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Developing a Sustainability Reporting Framework for Construction Companies: Prioritization of Themes with Delphi Study Approach

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Abstract: In the contemporary business environment, there is an increasing demand for companies to disclose information regarding their corporate sustainability practices. An increasing number of construction companies transparently publish their sustainability practices through corporate sustainability reports under the headings of economic, environmental, social and governance. In the context of current practices, construction companies publish corporate sustainability reports by using different reporting frameworks, especially in areas beyond financial aspects, including standards established by the Global Reporting Initiative (GRI) as well as various legal obligations such as the Corporate Sustainability Reporting Standard (CSRS). This diversity makes it difficult to compare reported data and draw meaningful conclusions. Therefore, this research aims to simplify the reported information by reducing corporate sustainability themes to the most relevant ones for construction companies. Sustainability reporting frameworks and guidelines were examined through thematic analysis; then, the materiality and validity of sustainability themes for construction "companies were assessed using the Delphi analysis technique. Themes such as "Energy" in the environmental dimension, "Health and safety issues" in the social dimension, "Financial performance" in the economic dimension and "Board structure" in the governance dimension were identified as the corporate sustainability themes with the highest degree of impact, with an acceptable consistency ratio as a result of the analyses. As a result of the study, a reporting framework was developed consisting of a total of twenty-six themes for construction companies. The identification of material themes facilitates the integration of construction companies into the corporate sustainability reporting process and provides benefits for the innovation and sustainability of the sector

Keywords: corporate sustainability; Delphi technique; sustainability reporting; sustainability; construction company

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1. Introduction

The United Nations Brundtland Commission on Environment and Development defines sustainable development as "the process that meets the needs of the present without jeopardizing the ability of future generations to meet their own needs" [1]. There is increasing pressure on companies worldwide, especially in developed countries, to comply with sustainability criteria and sustainable development goals. Stakeholders expect disclosures from companies not only on financial topics but also on their environmental

and social practices [2]. In response to these increasing expectations, companies publish sustainability reports.

Sustainability reports are also commonly used to disclose organizations' social and environmental impacts and efforts to achieve sustainable development goals. These reports provide stakeholders with transparent and meaningful information about the organization's sustainability performance and management processes. The reports are based on the principle of disclosing the impacts and contributions of companies to the three dimensions of sustainability (economic, environmental and social). The reporting of sustainability issues has advanced beyond superficial analyses in companies' annual reports [2]. The information disclosed can cover a wide range of topics, including emissions, waste management, supply chain sustainability, social responsibility and governance [3]. Corporate sustainability focuses on the development of strategies to create long-term shareholder value by balancing these three dimensions [4]. From this perspective, we can say that governance is one of the information topics included in the reports to disclose management issues in balancing these three dimensions. On the other hand, in reporting terminology, the concepts of corporate social responsibility (CSR), sustainable development, triple bottom line (TBL), reporting of non-financial information and environmental, social and governance (ESG) are sometimes used interchangeably [2]. This has caused confusion about which reporting method companies should use when disclosing information to stakeholders and the public, and emphasizes that a common conception should developed for the effective adoption and implementation of sustainability policies [5]. In this context, specific steps have been taken regarding corporate sustainability reporting, and the first stage of achieving sustainable development goals has been to determine how companies contribute to these goals.

Various standards and guidelines for reporting critical sustainability information have been prepared by many different organizations [5]. An example of such guidelines is the GRI reporting framework, which is widely used globally in sustainability reporting, as it is harmonized with many sustainability standards. Standards provide ease of comparison in companies' sustainability reports. The standards issued by the Sustainability Accounting Standards Board (SASB) and International Sustainability Standards Board (ISSB) is a set of standards that enable companies to report environmental, social and governance (ESG) performance in financially relevant metrics. AA1000 (issued by accountAbility) and SA8000 (issued by Social Accountability International) social responsibility standards, developed to provide a standard framework and common reporting standard for auditing the social performance of companies, are the two most effective practices. SA8000 focuses on labor issues in supply chains and covers employment and working conditions. It covers compliance with national or other applicable laws, a number of International Labor Organization conventions on employment, the Universal Declaration of Human Rights and the United Nations Convention on the Rights of the Child. AA1000 aims to improve accountability and performance through learning from stakeholder engagement.

Table 1 provides a comparative description of these standards and guidelines. These standards and reporting frameworks enable organizations to measure, report and improve their sustainability and corporate social responsibility performance. Some standards such as ISO 14001; CDP; TCFD etc. focus on environmental factors, others on social and labor issues such as SA8000 and ISO26000, while others integrate ESG (Environmental, Social, Governance) criteria into financial reporting such as ESRS, SASB and ISSB. (ESRS, SASB, ISSB, etc.)

Table 1. Review of sustainability reporting standards and guidelines.

Name	Year of Launch	Developer/Owner	Focus	Construction Industry specific	Type
GRI4	2000	Global Reporting Initiative	Social, Environmental, Economic	Yes	Guideline
ISO26000	2010	International Organization for Standardization	Social	No	Standards
ISO14001	1996	International Organization for Standardization	Environmental	No	Standards
SA8000	1997	Social Accountability International	Social	No	Standards
AA1000	1999	Institute of Social and Ethical Accountability	Social	No	Standards
SASB	2012	Sustainability Accounting Standards Board	Social, Environmental, Governance	Yes	Standards
ISSB	2021	International Sustainability Standards Board	Social, Environmental, Governance	No	Standards
CDP	2000	Carbon Disclosure Project—International non-profit organization	Environmental	Yes	Framework
IR	2010	International Integrated Reporting Council	Social, Environmental, Economic	No	Framework
TCFD	2017	Task Force on Climate-related Financial Disclosures	Environmental	No	Framework
ESRS	2022	European Union	Social, Environmental, Economic, Governance	Yes	Standards

In addition to these global standards, many countries have also developed country-specific guidelines for sustainability reporting. The study of sustainability reporting reveals significant variations in its development across different geographical regions. A notable aspect of this diversity is the presence of considerable scope for enhancement with respect to the quality and comparability of reporting [3]. Notwithstanding the heterogeneity in standards and guidelines, a substantial number of companies, particularly in developing countries, continue to refrain from reporting their sustainability performance [3]. This diversity results in information asymmetry in reporting due to discrepancies between standards and guidelines [6,7]. Moreover, the absence of mandatory requirements alone does not guarantee the reporting of sustainability issues, unless specific indicators and criteria are met [8].

Despite an increasing number of construction companies adopting sustainability reporting, the usefulness of these reports is debated worldwide. As the construction industry often characterized as "dirty, dangerous and difficult", a robust approach to sustainability reporting is needed to dispel negative perceptions and demonstrate commitment to sustainable practices [9]. However, the construction industry faces a number of challenges in effective sustainability reporting.

Specifically, sustainability disclosures are often not presented with the same level of rigor and discipline as financial reports [10]. The selection of sustainability data and reporting methods is frequently informed by organizational-specific conditions and managerial preferences, resulting in inconsistent disclosures within reports [11,12]. While the necessity for accurate and comparable sustainability data is increasing, the reliability and transparency of this data is often criticized [12–14]. Consequently, there is a discrepancy be-

tween the information contained in sustainability reports and the sustainability challenges that companies actually face [15]. All standard developers emphasize that companies should produce concise and comprehensive reports that focus on sustainability issues that are "material and meaningful" to them. Standards-based reporting guidelines state that materiality analysis can identify which issues are important to a company's organization, operations and performance [16].

