The model for measuring the Quality of Sustainability Reporting and Determinants: Application Analytic Network Process Fuzzy DEMATEL-Based Technique

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Abstract

Sustainability reporting is an important tool for decreasing information asymmetry, according to the stakeholders' demands for transparency. On the other hand, increasing transparency allows investors to have more appropriate evaluations of firms' activities and direct their investments to companies with more enthusiasm. In the organizational context, information asymmetry creates conflict between owners and managers. Managers tend to reduce the gap

between themselves and stakeholders, particularly shareholders, by producing and delivering reports. Companies use sustainability reports to connect with their society and environment, as well as a way to manage interactions with various stakeholders for societal approval and activity continuation. The primary purpose of this study is to provide a model for measuring the quality of sustainability reporting and the determinants. In terms of methodology, the current study is qualitative, deductive, cross-sectional, applied, and exploratory. The criteria were identified and extracted, then evaluated and prioritized using Multi-Criteria Decision-Making approaches including Fuzzy Analytic Hierarchy Process and Fuzzy Decision-Making Trial and Evaluation Laboratory Analytic Network Process-based. The FAHP test revealed that of the six indicators, the GRI's reporting guidelines for sustainability Checklist were placed highest. Internal Controls Reporting, Sustainability Innovation Performance, and Earnings Quality rated first to third, respectively, among the 25 criteria affecting the quality of sustainability reporting, according to the FDANP.

Keywords: Sustainability Reporting Quality, Internal Controls Reporting, Sustainable Innovation Performance, Earnings Quality, Value Relevance, FDANP

Introduction

Sustainability reporting has long been recognized as an important tool for organizations and companies to satisfy the rising need for transparency from customers, investors, and other stakeholders (Martinez et al., 2016). Firms, voluntarily report information on their economic, environmental, and social consequences through sustainability reports. This tool enables enterprises to eliminate information gaps and enhance the transparency of their good and bad performance over time (Nobanee and Ellili, 2016). Furthermore, increased transparency helps investors to make more accurate assessments of firms' activities and to better target their investments. Firms that demonstrate social commitment, accountability, and sustainability in their behavior acquire the legitimacy and social acceptability required by the community, and therefore stronger competitive positions and competitive advantages in the market (Martinez et al., 2016). As a result, many companies and organizations are paying more attention to sustainability concerns, as well as the adoption of

innovative business models and reporting techniques (Clark, Feiner, and Viehs, 2015). In the organizational context, information asymmetry, according to agency theory, creates a gap between shareholders and managers. According to signaling theory, managers strive to reduce the gap between themselves and stakeholders, particularly shareholders, by releasing a sign (report), i.e., relevant information (with information content) and quality, to various parties (Bae et al., 2018). Firms utilize sustainability reports as a tool to interact with the community and the environment, as well as to manage interactions with various stakeholders, to be acceptable in society according to legitimacy and stakeholders' theories (Behbahaninia and Golbidi, 2020).

Considering scientific studies on environmental and societal problems, stakeholders are becoming more aware of the issues and want companies to be held accountable (Yatiridis, 2013; Dissanayanke et al., 2016). In the mid-1990s, a global trend began for companies to include social and environmental information in their annual reports. Around 1998, firms began producing their own environmental reports, with 35 percent of American companies doing so. The International Corporate Governance Network (ICGN) reminded the business community that the environment is an important factor to consider when measuring corporate value, current and future opportunities and risks, and investing (El-Rahman, 2019). According to the GRI Database, 4445 entities from all around the globe prepared 4595 sustainability reports using GRI standards in 2020. Table 1 illustrates some of the countries that have reported on sustainability. Iran has four authorized organizations that represent the worldwide movement of companies reporting on sustainability. Ayandeh Bank, Fajr Energy Complex, Mapna, and Nouri Petrochemical Complex are the four Iranian organizations that have developed standard and certified sustainability reports.

