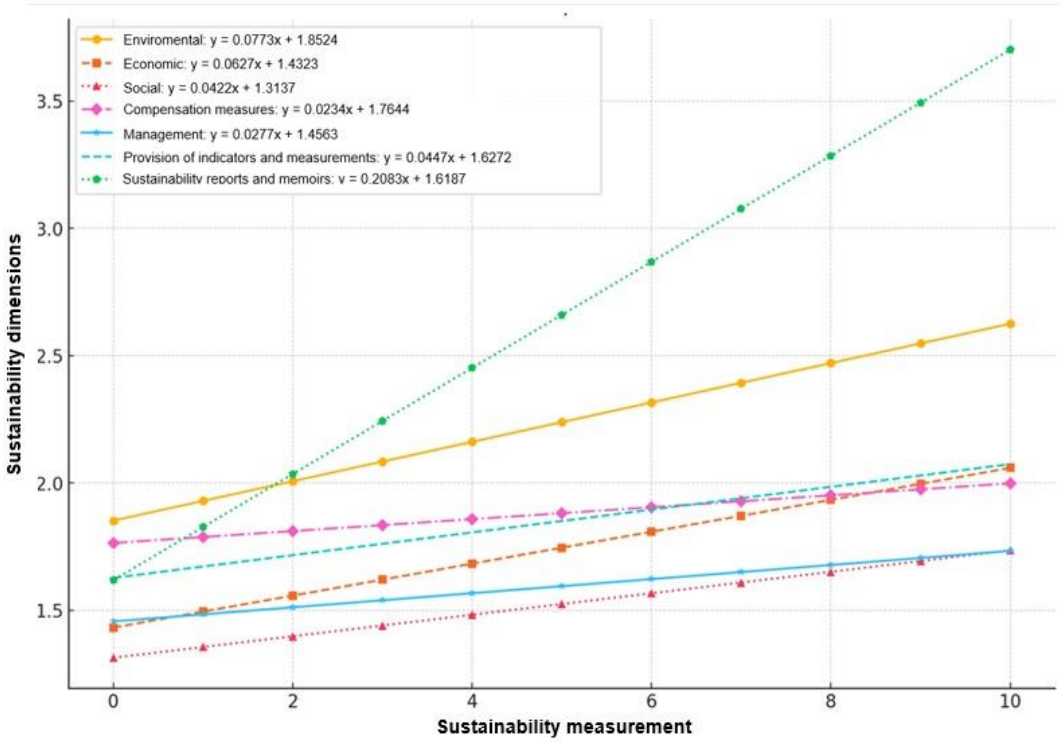

Figure 1. Deviation of the dimensions for sustainability management assessment.
Source: Own elaboration.

The data for the measures of central tendency of each dimension are presented below, together with the measures of dispersion. Additionally, the graphical representation of the integrated dimensions showing the variability of each component in **Figure 1** is used to visualize the dispersion.

Table 3 reveals significant patterns in the implementation of sustainable practices. "Responsible water consumption and conservation measures" stands out with a mean of 4.8 and a mode of 6, indicating high performance and consistency in its implementation, probably reflecting the prioritization of water resources as critical for sustainability. On the other hand, "Air pollution management" shows the lowest values in all measures of central tendency, with a mean of 3.5 and a mode and median of 3, suggesting that this area needs significant attention and improvement within environmental practices. The variables "Solid waste management" and "Verification of provenance and management of sustainable material use" also have high means, which is encouraging for material and waste sustainability. Overall, these data indicate that while some practices are well established and effective, others require strengthened strategies to optimize their environmental impact. Regarding dispersion, a high standard deviation is identified in the variable "Identification and control of liquid dumping", given that it is scored at 7.9 with a mean of 4.4. The other variables range between 1.3 and 2.0. The dispersion line is represented by the equation $y = 0.0773x + 1.8524$.

Table 3. Measures of central tendency and dispersion—Environmental dimension.