Materiality analysis in corporate sustainability reporting is shaped by various factors such as industry characteristics, stakeholder expectations, integration of global sustainability frameworks and organizational factors. There are many studies in the literature that examine the variables affecting materiality analysis and the impact of these variables on corporate sustainability performance [17–20]. There is a lack of sector-specific studies on which issues are important. Therefore, this study examines corporate sustainability reporting in the context of materiality analysis and aims to identify the material topics that should be included in corporate sustainability reporting for construction companies.

The present study is structured as follows. The introduction is followed by a discussion of the literature on corporate sustainability reporting in the construction sector and the background, materiality analysis, reporting trends and challenges related to corporate sustainability reporting in the construction industry. The third section presents the methodological approach used in the study and identifies important issues specific to construction firms. Finally, the fourth section discusses the main findings and makes recommendations for future research.

2. Related Literature and Background

2.1. Corporate Sustainability Reporting in the Construction Industry

The practice of sustainability reporting (SR) can assist companies in responding to regulatory requirements or external requests for information, implementing sustainability measures and planning or controlling corporate sustainability (CS) performance [21].

Corporate sustainability reporting is a multifaceted issue that encompasses stakeholder engagement, financial performance, reporting quality and corporate governance. The construction industry, a resource-intensive sector, is particularly affected by these dynamics, with stakeholders increasingly demanding accountability and transparency on sustainability practices [22].

The construction sector is characterized by considerable environmental impacts, in addition to its noteworthy social and economic impacts. It plays a pivotal role in maintaining and promoting social cohesion, as well as economic prosperity [23–25]. Sustainability exerts a significant influence on the economic dimension, given its capacity to generate employment opportunities and contribute to gross domestic product (GDP). However, companies must strike a balance between the demands of sustainability and the requirements of the business world [21]. At this point, there is a lack of focus on the organization itself. Glass and Dainty (2011) state that the biggest challenge for construction companies is to ensure that sustainability is visible and integrated across all business functions [26]. As the demand for transparency increases, construction companies must overcome these challenges to improve their sustainability practices and reporting. By doing so, they not only increase their market value, but also build greater trust among stakeholders.

The reasons behind an increasing number of companies in the construction industry publishing sustainability reports include awareness of environmental impacts such as land use or CO_2 emissions and the related need for legitimacy; compliance with legal requirements; integration of sustainability measures to gain competitive advantage and make corporate actions more sustainable; or the provision of information to different stakeholders [27].

The extant literature on corporate sustainability (CS) reporting approaches the reporting from different perspectives. Some investigators examine the reasons or drivers of CS reporting [28,29], while others focus on the reported content [30,31]. Other studies explore the application of data collected for reporting purposes in managing KS performance [32]. Research has demonstrated that the distribution, content and quality of reports vary across sectors [27]. Consequently, it is imperative to present the evidence on reporting in a sectoral overview. However, the construction sector lacks such an overview, despite its characteristics showing differences in reporting behavior and report content. This limitation significantly restricts the applicability of findings from other sectors in the construction sector [27]. This necessity has been acknowledged by GRI, which has developed revised standards for the construction and real estate sector, catering to the unique requirements of the sector [33].

Conversely, the construction industry is characterized by a multifaceted stakeholder structure, comprising a diverse array of stakeholders, including customers, government agencies, contractors, engineers and architects [34,35]. These stakeholders may exert varying degrees of influence on construction companies. The incorporation of sustainability reporting within corporate practices could facilitate a response to the interests and information needs of stakeholders [35]. The strategic inclusion of stakeholders in reporting could ensure the continuity of a company's success [36]. On the other hand, potential information asymmetry between corporate practices and reported issues may undermine stakeholder trust. However, this study approaches sustainability reporting from a corporate perspective and excludes the stakeholder perspective. Conversely, companies with a focus on conventional corporate objectives, such as enhancing access to capital markets or expanding their market share, are increasingly adopting sustainability reporting in addition to financial reporting for instrumental or strategic reasons [27]. From this perspective, sustainability reporting functions as a tool to reduce the existing information asymmetries between the company and strategic stakeholders regarding CS performance [34,35,37]. Hence, this study analyzes corporate sustainability reporting from an instrumental perspective.

2.2. The Need to Determine the Materiality of Themes Within the Scope of Corporate Sustainability Reporting

In recent years, the evolution of the risks companies face and investors' increasing awareness of the financial implications of these risks have resulted in an increased demand for corporate sustainability disclosures, especially from the investment community [38,39]. In this context, organizations report voluntarily or mandatorily in order to respond to the sustainability-related information demands of their internal and external stakeholders.

Sustainability reporting is an area that has been regulated by the European Union for a while, and the Directive [40] 2014/95/EU on the reporting of non-financial information (NFRD) is an important step towards a stricter legal regulation in this area. This was followed by the Corporate Sustainability Reporting Directive (CSRD) No. [38] 2022/2464/EU, obliging organizations operating in member states of the European Union to report their sustainability activities more extensively. The CSRD and the European Financial Reporting Advisory Group (EFRAG) promote the harmonization and digitization of sustainability disclosures and provide common reporting standards to comply with NFRD requirements on non-financial and diversity information [8].

One of the main challenges companies face in sustainability reporting is the lack of standardization in reporting frameworks and assessment methods [41,42]. Furthermore, sustainability assessment challenges include data collection and managing, materiality, verification and assurance processes, balancing transparency and commercial confidentiality, and stakeholder engagement and integration [3]. These challenges make it difficult for

organizations to effectively report their sustainability performance and accurately reflect the improvements they have made in these areas.

The literature on materiality analysis in corporate sustainability reporting reveals a complex interplay between stakeholder engagement, regulatory frameworks and the integration of sustainability objectives. Figure 1 is based on the interrelationship between these terms.

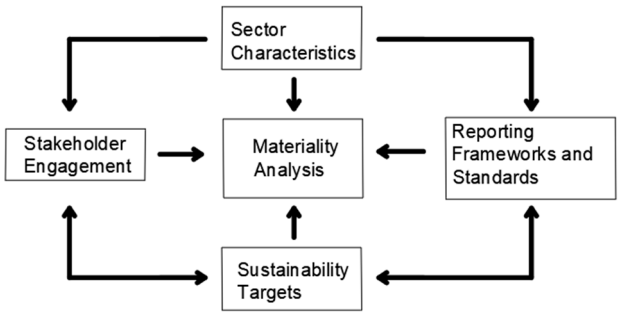

Figure 1. Materiality analysis and the influencing factors.

Materiality is commonly accepted as a fundamental component of corporate reporting [43–45]. Nevertheless, there remains considerable debate regarding the role and precise definition of materiality within the context of sustainability reporting [44]. This ongoing discussion has led to challenges in ensuring the comparability, reliability and relevance of sustainability-related disclosures [46–48].

Prior research has identified an imbalance in corporate sustainability reports (CSRs) published by companies, emphasizing the need for companies to elucidate their methodologies for identifying material themes. In this regard, materiality assessment assists companies in identifying and prioritizing sustainability-related issues [18]. The identification of relevant material issues constitutes the inaugural stage of materiality analysis.

Given the sheer scope of issues that are pertinent to business operations, it would be impractical for businesses to attempt to manage all issues. Consequently, materiality assessment plays a pivotal role in identifying environmental, social and governance (ESG) issues to be incorporated into sustainability reports [49]. Moreover, the absence of a robust materiality assessment leads to uncertainty about the reliability of the information presented, which might undermine the overall effectiveness of sustainability reports [18].

Integrating materiality into sustainability reporting processes is essential to promote transparency and accountability [9,50]. Therefore, it is necessary to identify and prioritize material themes that are of concern to both the company and its stakeholders [39].