Table 1. A number of reporting countries based on the GRI Database in 2020

Nations	USA	Germany	France	UK	Turkey	KSA	UAE	Iran
Organization	367	169	32	64	44	12	35	4
Report	444	217	38	67	62	16	55	5

Sustainability reports have made significant progress in various areas over the last few decades, but there are growing concerns about their quality (Michelon, 2015). Academic scholars have been examining the quality of sustainability reporting in different contexts in recent years. For example, Chauvey et al. (2015) reported low sustainability reporting quality in France. According to previous research in the United States, sustainability reporting is

a critical component (Cho et al., 2012). According to Michelon et al. (2015), the publishing of independent reports provides more information, but the quality is low. In a study conducted in the Netherlands, Gao et al. (2016) reported that firms with higher quality sustainability reporting received economic benefits such as institutional investment, increased coverage by financial analysts, and liquidity through the sale of more stocks. Al-Shaer and Khan (2016) found that the quality of sustainability reporting was positively and substantially linked with the success of gender diversity boards and independent female CEOs in the United Kingdom. Their following research in the United Kingdom (Al-Shaer and zaman, 2018) found that the presence of audit committees had an impact on the quality assurance of sustainability reporting. Other fascinating instances have been investigated in recent studies.

Rezaee and Tao (2019) found that when sustainability reporting quality was high in the United States, the positive correlation between sustainability reporting and the quality of intrinsic earnings was stronger. Diouf and Bioral (2017) conducted a study in Canada on stakeholder views of the impact and distribution of sustainability reporting. In earlier research, the authors conceived and assessed the quality of sustainability reporting. Rezaee and Tao (2019), for example, define sustainability reporting as the quantity of sustainability data and the GRI framework. Other research, such as Al-Shaer and Zaman (2018), used external assurance to determine the quality of sustainability reporting (independent auditing). According to the government's approach, Gao et al. (2016) looked at the quality of sustainability reporting from five perspectives: relevance, clarity, reliability, accountability, and coherence. Other studies have defined sustainability reporting quality in terms of three dimensions: content, validity, and communication (Helfaya et al., 2019) or four dimensions: relative quantity, density, accuracy, and management orientation (Michelon et al., 2015). relevance, comparability, verifiability, clarity, and neutrality are five essential characteristics of sustainability reporting quality information, according to Chauvey et al. (2015). To assess the quality of sustainability reporting, Khan et al. (2020) employed the criteria of relevance (information content) and verifiability.

To ensure the quality of sustainability reporting, the Global Reporting Initiative (GRI) has established principles that focus on it. Stakeholders, including investors, *accuracy*, *balance*, *clarity*, *comparability*, *verifiability*, and *timeliness*, among other aspects. It enables them to analyse the firm's performance correctly and logically and take necessary action. The writers of this paper were encouraged to "Explain the model for measuring the quality of

sustainability reporting and the determinants" given the fact that there are no studies on the subject in Iran.

In comparison to previous domestic research, the current study stands out by identifying, extracting, refining, and rating the indicators, as well as assessing the quality of sustainability reporting and determinants. The combined approaches of Analytic Network Process (ANP) and Decision-Making Trial and Evaluation Laboratory (DEMATEL) based on Fuzzy Inference System (FIS) were utilized for the first time in Iran in this study to investigate the internal linkages of factors affecting the model. Given this focus, we expect the current study, as well as the beginnings of quantitative analysis based on the identified factors in the field of reporting quality, to be long-lasting and beneficial to stakeholders, notably investors.

This research helps stakeholders, particularly investors, in evaluating a company's performance using non-financial quality data that includes all economic, social, and environmental dimensions. This information enables them to correctly and effectively estimate their risk and return on investment. On the other hand, it has created a management tool for directors to make appropriate decisions by taking an efficient approach and decreasing debt expenses, business political costs, and enhancing their incentives. What are the model findings for assessing the quality of sustainability reporting and the factors that influence it? is the main question of the study.