Components	Coding	Variable Name	Mean	Median	Mode	Standard Deviation	Variance
Environmental dimension	S.1.1	Energy efficiency or use of clean energies: solar or geothermal energy	3.7	4	4	1.8	3.4
	S.1.2	Solid waste management	4.1	4	4	1.6	2.5
	S.1.3	Use of sustainable materials	3.7	4	4	1.8	3.3
	S.1.4	Verification of provenance and management of the use of sustainable materials	3.9	4.5	5	1.7	2.8
	S.1.5	Responsible water consumption and conservation measures	4.8	5	6	1.3	1.8
	S.1.6	Quantification and control of greenhouse gas emissions.	4.0	5	5	2.0	4.1
	S.1.7	Identification and control of liquid discharges	4.4	4	5	7.9	61.8
	S.1.8	Air pollution management	3.5	3	3	1.7	3.0
	S.1.9	Construction noise control	3.4	3.5	5	1.9	3.6
	S.1.10	Biodiversity protection through specific programs and actions.	3.8	4	5	1.7	2.9
	S.1.11	Commitment and adoption of measures to reduce our carbon footprint	3.8	4	6	2.0	4.2

Source: Own elaboration.

The evaluation of the environmental dimension of corporate sustainability encompasses a series of practices and policies aimed at minimizing the ecological impact of operations. In this context, the results reflect the performance of certain critical variables, which are analyzed in greater depth: solid waste management focuses on optimizing recycling and reuse to reduce the amount of waste. The use of

sustainable materials, together with verification of their provenance and management, ensures that resources are sourced and used responsibly. Water conservation through responsible consumption and preservation techniques reinforces the sustainability of water resources. Measures to quantify and control greenhouse gas emissions, along with management of liquid discharges and air pollution, are key to mitigating adverse environmental impacts.

Table 4 shows variability in the performance of sustainability practices. "Promoting local development" records the highest scores with a mean of 4.6 and a mode and median of 5, indicating an effective and consistent approach.

Table 4. Measures of central tendency and dispersion—Economic dimension.

Components	Coding	Variable Name	Mean	Median	Mode	Standard Deviation	Variance
Economic dimension	S.2.1	Promotion of local development	4.6	5	5	1.2	1.5
	S.2.2	Construction of sustainable infrastructure	4.0	4	4	1.7	2.8
	S.2.3	Circular economy promotion and practices	4.1	4.5	6	1.8	3.3
	S.2.4	Sustainable urban mobility solutions	3.5	4	5	1.7	3.0
	S.2.5	Commitment and actions to promote urban sustainability	3.6	4	5	1.8	3.3
	S.2.6	Promotion of sustainable innovation	3.8	5	5	1.9	3.5
	S.2.7	Sustainable and smart roads	2.7	3	4	1.7	2.7

Source: Own elaboration.

In contrast, "Sustainable and smart roads" shows the lowest performance with a mean of 2.7, a median of 3 and a mode of 4, indicating the need for significant improvements. "Sustainable urban mobility solutions" and 'Sustainable infrastructure construction' show means of 3.5 and 4 with aligned modes and medians, reflecting moderate performance and uniform implementation. "Circular economy promotion and practices" show a mean of 4.1, a median of 4.5 and a mode of 6, suggesting the presence of high values that skew the mean towards higher performance. This analysis suggests uneven performance among the various economic practices, with some areas demonstrating considerable effectiveness while others, such as those related to infrastructure, require additional attention.

In terms of dispersion, a moderate standard deviation is perceived in the variables, reaching a dispersion of 1.9 as a maximum cap in this component and 1.2 as a minimum around the mean; therefore, there is some degree of consistency in the variable data. The equation representing this curve is $y = 0.0627x + 1.4323$ which is reflected in **Figure 1**.

The economic dimension of corporate sustainability focuses on strategies that ensure long-term economic growth while promoting environmentally responsible practices. This dimension includes the promotion of local development, which boosts the community economy by supporting local businesses and services. Sustainable infrastructure construction and sustainable mobility solutions demand projects that respect ecological principles and reduce the carbon footprint, while improving the quality of urban life. Circular economy practices and the promotion of sustainable innovation are crucial to maximize resource use and minimize waste. Similarly, the development of sustainable and smart roads, which has been under-appreciated, is

examined. This requires investing in advanced technologies that promote more efficient and cleaner transit, highlighting the commitment to infrastructure that drives both economic growth and environmental sustainability.