Materiality assessment refers to the importance of information that can influence stakeholders' decisions, and its application in sustainability reporting helps organizations focus on the most relevant issues affecting their operations and stakeholders [18,51]. Therefore, stakeholder engagement in materiality assessment ensures that the concerns and expectations of various stakeholders are considered in the materiality assessment process, thereby increasing the relevance and comprehensiveness of reported information [50]. Studies have shown that organizations that actively engage stakeholders in sustainability reporting processes tend to produce more meaningful and effective reports [52]. This engagement promotes a sense of ownership among stakeholders and aligns organizational strategies with societal expectations. It thus enhances corporate legitimacy and reputation [53].

Identifying material issues to report on is one of the key challenges in sustainability reporting for construction firms. Jones et al. discuss the effectiveness of construction companies' interaction with their stakeholders through panels and surveys in representing the views of their various stakeholders in reality [51]. This concern highlights the importance

of thoroughly examining the quality of sustainability reporting, especially when comparing practices among different countries [54]. On the other hand, Andriadi and Werastuti [54] show in their study that many construction companies may not completely disclose sustainability indicators, which may undermine the reliability of their reports. The content of sustainability reports also varies significantly among construction companies. Siew's (2017) analysis of Malaysian construction companies found that while corporate governance indicators are often reported, key indicators such as health and safety performance are often neglected [55]. The lack of comprehensive reporting can lead to perceptions of corporate hypocrisy, where companies may appear committed to sustainability without substantively addressing critical issues [56]. Such inconsistencies can damage a company's reputation and stakeholder trust as consumers and investors increasingly scrutinize corporate claims against actual practices.

3. Methodology of the Study

The methodology of this study is structured around determining the most relevant themes in corporate reporting based on contributions from the literature, standard practice guidelines and sustainability reports. The study combines various statistical methods, and the methods and approaches used to design the framework are presented in this section. Topics in the environmental, social, economic and governance dimensions are the list of important themes that need to be considered in assessing corporate sustainability performance in construction companies. In other words, the aim of the study is to develop a theoretical framework that identifies the main corporate sustainability issues that affect the sustainability performance of construction companies. The methodology of the study is structured in three stages, and the methods applied in each stage are summarized in Table 2 below.

Table 2. Research methods and stages.

	Research Methods	Research Objectives Fulfilled
I	Systematic Literature Review and Frequency Analysis	Determining the performance indicators used in corporate sustainability reporting and categorizing them under corporate sustainability pillars and headings
II	Pareto Analysis Technique	Reducing the number of CS theme headings.
III	Delphi Analysis Technique	The identification of key common corporate sustainability topics applicable and appropriate to construction companies

In the first stage, a set of key performance indicators (KPIs) were defined for the main environmental, social, economic and governance dimensions used in corporate sustainability assessment. These were grouped under common overarching themes. In the second stage, the topics were assessed according to their frequency of occurrence in the sources and their number was reduced using the Pareto Analysis Technique. In the third stage, experts were asked about corporate sustainability topics, and the Delphi Technique was used to develop a framework of key topics for construction companies to use in corporate sustainability assessment and reporting.

3.1. Systematic Literature Review and Frequency Analysis

The areas or operations that can be measured by indicators are called variables of corporate sustainability. Several recent studies have shown that there is significant variation in the selection of variables [57–59].

In the first phase, a set of generic performance indicators was developed to provide a comprehensive overview of indicators related to corporate sustainability. This set was

created by systematically reviewing performance indicators utilized in both theoretical and practical contexts, drawing from diverse sources such as literature, reports, indices and guidelines through thematic analysis. In order to create a list of possible indicators of corporate sustainability performance, the literature on sustainability performance assessment was reviewed in 3 groups. The first group the review involved the use of Boolean logic by formulating a search query for the "Web Of Science" database. It involved the use of a combination of keywords: "corporate sustainability", "indica* OR factor* OR parameter*", "measure* OR assess* OR evalua*"; "construction" was used in "All fields". The study was restricted to the last ten years (from 2015 to 2024). The search resulted in 32 studies. The search results were further reviewed, and articles focusing on sustainability assessment and sustainability indicators were selected. At the end of the preliminary review, 4 studies were excluded. The search string was further expanded to ensure high-quality results, and further studies identified as thematically relevant through the snowballing method were included in this list, resulting in detailed readings of 38 studies in total.

The second group of sources consisted of standards, guidelines and indices related to sustainability performances. The following table provides a comprehensive overview of the standards/guidelines commonly used in corporate sustainability reporting and the topics they focus on. The standards that do not include the environmental dimension of the standards mentioned in the introduction have been excluded, as the impact of the construction sector on environmental sustainability cannot be ignored.

The third group of sources consisted of sustainability reports published by construction companies. For this purpose, 5 Turkish construction companies ranked in the top 40 of the ENR 250 list in 2022 were selected. An in-depth review of the 5-year (2018–2022) sustainability reports published by these companies was conducted, and sustainability indicators were included in the indicator set based on the materiality analysis reported by these companies.

The indicators were then grouped into topics related to corporate sustainability, with each indicator assigned to a specific theme based on its relevance to the four dimensions of sustainability (environmental, social, economic and governance). In the following steps of the study, Pareto analysis and the Delphi method were applied to these topics, respectively. The study methodology is visualized in Figure 2 for clarity.

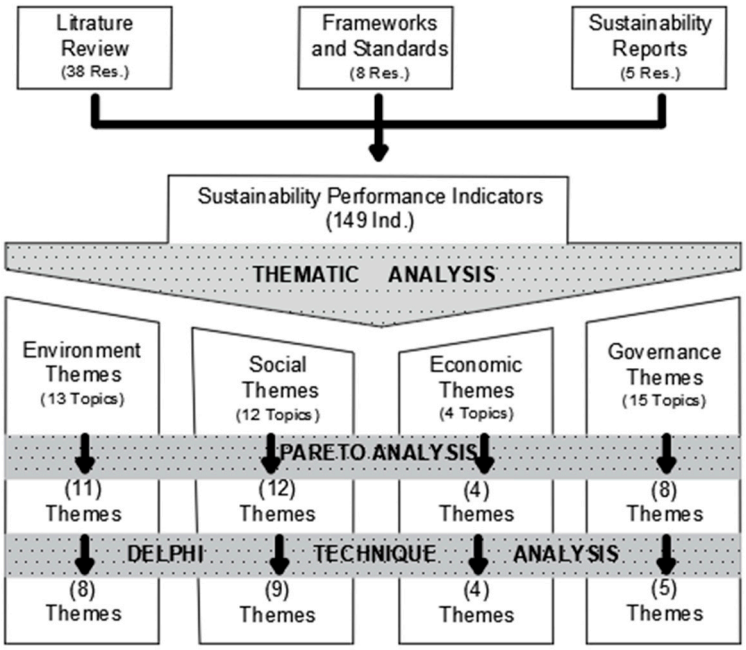

Figure 2. Research methodology.

For this purpose, 38 studies from the literature that assess corporate sustainability measurement through indicators, 8 guidelines or assessment frameworks (sustainability indices) commonly used by companies for CS assessment, and 5-year sustainability reports of five construction companies were reviewed through thematic analysis, and the indicators used were listed. The 5-year sustainability reports of five construction companies were analyzed and presented as a single source as ref. no 90for the clarity of the study. The indicators were then grouped under common themes. "Themes" define the corporate sustainability topics that the indicators are related to in this study. Table 3 provides a comprehensive overview of the sources from which the themes are cited. The frequencies of the themes were calculated by considering the frequency of the indicators in the sources.

Table 3. Frequency of the CS themes.