The main purpose of this research is to describe the model for determining the quality of sustainability reporting as well as the factors that influence it. Furthermore, the first sub-objective is to develop and extract metrics or models for assessing the quality of sustainability reporting using content analysis of the academic literature. The second sub-objective is to investigate the research literature and use content analysis to find and extract the factors affecting the quality of sustainability reporting. The third sub-objective is to use a Delphi survey and Multi-Criteria Decision-Making models, such as FAHP and FDANP methods, to purify the identified and extracted metrics or patterns of sustainability reporting quality and determinants. Their internal relationships are identified and ranked in the end.

The current study contributes to the existing body of knowledge on sustainability reporting by addressing four major issues. First, the findings of this study may be used to create theoretical basics for literature on corporate sustainability, governance, and financial governance. Second, corporate managers will use the findings of this study to constantly create value by maximizing positive aspects and decreasing negative aspects. Third, advising

policymakers, such as the auditing organization, the Securities and Exchange Commission to develop reporting standards and regulations. Fourth, the proposed model would provide a new paradigm and scope for academics to use in future research to quantitatively investigate and evaluate the factors influencing the quality of sustainability reporting.

Literature Review

Sustainability reporting

The World Commission on Environment and Development established the aspirational aim of sustainable progress in 1987, defining it as "development that fulfills current demands without affecting future generations' ability to satisfy their own needs." As a result, organizations play a critical role in accomplishing this aim. All organizations contribute to sustainable development in good and bad ways through their actions and interactions. Sustainability reporting, as defined by the GRIs, is an organization's method of publicly reporting on its economic, environmental, and social effects, as well as its positive and negative contributions to the goal of sustainable development. Throughout this procedure, a firm determines its significant economic, environmental, and societal consequences and discloses them in accordance with a globally accepted standard. The GRIs provide a common vocabulary for organizations and stakeholders to agree on and understand the economic, environmental, and social effects of organizations. The Standards are intended to increase worldwide comparability and quality of the information on these consequences by allowing for more transparency and accountability. GRI-based sustainability reporting should portray a fair and reasonable picture of an organization's positive and negative contributions to sustainable development. The statement prepared through sustainability reporting allows internal and external stakeholders to form opinions and make enlightened decisions regarding an organization's engagement in sustainable development.

Relevant and key firm stakeholders have reported the influence of the quality of sustainability reports on decision-making in various sustainable development goals throughout the world. Firms that want to maintain their credibility, on the other hand, reveal more consistent, unrealistic, and deceptive information (Chou et al., 2018). Furthermore, when publishing good vs negative sustainability information, stakeholders are only exposed to positive news, which has an impact on their trust in sustainability reports (Unerman et al., 2014). This tarnishes a company's reputation, and such conduct is hazardous to long-term development in terms of the influence of corporate

performance on society. As a result, the fundamental goal of the sustainability performance report is not met (Unerman et al., 2014). Firms use sustainability performance reports as a linguistic tool to portray a different picture of themselves by releasing reliable data solely to legitimize their performance in such instances (Gary, 2010; Chou et al., 2012; Milne & Gray, 2013). Stakeholder pressure for a transparent and credible corporate sustainability report to illustrate firm sustainability commitments in a realistic approach grows as a result of this (Al-Shaer & Zaman, 2016).

Agency Theory

Despite firms' ongoing efforts to disseminate more additional information about their performance, there is a critical information asymmetry between stakeholders and management, which is a significant activity in the reporting way (Briem and Wald, 2018). *Information asymmetry* is a situation in which one person has more information than the other. It frequently occurs between management and shareholders. The main objective of reducing information asymmetry between managers and shareholders is to provide a high level of transparency in company performance, allowing shareholders to analyze company conduct in greater depth (Jensen and Berg, 2012). Transparency in corporate reporting refers to the quantity of information about an organization that is available to allow outside groups (such as auditing firms) to monitor internal operations and performance (Hamed et al., 2020). Transparency is a basic and essential component in enhancing public accountability. Agency and legitimacy theories give a comprehensive viewpoint to support the idea that transparency is a fundamental and vital factor in improving public accountability (Stefanescu et al., 2016). Voluntary disclosure is one of the numerous strategies to enhance reporting transparency. Voluntary disclosure helps to alleviate information asymmetry and agency issues by providing relevant information about the firm. Transparency is also a sign of improving operational quality and cost-effectiveness (Sehar and Tufail, 2013).