The social dimension represented in **Table 5** reflects strong performance in several areas, highlighting "social inclusion and diversity", "safety and health at work", and "decent working conditions", all with means above 4.7 and consistently high modes and medians. These results suggest that practices in these areas are robust and consistently applied among the companies evaluated. However, areas such as the construction of schools, hospitals and community centers, and projects with social impact such as wind and solar farms, show considerably lower performances with means close to 3 and similarly low median and mode values, indicating a need for significant improvement in these areas. These discrepancies highlight the contrasting commitment and effectiveness of companies in addressing different aspects of social sustainability, suggesting that while some aspects are well integrated and effective, others require urgent attention to achieve a more balanced social impact.

Table 5. Measures of central tendency and dispersion—Social dimension.

Components	Coding	Variable Name	Mean	Median	Mode	Standard Deviation	Variance
Social dimension	S.3.1	Generation of local employment	4.8	5	6	1.5	2.4
	S.3.2	Social responsibility actions	4.7	5	6	1.5	2.3
	S.3.3	Overt social equity actions	4.6	5	5	1.4	1.9
	S.3.4	Measures for the protection of human rights	4.7	5	5	1.3	1.7
	S.3.5	Social inclusion and diversity	5.0	6	6	1.5	2.2
	S.3.6	Occupational health and safety	5.0	5.5	6	1.4	2.0
	S.3.7	Decent working conditions for all workers	4.9	5	6	1.5	2.3
	S.3.8	Construction of schools, hospitals and community centers	2.9	3	3	1.8	3.3
	S.3.9	Measurement and promotion of employee well-being	4.8	5	6	1.6	2.6
	S.3.10	Promotion of education and sports	3.9	5	5	1.9	3.6
	S.3.11	Housing with access for vulnerable communities	3.2	4	4	1.8	3.4
	S.3.12	Support for training	4.2	5	5	1.8	3.3
	S.3.13	Projects with social impact such as wind and solar farms, among others	2.9	4	4	1.8	3.3

Source: Own elaboration.

On the other hand, a moderate standard deviation is perceived in the variables, reaching a dispersion that is between 1.9 and 1.3 around the mean, indicating that the data are not highly clustered at the mean; however, they provide a more stable representation of the data. For this case the equation of the line is $y = 0.0422x + 1.3137$ which is also included in **Figure 1**.

The social dimension in sustainability is evaluated from the integration of ethical and equitable practices that benefit both employees and the community in general. This dimension includes the protection of human rights and social inclusion, which are highlighted as the basis for generating a respectful and diverse work environment.

In terms of ensuring occupational health and safety, companies also focus on providing decent working conditions that promote a safe and healthy work environment. In addition, the construction of infrastructure such as schools, hospitals and community centers, as well as projects with social impact, such as the creation of wind and solar farms, demonstrate a low commitment to improving the quality of life and the concentration of little effort to contribute to a more sustainable and responsible future.

The compensation measures dimension illustrated in **Table 6** shows a significant variability in the measures of central tendency among its variables. The predominant mode of 6 in several categories indicates a high frequency at certain levels of performance, although this is not uniformly reflected in the medians and means, which are generally lower. For example, while reforestation, creation or preservation of green spaces has a mean of 3.9, median of 5 and mode of 6, other aspects such as landscape management, aesthetic and ecological improvement have a lower mean of 3.7 with a median and mode of 4. The areas related to supporting the provision of health services and development of community projects with lower means around 3.7 indicate possible areas for improvement. The results suggest limited commitment in relation to this dimension, where some measures are well implemented and others require further attention to increase their effectiveness and consistency.

In this same dimension, a moderate standard deviation is identified that fluctuates between 1.5 and 2.0 of the mean; therefore, there is some degree of consistency in the data of the variables, given that in this component the range of deviation is small. The equation $y = 0.0234x + 1.7644$ represents the curve related to this deviation.