	Code	Freq. %	Themes	References
ENVIRONMENTAL	ENV1	80.4	Gas emissions	[41,57–92]
	ENV2	84.8	Water emissions	[41,57–60,62,63,65,66,68–77,79–98]
	ENV3	13	Noise pollution	[58,62,64,70,80,97]
	ENV4	37	Material	[41,57,59,62,64,68,70,74,80–83,89,91,93,95,97]
	ENV5	80.4	Waste	[41,57–62,64–66,68–87,89,91,94,96–99]
	ENV6	87	Energy	[41,57–85,88–96,98]
	ENV7	52.2	Biodiversity	[57–62,64,65,68,70,73,74,76,79,80,82–84,86,90–92,97]
	ENV8	41.3	Environmental impact and certifications	[57–59,61,68,74,76,79,80,82,85,86,88,89,92,93,95,98,99]
	ENV9	30.4	Eco-friendly production	[59,61,63,65–68,73,79,81,92,99–101]
	ENV10	21.7	Resource/raw material usage	[57,58,64–66,69,74,80,82,96]
	ENV11	19.6	Recycling	[58,61,63,64,69,76,78,91,99]
	ENV12	30.4	Fuel consumption/logistics	[57–59,61,70,74,76–78,82,93,96,97,99]
	ENV13	8.7	Environmental concerns of stakeholders	[61,69,74,82]
SOCIAL	SOC1	69.6	Employee satisfaction/turnover rates	[41,57–61,63,64,66,69–72,74–76,78,79,81–87,91–93,95,96,99,102]
	SOC2	68.1	Education	[57,58,62,64,66,69–85,89,91–93,95,96,98,100–102]
	SOC3	61.7	Gender and diversity	[41,57,58,60,61,63–66,71,73–78,80–85,89,91–93,96,98,102]
	SOC4	52.2	Employment	[57,59,62–65,67,70–74,76–78,80,82,83,91,93,97,99,101,102]
	SOC5	69.7	Health and safety issues	[57–60,62,63,65,66,69,70,72–76,78–84,87,89,92–94,96–99,102]
	SOC6	50	Community engagement	[57–61,65,66,73,74,79–82,86–89,92,93,95,98–100]
	SOC7	63	Social impact	[41,57–59,61–64,66,70,73–76,79–82,84,86,88,89,92,94,95,97,98,100,102]
	SOC8	63	Stakeholder satisfaction/communication	[41,57–62,65,66,69,74–76,79–82,84,86–88,92–94,96–99,101]
	SOC9	21.7	Ethics	[57,58,61,64,65,71,74,92,94,98]
	SOC10	21.7	Anti-corruption	[61,65,74,82,84,87–89,92,94]
	SOC11	50	Human rights	[57,61,62,64,66,73,74,79,81–89,91–93,96,97,99]
	SOC12	21.7	In-organizational awareness	[58,61,69,74,78,80,81,99,101,102]
ECONOMICAL	ECO1	34.8	Investments	[57,58,61,65,66,71,73–76,81–83,93,96,102]
	ECO2	50	Revenue	[41,57–59,61,62,64,65,67,69,71,74–76,78,80–83,93,94,97,100]
	ECO3	52.2	Cost/expense/expenditure	[41,57–59,61,62,64–67,69,72,74–78,82,83,91,92,94,95,101]
	ECO4	34.8	Financial performance	[41,57,59,61,64–67,74–78,82,83,91,92,94]

Table 3. *Cont.*

	Code	Freq. %	Themes	References
GOVERNANCE	GOV1	32.6	Management board structure/diversity	[41,57,66,71,74,76,79,82,83,86–89,93,96]
	GOV2	13	Sustainability reporting	[60,71,73,74,82,96]
	GOV3	30.4	Ethical standards	[41,57,59,60,65,69,70,73,79,82,85–88,92,96]
	GOV4	10,7	Sustainability strategies	[61,70,71,74,82,96]
	GOV5	19.6	Process optimization/cost reduction targets	[61,65,69,70,80,82,87,96,99]
	GOV6	32.6	Tackling the climate crisis	[59,62,73,74,79,80,82,85–88,90,92,95,98]
	GOV7	34.8	Effective environmental management	[59,62,66,68,69,73,74,80,82,89,90,92,96,98,100,101]
	GOV8	28,3	Compliance (compliance with legislation/standards)	[41,57,59,64,68,73,74,82,92,94,95,97,99,101]
	GOV9	6.5	Leadership and knowledge management	[62,82,99]
	GOV10	52.2	Governance quality	[41,57–59,64,65,71,73,74,76,79,80,82,85,86,89,90,92,93,96,98–101]
	GOV11	26.1	Supply chain management	[57,69,79,81,82,89,92–94,96,97,99]
	GOV12	13	Technological feasibility (R&D)	[59,64,92,95,99,100]
	GOV13	6.5	Participation in politics & payments to public officials/institutions	[57,74,80]
	GOV14	13	Innovation	[59,66,70,80,99,100]
	GOV15	4.3	Productivity enhancement	[82,99]

3.2. Reducing the Number of Corporate Sustainability Themes: Pareto Analysis

In the second stage, the topics in the 4 dimensions of corporate sustainability (social, environmental, economic, management) were reduced to a lesser number of topics using the Pareto technique. Pareto analysis is a technique used to separate the important causes of a problem from the relatively less important causes and is expressed in a bar diagram. The Pareto principle (also known as the 80–20 rule, the law of the significant few, and the principle of factor sparsity) states that for most events, roughly 80% of the impacts are caused by 20% of the factors. From this perspective, an assessment of key issues related to corporate sustainability in line with this principle yields the diagram below (Figure 3).

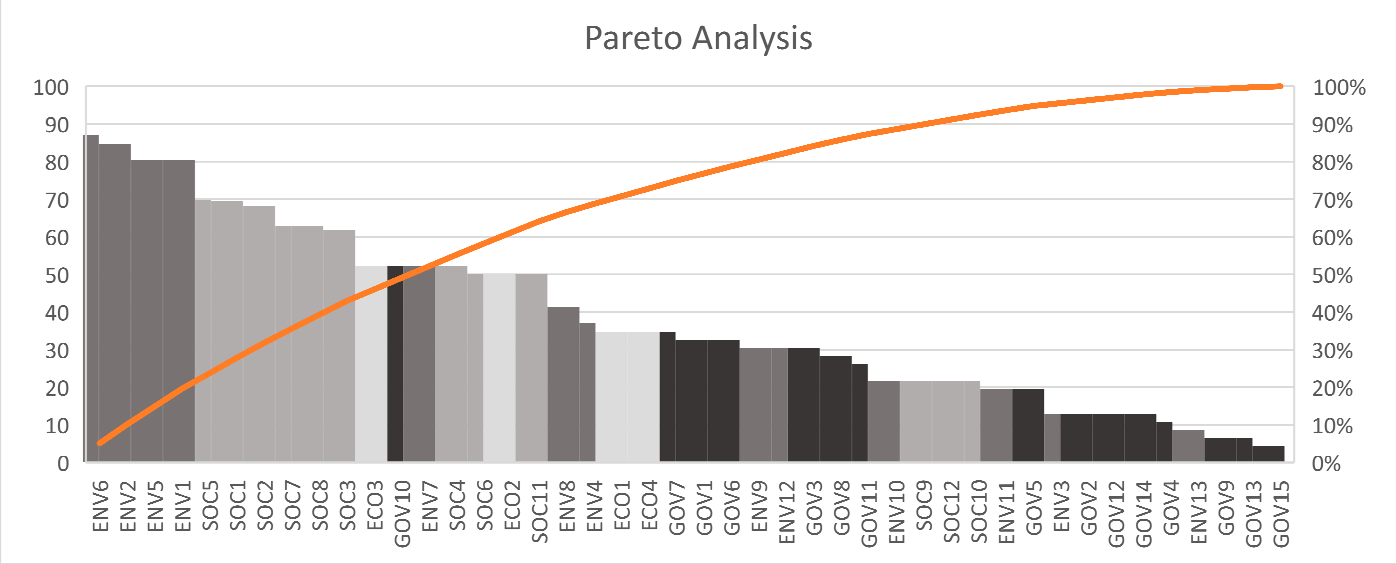

Figure 3. Results of the Pareto analysis technique.