Stakeholder Theory

Firms can have a more effective relationship with stakeholders by achieving the stated goals, according to stakeholder theory. This relationship also improves the company's reputation and has a beneficial impact on its financial success (Bose et al., 2017). Responsive to stakeholder requests also contributes to a competitive edge and long-term viability (Needless et al., 2016). This idea also claims that meeting stakeholder expectations and being able to respond to their demands is essential for a company's legitimacy and long-term success (Ferri et al., 2016). In this regard, Oshika and Saka (2017) concluded that the

major reason for Japanese firms' long-term viability was because management adopted "the idea of stakeholder satisfaction" for economic performance and included it into their sustainability reports. Following the global financial crisis of 2008, stakeholders, regulators, and others focused their attention on a company's long-term viability and sustainability (Adams and Simnett, 2011). As a result, they (stakeholders) want more non-financial data and encourage firms to include more information in their annual reports regarding corporate governance, social and environmental concerns, and sustainability (Comilleri, 2018; Needles et al., 2016; Velte and Stawinoga, 2017).

Legitimacy Theory

Legitimacy in society is a key strategic component for businesses looking to grow in the future. Legitimacy may be used to develop a business strategy, particularly when it comes to the firm's social standing. Organizations are continuously seeking for strategies to assure their performance within society's scope, context, and standards, according to the legitimacy hypothesis. Legitimacy is a mental state of individuality and a group of persons who are hypersensitive to both physical and non-physical signs of the environment. As a consequence, legitimacy varies according to the location and time coordinates. According to the legitimacy theory, organizations are always on the lookout for ways to ensure that their performance stays within the limits and norms set by society. According to this notion, organizations seek legitimacy by conforming to the standards and guidelines established by the society in which they function (Ruhana and Hidayah, 2020).

Signaling Theory

In a competitive environment, signaling theory is concerned with resolving information imbalance (Taj, 2016). This theory focuses on management's objective of disseminating market, stakeholder, and community information and signals. In the organizational context, information asymmetry can lead to disputes between owners and agents, but the sign bridges the gap by delivering relevant and high-quality information to all stakeholders. Furthermore, high-quality signals (information) suggest that outsiders (buyers, investors) can rapidly grasp the company's capabilities (to bear and manage expenses) and, as a result, the amount to which sales and stock prices may grow. The price of a stock on the market might suddenly rise. As a result, management should consider signaling as a strategic instrument in the decision-making process for social and environmental investments. Furthermore, sign theory explains the trustworthiness of signs as a tool for honesty, as well as management's willingness and commitment to society and stakeholders (Mavlanova et al., 2012).

Committed management sends out positive signals that improve the dependability of information (Taj, 2016). As a result, companies use numerous techniques to transmit signals to stakeholders to decrease information asymmetry. Disseminating information in a report is one of the most useful transmission methods (annual financial reports and stability) (Ching et al., 2017). According to signaling theory, successful management communicates with stakeholders about the firm's commitment and long-term strategy on sustainability performance through corporate sustainability reports or corporate responsibility (Bae et al., 2018). Furthermore, sustainability reporting demonstrates good company governance, financial stability, an active environmental strategy, corporate social responsibility, climate change commitment, transparency, and overall connection with stakeholders. As a result, sent signals decrease information gaps between companies and their many stakeholders (internal and external) and give a competitive advantage by decreasing the legitimacy gap with society (Ching et al., 2017). Furthermore, stakeholder feedback signals are necessary for the company to comprehend the true distance between managers and stakeholders, as well as to promote the development and implementation of a better program to close that gap.

Research background

In research, Hemmati et al. (2019) found that a value-added social statement might be a useful report for assessing a company's economic, social, and environmental performance.