Table 6. Measures of central tendency and dispersion—Compensation measures.

Components	Coding	Variable Name	Mean	Median	Mode	Standard Deviation	Variance
Compensation measures	S.4.1	Reforestation, creation or preservation of green spaces	3.9	5	6	2.0	4.0
	S.4.2	Support for the provision of health services	3.7	4	6	2.0	3.9
	S.4.3	Landscape management, aesthetic and ecological improvement	4.1	4	4	1.5	2.4
	S.4.4	Support for educational programs	4.2	5	5	1.6	2.5
	S.4.5	Donations to non-profit entities	4.0	4	6	1.9	3.5
	S.4.6	Housing plans and programs	3.7	4	6	2.0	4.0
	S.4.7	Development of community projects	3.8	4	5	2.0	4.1
	S.4.8	Employee family benefit plan	4.1	5	6	2.0	3.8
	S.4.9	Scholarships for employees' families	3.6	4	6	2.0	4.1
	S.4.10	Additional compensation measures implemented by the company	3.7	4	6	2.0	3.9

Source: Own elaboration.

Table 7 indicates an overall positive performance; most variables show consistently high mode and median values, especially in critical aspects such as respect for human rights and risk control and humanitarian payments, with a mode and median of 6. However, the alignment of internal practices with external partners stands out as a significant exception with considerably lower values (mode of 2, median of 2.5 and mean of 2.9), indicating a critical area for improvement. This gap suggests that,

although there is a strong commitment to sustainability in most aspects of management, consistency between internal practices and external partner expectations needs to be effectively addressed.

Also, a moderate standard deviation is identified among the various component variables, fluctuating between 1.2 and 2.0 around the mean; therefore, there is some degree of consistency in the variable data. The equation corresponding to this deviation is $y = 0.0277x + 1.4563$.

Table 7. Measures of central tendency and dispersion—Management.

Components	Coding	Variable Name	Mean	Median	Mode	Standard Deviation	Variance
Management	S.5.1	Commitment to anti-corruption, transparency and ethics.	5.0	5.5	6	1.2	1.5
	S.5.2	Selection of suppliers based on sustainability criteria and green purchasing.	4.2	4	6	1.8	3.2
	S.5.3	Respect for human rights	5.2	6	6	1.3	1.7
	S.5.4	Research in sustainable development	4.1	5	5	1.8	3.4
	S.5.5	Governance / Corporate governance	4.5	5	6	1.8	3.3
	S.5.6	Taxation and control	4.2	5	6	1.8	3.1
	S.5.7	Risk control and management	5.0	6	6	1.3	1.6
	S.5.8	Equal pay regardless of gender	4.9	6	6	1.6	2.5
	S.5.9	Occupational health and safety measures	4.8	5	6	1.6	2.4
	S.5.10	Two-way communication with stakeholders	4.4	5	6	1.8	3.2
	S.5.11	User satisfaction evaluation and management	4.1	5	6	2.0	3.8
	S.5.12	Standardization of internal practices with external partners	2.9	2,5	2	1.7	3.1
	S.5.13	Inclusion of sustainability in the quality management system	4.1	5	6	1.8	3.2
	S.5.14	Integration of sustainability in the strategic plan and programs.	4.2	5	6	1.9	3.5
	S.5.15	Accountability	4.4	5	6	1.9	3.5

Source: Own elaboration.

Table 8 presents a varied spectrum of measures of central tendency for each variable evaluated. The environmental and economic indicators show a medium and median level above 4, with modes at 6, indicating a generalized tendency towards high evaluations in these areas, possibly reflecting a conscious integration of sustainable environmental and economic practices within the companies. However, the social and cultural indicators show a lower evaluation, especially the cultural ones with a median of 3 and a mode of 4, suggesting that these areas could be less developed or less prioritized within the sustainability policies of the organizations analyzed. The inclusion of indicator results in management reports has a median of 4, which could be improved to foster greater transparency and accountability. Finally, the management of improvement plans has the highest median of 5 and a mode of 6, indicative of a robust commitment to continuous improvement.