Using the Pareto technique, sustainability topics were evaluated according to their frequency of occurrence in the sources, and topics below 20% were eliminated. These issues were recorded most frequently in the management dimension, with 7 topics. In the economic dimension, 4 topics with the lowest 34.8% and, in the social dimension, 12 topics with the lowest 21.7% remained valid. The lowest elimination was sound pollution, with 13% and recycling, with 19.6% in the environmental dimension. Recycling, based on the literature, was not eliminated even though it was below 20%. Topics eliminated in the governance dimension were sustainability reporting, technological feasibility, innovation, sustainability strategy, leadership and knowledge management, political participation and efficiency enhancement. Table 4 summarizes the reduced corporate sustainability topics that were converted into survey questions.

Table 4. Reduced corporate sustainability topics.

Code	Name	Explanation
ECO1	Investments	R&D Investments, Investing in green construction projects/operational infrastructure/environmental (conservation) projects/social projects
ECO2	Revenue	Profit, Return on investment/equity, Gross revenue, Net sales, New marketshare opportunities, Sales growth
ECO3	Cost/expense/expenditure	Fines, Taxes, Environmental costs, Training and expenditures, Staff costs, Operating costs, R&D/innovation expenditures, Monetary value of sanctions/obligations
ECO4	Financial performance	Profitability indicators, Indebtedness indicators, Liquidity indicators, Operating and other indicators, Return on assets/capital stock
SOC1	Employee satisfaction/ turnover rates	Fair pay, Social benefits, Career and employment stability, Staff development, Employee turnover rates, Employee–managerial relations, Employee loyalty, Workers' rights policies
SOC2	Education	Staff training, Supplier training, Innovation ideas, Staff qualification and upskilling, Skill development orientation
SOC3	Gender and diversity	Employee diversity, Non-discrimination policy, Demographic factors, Diversity and inclusion, Female/male staff ratio
SOC4	Employment	Responsible corporate governance, Labor and industrial relations, Use of local labor
SOC5	Health and safety issues	Workplace accidents and injuries, Safety violations, Occupational health and safety certificates
SOC6	Community engagement	Local recruitment, Community enhancement projects, Interaction with local communities, Stakeholder interaction
SOC7	Social Impact	Social obligations, Protection of local culture, Social value of products and services, Beneficial relations with communities, Public health and safety, Safe and quality products
SOC8	Stakeholder satisfaction/communication	Customer and stakeholder occupational safety and health, Stakeholder education, Stakeholder engagement, Fair relations with suppliers, Stakeholder and customer relations, Taking responsibility for stakeholder concerns
SOC9	Ethics	Violation of ethical rules, Business ethics, Compliance with laws, standards and rules, Leadership ethics and competitive behavior
SOC10	Anti-corruption	Policies and procedures on corruption, Tax transparency
SOC11	Human rights	Respect and protection of human rights, Working conditions, Equality policies
SOC12	In-Organizational awareness	Awareness of staff on sustainability issues, Corporate citizenship and contribution, Organizational culture, Attitudes and actions of managers
ENV1	Gas emissions	Greenhouse gas emissions, Carbon emissions, Carbon efficiency, Air quality
ENV2	Water emissions	Total fresh water used for activities, Amount of recycled water
ENV4	Material	Raw material efficiency, Sustainable material use, Efficiency of material consumption, Use of recycled materials
ENV5	Waste	Solid, liquid, gaseous wastes generated by the company, Reduced construction waste related to on-site construction and off-site processing or fabrication
ENV6	Energy	Energy efficiency, Energy saving, Renewable/non-renewable energy use
ENV7	Biodiversity	Changes in land use, Impact of activities on local and global biodiversity, Protected Habitats, Project impacts on archaeological sites
ENV8	Environmental impact and certifications	Impact of the value chain on the environment, Effectiveness of environmental improvement/reduction of environmental impact, Impact assessment and reports, Green building certificates
ENV9	Eco-friendly production	Lifecycle of the product, Product responsibility, Capacity to produce quality goods and services

Table 4. *Cont.*

Code	Name	Explanation
ENV10	Resource/raw material usage	Resource efficiency, Reduction of resource use, Responsible sourcing strategy
ENV11	Recycling	Amount of waste recycled/disposed of
ENV12	Fuel consumption /logistics	Amount of fuel used for transport and logistics in activities, Removal of demolition and excavation waste, Logistics/reverse logistics
GOV1	Management board structure/diversity	Level of gender and ethnic diversity on the board, Board structure and independence, Leadership diversity
GOV3	Ethical standards	Use of practices such as anti-corruption plans/policies, ethical resource utilization standards and commitment to these practices—continuity
GOV5	Process optimization and cost reduction activities	Activities to reduce and eliminate waste, re-processing and losses in the production process, Process optimization and cost reducing measures on sustainability issues/Process stabilization, Marketing/Quality improvement
GOV6	Tackling the climate crisis	Management practices, Climate change strategy, Emission reduction strategies
GOV7	Effective environmental management	Product and service management, Environmental Policy/Environmental vision/Environmental Management System/Environmental Management structure, Waste/Water management
GOV8	Compliance (compliance with legislation and standards)	Government oversight, Compliance with the legislation standard, Obligation to comply with national regulations
GOV10	Governance quality	Effectiveness of performance management system, Corporate efficiency, Risk and crisis management, Effectiveness of corporate governance, Corporate transparency (disclosure–transparency–reporting), Information assurance and cyber security
GOV11	Supply chain management	Supplier support and co-operation, Supply chain sustainability

3.3. Delphi Technique

In this section, a Delphi study was conducted by converting the reduced number of sustainability topics into survey questions to ask the experts about their validity and importance in ensuring the corporate sustainability of companies in the construction sector.

Delphi studies are used as a prediction tool, as a consensus research tool, as an analysis tool (e.g., to explore drivers and barriers [103] and as a policy development or framework development tool [59,104]. In this study, the Delphi research technique was used to frame the topics that experts consider to be material to and having an effect on the corporate sustainability performance of construction companies.

Despite different purposes and applications, a common feature of all Delphi studies is the involvement of a panel of experts in a structured process [105] to "capture and develop expert opinions based on the experiences of those actively working in a field" [103,104]. Therefore, the sampling of the study consists of architects and engineers working in sustainability-related departments of construction companies, academicians and experts working in the field of sustainability. The selection of the experts was based on the criterion that the participating experts were working in the sustainability department of the construction company or specialized in sustainability. The Delphi method aims to construct a consensus among experts in a particular research area, especially when limited information is available on the topic. In some cases, four expert opinions may be enough to apply the method [106]. Table 5 presents the demographic data of the 13 experts who participated in the study.

Table 5. Demographics of the experts.