According to Rezaee and Tao (2019), the positive relationship between innate earnings quality and sustainability reporting quantity may be increased while the negative relationship between discretionary earnings quality and sustainability disclosure quantity can be decreased. Furthermore, their further research suggested that the relationship between earnings quality and sustainability disclosure quantity is influenced by corporate structure and prior-year sustainability performance.

After adjusting for numerous firm-specific variables, Alipour et al. (2019) discovered a substantial positive link between environmental reporting quality and earnings quality in research.

Abdi et al. (2020) categorized sustainability reporting factors into five primary types and 24 criteria in their analysis. Environmental requirements, corporate governance characteristics, and structural aspects of the company were ranked first among the sustainability reporting drivers by experts. The criteria of legal requirements, board member independence, and profitability

ranked first and second, respectively, in the rating of the indicators. The criteria of legal requirements, board member independence, and profitability ranked first and second, respectively, in the rating of the indicators.

Moses et al. (2020) performed research in Malaysia to better understand the link between corporate governance mechanisms and the quality of sustainability reporting. They looked at how the quality of sustainability reporting affected the board's features. The findings demonstrated a favorable link between the aspects of corporate governance strategies and the quality of sustainability reporting, as predicted by numerous theories.

In a research, Correa-Garcia et al. (2020) looked at the elements that influence the quality of sustainability reporting in Latin American companies. The findings revealed that group control concentration had a detrimental impact on the quality of sustainability reporting. According to their findings, foreign ownership restrictions, the age of company groupings, and the size of the board of directors have all helped to improve the quality of sustainability reporting.

Khan et al. (2020) used the framework of the World Bank Report on Bangladesh's Banks to examine the quality of sustainability reporting and the influence of regulatory requirements, social performance, and a standard reporting structure. The quality of sustainability reporting improved when regulatory standards and social performance were measured using the GRI's criteria.

In a study of sustainability reporting in Italian public service firms, Badia et al. (2020) addressed the issue of quality. Despite the rising use of non-financial reporting in organizational life, their findings revealed that it is not widely used inside public services. They discussed the topic of sustainability reporting quality and came to the conclusion that non-financial reporting is generally accurate, clear, and comparable; timeliness and stakeholder participation appear to be acceptable, but reliability appears to be missing.

In his study, Al-shaer (2020) looked at data from FTSE 350 companies from 2007 to 2018 and found that companies that publish high-quality sustainability reports are both positively and negatively linked with profits management measures.

Adaui (2020) investigated the influence of new regulatory requirements for sustainability disclosure on the quality of sustainability reporting. Despite the introduction of new regulatory requirements, the quality of sustainability reporting continued to improve, according to the findings of the study.

Jadoon et al. (2021) assessed the impact of sustainability reporting quality on sustainable corporate performance information content using data from 247 enterprises in 21 countries and the Green Economic Growth Index. The findings of the regression analysis revealed that the information content of sustainability performance derived from economic, social, and corporate governance components. Investors, on the other hand, saw the environmental performance as unimportant to boost the firm's worth. According to their findings, the quality of sustainability reporting has a significant impact on corporate governance information content. As a result, investors considered it as a new corporate governance tool.

Population and Sample in Multi-Criteria Decision-Making

Population and sample are two of the most important considerations in multi-criteria decision-making. We started by defining the experts. Academics and management accounting and economics professionals with at least a master's degree are among the experts in this study. When the scope of the research involves a specific company or institution, the intentional sampling technique is utilized in Multi-Criteria Decision-Making (MCDM) procedures. Furthermore, education and experience are factors, and several specialists from that company are chosen as a sample (Habibi et al., 2014). The snowball sampling approach was selected since the scope of the current study is broader than an organization and encompasses a specific scientific subject such as the quality of sustainability reporting. In this research, 40 experts were employed in the Delphi stage and 10 in the subsequent phases.