Regarding the measures of dispersion, a moderate standard deviation is identified, fluctuating between 1.7 and 2.1 around the mean; therefore, there is a certain degree of consistency in the data of the variables, given that in this component the range of deviation is reduced. The equation that corresponds to this deviation is $y = 0.0447x + 1.6272$.

Table 8. Measures of central tendency and dispersion—Arrangement of indicators and measurements.

Components	Coding	Variable Name	Mean	Median	Mode	Standard Deviation	Variance
Arrangement of indicators and measurements	S.6.1	Environmental indicators and periodic measurement of environmental impact	4.3	4.5	6	1.8	3.2
	S.6.2	Economic indicators and regular measurement of economic impact	4.3	5	6	1.7	3.0
	S.6.3	Social indicators and periodic measurement of social impact	3.8	4	4	1.7	2.9
	S.6.4	Cultural indicators and periodic measurement of cultural impact.	3.2	3	4	1.7	2.9
	S.6.5	Inclusion of indicator results in management reports.	3.9	4	4	1.7	3.0
	S.6.6	Indicators and measurement of Sustainable Development Goals (SDGs)	3.7	4	5	1.9	3.6
	S.6.7	Management of improvement plans	4.0	5	6	2.1	4.3

Source: Own elaboration.

In **Table 9** the data reveal central trends that suggest variability in sustainability disclosure practice. The variable "Elaborates and socializes sustainability reports" shows a mean of 4, with a median of 5 and mode 6, indicating a general trend towards a higher frequency in these practices, but with a significant variability that could indicate differences in the commitment or capacity of the companies. "Conducting and socializing sustainability reports" presents a median of 3.7 and a mode of 5, which could suggest that, although many companies achieve moderate levels of implementation, a substantial group achieves more advanced practices. Finally, the variable "Publication of sustainability reports on the WEB" has the lowest mean of 3.3 and a mode of 6, which reflects a large discrepancy between companies that do not publish regularly and those that do so prominently, making accessibility to this information difficult.

Table 9. Measures of central tendency and dispersion—Sustainability reports and reports.

Components	Coding	Variable Name	Mean	Median	Mode	Standard Deviation	Variance
Sustainability reports and reports	S.7.1	Prepares and disseminates sustainability reports	4.0	5	6	1.9	3.7
	S.7.2	Prepares and shares sustainability reports	3.7	4	5	1.9	3.4
	S.7.3	Publishes sustainability reports on the web	3.3	4	6	2.3	5.4

Source: Own elaboration.

For this last dimension, a moderate standard deviation is identified, within the range of 1.9 and 2.3 around the mean, where the dispersion of the variable "Publishes sustainability reports on the WEB" is the second one that presents a higher elevation and wider difference in the mean with respect to the other variables. This deviation is represented by $y = 0.2083x + 1.6187$. Nevertheless, **Figure 1** shows that there is a certain degree of consistency in the data.

From the above, it can be inferred that the components are implementing actions that have obtained successful results. However, in the environmental and social

dimension, the variables of "Air pollution management" and "Construction of schools, hospitals and community centers" are at the beginning of testing. As for the Management component in the "Homologation of internal practices with external partners" variable, written actions are being generated.

The system of equations derived from the standard deviations in **Figure 1** resulted from assessing sustainability management in companies in the industrial sector; it provides a mathematical representation of how each dimension of sustainability varies with respect to an independent variable (x). Each equation of the form $y = mx + b$ describes the linear relationship between (x) and (y) for a specific dimension of sustainability. The environmental dimension increases by 0.0773 units. The intersection on the (y) axis is 1.8524, indicating the base value of this dimension when ($x = 0$). The economic dimension increases by 0.0627 units for each unit change in (x), with an initial value of 1.4323 when ($x = 0$). For the social dimension, the increase is 0.0422 units per unit of (x), starting at 1.3137 when ($x = 0$). For the compensation measures dimension, the increase is 0.0234 units per unit of (x), starting from a value of 1.7644. The management dimension increases by 0.0277 units per unit of (x), starting at 1.4563. The indicators and measurements provision increases by 0.0447 units per unit of (x), starting at a value of 1.6272. The sustainability reports and reports dimension have the largest increase, with 0.2083 units per unit of (x), starting from 1.6187.