Expert	Area of Expertise	Term of Office	Position in the Company
P1	Architecture	>20 years	Acamedician
P2	International Relations	1–5 years	Senior manager

Table 5. *Cont.*

Expert	Area of Expertise	Term of Office	Position in the Company
P3	Environmental Engineering	11–20 years	Intermediate level manager
P4	Environmental Engineering	11–20 years	Sustainability manager/director
P5	Construction Engineering	>20 years	Acamedician
P6	Architecture	1–5 years	Sustainability manager/director
P7	Business Administration	>20 years	Sustainability manager/director
P8	Architecture	>20 years	Expert (Junior manager)
P9	Construction Engineering	11–20 years	Acamedician
P10	Architecture	11–20 years	Senior manager
P11	Construction Engineering	11–20 years	Intermediate level manager
P12	Business Administration	>20 years	Senior manager
P13	Architecture	>20 years	Senior manager

The advantages of the Delphi study over an interview are the elimination of interventions such as interaction between participants, the prevention of anonymous responses and the access to a "geographically spread group of experts" via the internet [104]. In this way, it was possible to include relevant experts from different geographies and regions in the study on corporate sustainability, which is considered at the global level.

The method is characterized by the process of selecting a panel of experts, gathering their opinions through sequential questionnaires, and then providing collective feedback. Experts should be consulted at least twice for each question or for three rounds if the consensus reached in the first round is not sufficient [8]. This process is stopped when the purpose of the study is achieved or if no major change is expected [105]. In the study, two rounds were conducted in order to obtain consistent results.

In the study, 13 participants were asked in two rounds to identify the most important sustainability dimensions for corporate sustainability (social, environmental, governance, economic) and the representation of issues in these dimensions, i.e., their materiality and validity. The 13 experts who participated in the first round participated fully in the second round. The experts were from the fields of engineering, architecture and business, with an average of 11 to 20 years of experience.

In the field of scientific research, the term "consensus" is defined in a variety of ways. Various techniques have been proposed in the academic literature to define consensus, including the relative interquartile range, the typical deviation of different distributions of results and the coefficient of variation [107,108]. In this study, Zeliff and Heldenbrand's definition of consensus was used and items with an interquartile range (R = Q3–Q1) of less than 1.2 were considered as consensus items [109]. The first quartile (Q1) defines the point where 25% of the responses are listed to the left and 75% are listed to the right, and the third quartile (Q3) defines the point where 25% of the responses are listed to the right and 75% are listed to the left.

4. Results

In this section of the study, the results of the Delphi technique applied to the corporate sustainability themes previously identified through thematic analysis and reduced by Pareto analysis are presented. The study was conducted in two rounds. In the first round, the experts were asked demographic questions and which of the sustainability dimensions were more important in ensuring corporate sustainability and the importance of the themes

in the dimensions for the construction companies. The results were analyzed statistically. For the analysis of the second-round Delphi survey, the statistics obtained from the first Delphi survey were used. The calculated statistics are listed as impact level, impact degree, median, Q1 (first quarter), Q3 (third quarter) and R (range) (Table 6).

Table 6. The results of Delphi analysis.

		Impact Level **		Degree of Impact ** (Mean)		Median		Standard Deviation		Interquartile Range (Q3–Q1)	
		1. Round	2. Round	1. Round	2. Round	1. Round	2. Round	1. Round	2. Round	1. Round	2. Round
ENV1 *	Gas emissions	4	5	4.08	3.92	5.00	5.00	1.115	1.382	2.00	2.00
ENV2	Water emissions	7	-	3.62	-	4.00	-	870	-	1.00	-
ENV3	Material	2	-	4.46	-	5.00	-	660	-	1.00	-
ENV5	Waste	3	1	4.31	4.46	5.00	5.00	1.032	0.776	1.50	1.00
ENV6	Energy	1		4.69		5.00		0.63		0.50	
ENV7 *	Biodiversity	10	6	3.00	3.54	3.00	3.00	1.08	1.127	2.00	1.50
ENV8	Environmental impact and certifications	7	-	3.62	-	4.00	-	0.961	-	1.00	-
ENV9	Eco-friendly production	9	-	3.23	-	3.00	-	0.927	-	1.00	-
ENV10	Resource/raw material usage	6	2	3.69	4.31	4.00	4.00	1.182	0.630	1.50	1.00
ENV11 *	Recycling	8	4	3.54	4.08	3.00	5.00	1.127	1.188	1.50	2.00
ENV12	Fuel consumption/logistics	5	3	4.00	4.23	5.00	4.00	1.472	0.599	1.50	1.00
SOC1	Employee satisfaction/ turnover rates	2	2	4.00	4.38	4.00	5.00	1.155	0.768	2.00	1.00
SOC2	Education	1	-	4.15	-	4.00	-	0.689	-	1.00	-
SOC3 *	Gender and diversity	6	6	3.54	3.62	3.00	3.00	1.198	0.961	2.50	1.50
SOC4	Employment	5	-	3.62	-	4.00	-	0.961	-	1.00	-
SOC5	Health and safety issues	2	1	4.00	4.69	4.00	5.00	0.913	0.630	2.00	0.50
SOC6	Community engagement	4	8	3.85	3.31	4.00	3.00	0.987	0.855	2.00	1.00
SOC7	Social impact	2	6	4.00	3.62	4.00	4.00	1	0.870	2.00	1.00
SOC8 *	Stakeholder satisfaction/communication	1	3	4.15	4.15	5.00	4.00	1.068	0.801	2.00	1.50
SOC9	Ethics	4	5	3.85	3.69	4.00	4.00	0.987	0.947	2.00	1.00
SOC10 *	Anti-corruption	7	5	3.38	3.69	3.00	3.00	1.193	1.032	1.50	2.00
SOC11	Human rights	5	4	3.62	3.77	3.00	4.00	1.121	0.832	2.00	1.00
SOC12	In-Organizational awareness	3	7	3.92	3.54	4.00	4.00	0.76	0.967	1.50	1.00
ECO1	Investments	4	-	4.46	-	5.00	-	0.776	-	1.00	-
ECO2	Revenue	2	-	4.69	-	5.00	-	0.63	-	0.50	-
ECO3	Cost/expense/expenditure	3	-	4.54	-	5.00	-	0.776	-	1.00	-
ECO4	Economic performance	1	-	4.85	-	5.00	-	0.376	-	0.00	-
GOV1	Management board/diversity	1	-	4.62	-	5.00	-	0.65	-	1.00	-
GOV3 *	Ethical standards	3	3	4.00	4.00	4.00	4.00	1	1.000	2.00	2.00
GOV5	Process optimization/cost reduction targets	1	-	4.62	-	5.00	-	0.506	-	1.00	-
GOV6 *	Tackling the climate crisis	7	6	3.08	3.46	3.00	4.00	1.256	1.266	2.00	1.50

Table 6. *Cont.*

		Impact Level **		Degree of Impact ** (Mean)		Median		Standard Deviation		Interquartile Range (Q3–Q1)	
		1. Round	2. Round	1. Round	2. Round	1. Round	2. Round	1. Round	2. Round	1. Round	2. Round
GOV7 *	Effective environmental management	6	5	3.23	3.54	3.00	4.00	1.013	1.270	2.00	2.00
GOV8	Compliance	5	1	3.69	4.54	4.00	5.00	1.109	0.519	2.00	1.00
GOV10	Governance quality	2	2	4.15	4.38	4.00	4.00	0.899	0.650	2.00	1.00
GOV11	Supply chain management	4	4	3.77	3.77	4.00	4.00	1.013	0.725	2.00	0.50

* unreconciled and eliminated themes at the end of the second round of Delphi. ** Level of impact: Represents the order of the studied parameters according to the average. 1 is the highest level of impact. ** Degree of impact: Statistically represents the average score (mean).

In the second round, the items on which no consensus could be reached in the first round were asked to the experts again with the averages obtained from the first round. As a result of the second round of analysis, items with an interquartile range of more than R = 1.2 were eliminated as no consensus could be reached. In this section, the results of the analysis will be explained separately for each sustainability dimension.

In the environmental dimension, in the first round, the experts reached consensus on "Water emissions", "Materials", "Energy", "Environmental impact and certifications" and "Eco-friendly production". For this reason, the six themes on which consensus could not be reached, such as "Gas emission", "Waste", "Biodiversity", "Resource and raw material usage", "Recycling" and "Fuel consumption/logistics", were asked again in the second round. At the end of the second round, two topics ("waste", "resource and raw material usage") experienced a change in the interquartile range, and a consensus was reached. "Gas emissions", "Biodiversity" and "Recycling" were eliminated, as the "R" value remained above 1.2 in the second round. In the environmental dimension, energy had the highest impact (μ = 4.69; level of impact = 1) and "Biodiversity" had the lowest impact (μ = 3.0; level of impact = 10).

In the social dimension, according to the results of the first round, the experts reached consensus on only two topics, namely "Education" and "Employment", and failed to reach consensus on 10 topics, such as "Employee satisfaction", "Gender and diversity", "Health and safety issues", "Community engagement", "Social impact", "Stakeholder satisfaction/communication", "Ethics", "Anti-corruption", "Human rights" and " In-Organizational awareness". As a result of the second round, seven of these ten topics ("Employee satisfaction", "Health and safety incidents", "Community engagement", "Social impact", "Ethics", "Human rights" and "In-Organizational awareness") changed within the interquartile range and consensus was reached. "Gender and diversity", "Stakeholder satisfaction/communication", "Social impact" and "Anti-corruption" were eliminated. In the social dimension, "Health and safety issues" had the highest impact (μ = 4.69; level of impact = 1), and "Community Engagement" had the lowest impact (μ = 3.31; level of impact = 8).

In the management dimension, out of the eight topics asked to the experts in the first round, consensus was reached only on "Management board" and "Process optimization and cost reduction targets". In Round 2, the experts were asked again about six themes: "Ethical standards", "Tackling the climate crisis", "Effective environmental management", "Compliance", "Governance quality" and "Supply chain management". As a result of this round, three themes ("Compliance", "Governance quality" and "Supply chain management") changed between quartiles and a consensus was reached. In this dimension, "Management board and diversity" had the highest impact (μ = 4.62; level of impact = 1) and "Tackling the climate crisis" had the lowest impact (μ = 3.46; level

of impact = 6). "Ethical standards, "Tackling the climate crisis" and "Effective environmental management" were eliminated due to lack of consensus. The list of consensus themes in each sustainability dimension is shown in Table 7.

Table 7. Reduced relevant sustainability themes list in construction companies.

Economic	Governance
ECO1-Investments	GOV1Management board/diversity
ECO2-Revenue	GOV5-Process optimization/cost reduction targets
ECO3-Cost/expense/expenditure	GOV8-Compliance
ECO4-Economic performance	GOV10-Governance quality
	GOV11-Supply chain management
Environment	Social
ENV2-Water emissions	SOC1-Employee satisfaction/turnover rates
ENV3-Material	SOC2-Education
ENV5-Waste	SOC4-Employment
ENV6-Energy	SOC5-Health and safety issues
ENV8-Environmental impact and certifications	SOC6-Community engagement
ENV9-Eco-friendly production	SOC7-Social impact
ENV10-Resource/raw material usage	SOC9-Ethics
ENV12-Fuel consumption/logistics	SOC11-Human rights
	SOC12-In-Organizational awareness

As a result of the sequential analyses (Figure 4), corporate sustainability themes were categorized into four dimensions for the construction companies, and a set of 26 themes was created in total.

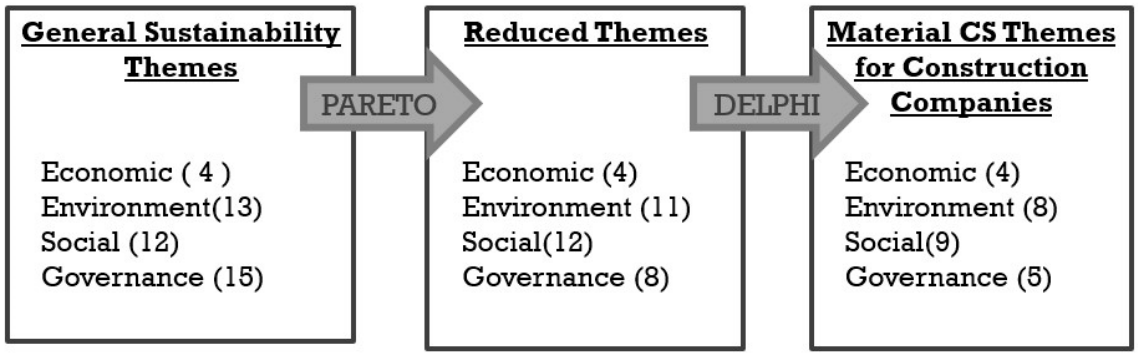

Figure 4. Number of corporate sustainability themes in each analysis stage.

5. Discussion

In this chapter, the proposed framework summarizes and discusses corporate sustainability issues and their importance. The 26 key themes identified through the Delphi technique are evaluated along the dimensions of sustainability. The results help to identify critical areas for the construction sector in the environmental, social, economic and governance dimensions. The results are consistent with the literature, but also point to divergent views in the literature in some areas.

Environmental sustainability is a very important theme for the construction industry. Rajabi [70] found that most of the environmental impacts in the construction industry are caused by topics such as energy efficiency, water consumption and waste management [70]. In our study, the consensus on topics such as "water emissions", "materials" and "energy" indicates a common recognition of the materiality of this theme, while more niche topics such as "gas emissions" and "biodiversity" are ignored, suggesting that environmental awareness in the sector is still limited. At the same time, this finding points to the fact

that concern for environmental sustainability in the construction industry is sector-specific and that specific themes need more emphasis. This view is consistent with Jing et. al. (2024), who emphasize that environmental sustainability is prioritized in the construction industry, and that focusing on topics such as "energy efficiency" and "water management", in particular, would be more effective [110]. However, less emphasis on topics that have no direct environmental impact but contribute to the long-term health of ecosystems, such as "biodiversity", contrasts with some research. For example, Opoku (2019) emphasizes that raising awareness on the impacts of the built environment on biodiversity loss is key to achieving the SDGs [111]. This creates a contradiction, suggesting that the construction sector needs to extend beyond its direct environmental impacts and focus more on ecosystems and biodiversity. In this respect, it is understood that construction firms need a broader perspective on environmental impact reporting.

On the other hand, the identification of energy efficiency and material use as material topics in sustainability reporting reflects the industry's endeavor to comply with global environmental targets. Kibert (2016) stated that energy consumption and sustainable use of materials should be key priorities in the construction industry [112]. These findings reveal the importance of energy efficiency and materials management for environmental sustainability.

Social sustainability is also of critical importance to stakeholders in the construction sector. Within the social dimension, while there was consensus among experts on education and employment, there was divergence on other topics. Rostamnezhad (2022) stated that social sustainability in the construction industry should not be limited to only occupational health and safety, but should also consider employee satisfaction, community engagement and diversity [113]. The prominence of social dimensions such as "education" and "employment" in our research indicates that social responsibility projects in the sector have increased, but topics such as social diversity and stakeholder satisfaction are still under-reported. In the second round, there was consensus on topics such as "Employee Satisfaction" and "Health and Safety Incidents", while topics such as "Gender and Diversity" and "Stakeholder Satisfaction/communication" were excluded. This finding implies that more efforts need to be directed towards prioritizing social sustainability in the construction industry.