Regarding the analysis of slopes and intersections, according to **Table 10**, the slope of each equation indicates the rate of change of the corresponding dimension with respect to (x). The dimension with the highest slope is "Sustainability reports and reports" (0.2083), suggesting that this dimension is the most sensitive to changes in (x). On the other hand, the dimension with the lowest slope is "Compensation measures" (0.0234), indicating a lower sensitivity to changes in (x). The intersection on the (y) axis represents the baseline value of each dimension when ($x = 0$). These initial values reflect the sustainability baseline for each dimension without considering the influence of the variable (x).

Table 10. Intersections between deviations of dimensions of sustainability.

Dimensions	***X***	***Y***
Environmental-Economic	−28.77	−0.37
Environmental-Social	−15.35	0.67
Environmental-Compensation	−1.63	1.73
Environmental-Management	−7.99	1.24
Environmental-Indicators	−6.91	1.32
Environmental-Sustainability	1.78	1.99
Economic-Social	−5.79	1.07
Economic-Compensation	8.45	1.96
Economic-Management	0.69	1.48
Economic-Indicators	10.83	2.11
Economic-Sustainability	−1.28	1.35

Table 10. (*Continued*).

Dimensions	***X***	***Y***
Social-Compensation	23.97	2.33
Social-Management	9.83	1.73
Social-Indicators	−125.4	−3.98
Social-Sustainability	−1.84	1.24
Compensation-Management	71.65	3.44
Compensation-Indicators	6.44	1.92
Compensation-Sustainability	0.79	1.78
Management-Indicators	−10.05	1.18
Management-Sustainability	−0.90	1.43
Indicators-Sustainability	0.05	1.63

Source: Own elaboration.

The intersections of the lines represent the points at which two different trends coincide, which can be useful to identify key moments or equivalencies between different metrics. In this analysis, we observe that the line intersections have values of (X) that vary considerably, from negative values such as the intersection between "Social" and "Indicators" at ($X = -125.40$), to positive values such as the intersection between "Compensation" and "Management" at ($X = 71.65$). Negative values suggest that these intersections occur outside the typical range of analysis, i.e., before the origin point at ($X = 0$), which may indicate a significant difference in the initial trends of these metrics. In contrast, intersections with positive values within the range of analysis indicate points where the metrics converge in real, observable situations. For example, the intersection between "Environmental" and "Sustainability" at ($X = 1.78$) reflects a point early in the analysis where both metrics reach the same value, suggesting a close relationship between these two dimensions. These intersections provide valuable insight to assess the relationships and balance points between different aspects analyzed, allowing analysts to identify opportunities and areas for improvement.

4. Conclusion

The combined intercepts and slopes provide a comprehensive view of how the different dimensions of sustainability behave in the industrial sector. The different rates of change and initial values show that, although all dimensions are influenced by the independent variable (x), each has its own dynamics. This system of equations can be used to predict how the different dimensions of sustainability may evolve in response to changes in (x), helping companies to identify areas of focus and improvement in their sustainable practices.

It is also observed that most of the variables show a standard deviation ranging between 1.2 and 2.3, indicating relative consistency in the data; in the case of the environmental dimension the exception is presented in the variable "Identification and control of liquid dumping" with a high standard deviation of 7.9, suggesting a large dispersion in the data with respect to the mean. This implies a significant variability in the observed values.

In short, the identification of the factors that influence sustainability management is fundamental to evaluate the sustainable performance of an organization. This evaluation, which begins with the implementation of environmental indicators, makes it possible to measure the impact that the company's operations have on the environment, and in turn contributes to recognizing areas for improvement and mitigating negative effects on the environment. Economic indicators evaluate the economic impact of sustainable practices, demonstrating how sustainability can coexist with profitability and economic growth. And social indicators measure the impact of business activities on the community and employee well-being, essential to fostering a fair and responsible work environment.

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