Gray (2006) argued that social sustainability should focus on factors such as occupational safety and employee health [114], but Porter & Kramer (2011) pointed out that topics such as "stakeholder satisfaction" and "social interaction" are also critical for long-term sustainability [115]. Employee satisfaction should be more prominent in a field with challenging working conditions such as the construction industry, but ignoring social diversity and stakeholder engagement can weaken a firm's relationship with society. At this point, it is clear that sustainability reporting should focus not only on internal factors but also on relationships with external stakeholders. Rostamnezhad (2022) highlighted the importance of community engagement in the construction industry for project success, stating that it is not enough for firms to focus only on occupational health; they also need to manage their social impact and stakeholder relationships. These findings suggest that there is a need for social sustainability strategies to have a broader scope in construction firms [113].

On the economic dimension, the fact that there was complete consensus in the first round on issues such as "financial performance", "revenue", "investment" and "costs/expenses" shows that economic sustainability is a critical factor for the long-term growth of construction companies. Economic sustainability is particularly important to ensure financial stability in the construction sector. Kocmanová and Dočekalová (2012) argued that focusing economic indicators on key topics such as "Financial Performance", "Investment" and "Revenue" will support the sustainable growth of the companies. Similarly,

in this study, the high impact of "Financial Performance" indicates that these indicators are critical for the sector [116]. However, the relatively low impact level of themes such as "Expenses" suggests that the construction sector relies only on short-term financial indicators and may be lacking in long-term economic strategies.

Kolk (2008) stated that economic sustainability is not only profit-oriented, but also requires long-term investments and strategic financial planning [117]. Elkington (1997) also emphasized that the economic dimension should be compatible with social and environmental sustainability [118]. In this context, it is clear that economic sustainability targets should focus not only on short-term financial performance, but also on long-term investments and sustainable growth. However, an emphasis on shorter-term indicators in reporting may neglect the long-term strategic aspects of sustainability.

Another point to be considered in economic sustainability is the increased emphasis on sustainable investments. Zuo & Zhao (2014) state that sustainable investments in the construction industry are directly related to financial sustainability and environmental performance, and that increasing these investments will strengthen the competitive advantage in the sector [119].

In the governance dimension, it is frequently emphasized in the literature that the organizational structure and processes should be aligned with sustainability goals in order to effectively implement sustainability strategies. Gardazi et al. (2020) state that in order to achieve the sustainability goals of companies, boards of directors should firmly adopt and monitor these strategies [120]. In this study, the consensus on management-related issues such as "Management board" and "Process optimization" indicates that the sector has a more effective management approach in this dimension. Porter & Kramer (2011) stated that integrating the management structure into sustainability strategies will help firms both increase their internal efficiency and fulfill their environmental and social responsibilities [115]. On the other hand, the lack of consensus on topics such as "ethical standards" and "tackling the climate crisis" indicates that, especially when it concerns global problems such as "tackling the climate crisis", local construction companies do not sufficiently embrace these problems in a global context. This finding contradicts Gray (2006), who argues that ethics and sustainability principles at the management level are critical to the long-term success of companies and that elements such as "ethical standards" should not be ignored [114]. Global challenges such as "tackling the climate crisis" may not be an immediate priority for local construction firms, as such large-scale issues are often addressed by government policies and global agreements. On the other hand, Unegbu (2024) emphasizes that climate change and sustainability strategies need to be integrated more effectively in the construction sector [121].

6. Conclusions

Materiality and prioritization analysis is an important process in sustainability reporting. While many researchers have studied sustainability reports, there is little empirical evidence on how firms conduct materiality analysis and how they report it in their sustainability reports. Approaches to identifying material corporate sustainability themes have caused some controversy and disagreement. The use of one-dimensional approaches to identify and assess material topics is limited and insufficient for company owners, investors and other stakeholders. Stakeholders are increasingly interested not only in economic performance but also in the company's impact on the environment and society. Corporate stakeholders expect clear and relevant information for their decision-making processes. The proposed framework therefore extends corporate sustainability performance to include a fourth pillar, corporate governance, based on the triple bottom line, as distinct from existing complex indicators and indices.

This study aims to explain materiality analysis in corporate sustainability reporting and to identify and assess the material themes specific to construction companies and the construction industry for reporting. The results indicate that a number of important sector-specific topics become prominent and should be considered in corporate sustainability reporting. Therefore, the key themes for corporate sustainability assessment are framed based on the construction industry and expert opinions on sustainability.

Composite indicator systems are one of the ways to create a tool for measuring and assessing the sustainability of firms and allow for an assessment of whether firms are heading towards sustainability [41]. Therefore, the important set of topics created through indicators can be used as a tool to assess the sustainability performance of firms.

The set of important themes related to the corporate sustainability of construction companies was identified on the basis of the recommendations of international organizations and expert opinions. The topics compiled from the literature were reduced by approximately 41% using various techniques, and the redesigned set consists of 26 themes in total, including environmental (8), social (9), economic (4) and governance (5) dimensions. The themes determined for construction companies can be used in the materiality analysis included in the sustainability reports that have become obligatory with regulations such as CSRD. This describes how this research results can be used in practice and its facilitating effect in implementations.

The main positive aspect of identifying these themes is that, compared to a set of specific indicators, the framework summarizes a company's sustainability and allows for a rapid and meaningful comparison. At the same time, the framework allows for more in-depth analysis through sub-themes for specific areas and dimensions of sustainability for construction companies. On the other hand, the limitation of this study is that the results are valid for large and medium-sized international construction firms. Future studies can be advanced to address regional differences in the construction sector, firm types and firm size.

The results also suggest that the materiality analysis needs to be adapted to sector-specific criteria in order to improve the effectiveness of sustainability reporting in the construction sector. Adapting generic sustainability frameworks to the sector not only improves the accuracy of reports, but also provides decision makers with more meaningful and implementable information. In this sense, construction companies need to balance sector-specific standards and global sustainability development goals in their sustainability reporting [117].

This study differs from other studies in the literature in that it adds the governance dimension as an information heading to the social, environmental and economic dimensions while providing information on the sustainability impacts and performance of firms.

On the other hand, the construction sector is different from other sectors. The identification of prominent themes for this sector differentiates this study from other studies on sustainability reporting.

In conclusion, the findings of this study highlight the need for construction companies to enhance their decision-making processes based on materiality analysis in sustainability reporting. As stated in the literature, focusing only on environmental factors may not be sufficient to ensure the long-term sustainability of the company; the integration of economic, social and governance factors provides a more comprehensive and effective sustainability reporting [114]. In this context, it would be helpful for companies in the construction sector to accurately analyze stakeholder expectations and design their sustainability reports accordingly in order to achieve a competitive advantage in the sector.

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Institutional Review Board Statement: Ethical review and approval were waived for this study due to the YTU Social Sciences Institute Scientific Research and Publication Ethics Board Directive "Actions That Cannot Be Considered Contrary to Ethical Principles ARTICLE 7-(1) Using anonymous information, basic information of scientific fields, mathematical theorems and proofs, etc. in studies, provided that the original style and expression of another person is not used verbatim, cannot be considered as an ethical violation." Our study falls within this scope. Here are the links: https://sbe.yildiz.edu.tr/sayfa/10/Etik-Kurul-Ba%C5%9Fvurusu/276 (accessed on 1 March 2025).

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Abbreviations

The following abbreviations are used in this manuscript:

CS	Corporate Sustainability
GRI	Global Reporting Initiative
CSRS	Corporate Sustainability Reporting Standards
SDGs	Sustainable Development Goals
TBL	Triple Bottom Line

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