Data collection tools in Multi-Criteria Decision-Making methods

Thurstone was the one who initially offered a few comparisons. According to Thurstone (1927), if a group's members are to be assessed fairly, they should be compared in pairs. To explain this, he introduced the word paired. Thomas Saati utilized the same methodology to assess the superiority of the items in each cluster when he developed the Analytic Hierarchy Process method. As a result, this questionnaire is also known as the paired comparison questionnaire. It's also known as the Expert Questionnaire since it's frequently used to evaluate expert opinions.

In multi-criteria decision-making procedures, a matrix is utilized to collect data, and the values are usually genuine statistics. Pairwise comparisons, as we'll discover if we pay attention to them, aren't statistical surveys. It's simply a mathematical matrix comprising comparing pairs of variables. As a result, pairwise comparisons are only a mathematical matrix

with no statistical value, and the words attitude or attitude scale, such as the Thurston scale, are preferred. As a result, the pairwise comparison matrix's validity and reliability are useless because the questionnaire is not used. In the Analytic Hierarchy Process (AHP), the inconsistency rate is used to assess the validity of pairwise comparisons, whereas the reliability rate is utilized in the ANP based on Fuzzy DEMATEL (DANP). The paired comparisons were carried out logically and properly if the inconsistency and reliability rates were less than 0.1 and 0.05, respectively (Tables 2 - 7).

Table 2. Delphi Expert Opinions on Screening Criteria and Effective Factors

Criteria	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A					✓
B				✓	
C			✓		
D		✓			

Table 3. Likert scale for use in the Delphi method and related fuzzy numbers

Scale	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Definite number	1	2	3	4	5
Fuzzy numbers	(1.1.1)	(1.2.3)	(2.3.4)	(3.4.5)	(4.5.6)

Table 4. Example of Expert Questionnaire Used in AHP Based on Thurston Attitude Scale (1927)

Criteria$_i$	Score																		Criteria$_j$
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
A			✓															B
A				✓														C
A															✓			D
B			✓															C
B																✓		D
C																	✓	D

Table 5. Basic Scale of Preferences for Judging the Saati Method and Related Fuzzy Numbers

Scale	Equally	Between	Moderately	Between	Strongly	Between	Very Strongly	Between	Extremely
Definite number	1	2	3	4	5	6	7	8	9
Fuzzy numbers	(1.1.1)	(1.2.3)	(2.3.4)	(3.4.5)	(4.5.6)	(5.6.7)	(6.7.8)	(7.8.9)	(8.9.10)

Table 6. Sample of Parallel Comparison Attitude Scale Based on DEMATEL Technique

Criteria$_{ij}$	A	B	C	D
A	0	(0.1.2.3.4)	(0.1.2.3.4)	(0.1.2.3.4)
B	(0.1.2.3.4)	0	(0.1.2.3.4)	(0.1.2.3.4)
C	(0.1.2.3.4)	(0.1.2.3.4)	0	(0.1.2.3.4)
D	(0.1.2.3.4)	(0.1.2.3.4)	(0.1.2.3.4)	0

Table 7: Scale of the effect of factors on each other based on the DEMATEL technique and related fuzzy numbers

Scale	No	Very Low	Low	Hight	Very Hight
Definite number	0	1	2	3	4
Fuzzy numbers	(0,0,0.25)	(0,0.25,050)	(0.25,0.50,0.75)	(0.50,0.75,1)	(0.75,1,1)

The most important Determinants

Internal control reporting

Internal control, as a monitoring tool, minimizes information asymmetry between firms and stakeholders by connecting them to markets. Successful internal control also improves the efficiency and quality of the information system. It also establishes a proper structure for dividing duties, monitoring, and power balance, eliminates conflicts of interest between corporations and stakeholders, and safeguards the rights and interests of stakeholders. This internal control also motivates companies to operate hard to enhance their corporate social responsibility performance (Li, 2020). Based on a sample of 1767 firms in China between 2011 and 2016, Li et al. (2018) found that

sufficient internal control has pushed corporations to take on considerably higher social obligations.

Sustainable innovation performance

Sustainable innovation, according to Bos-Brouwers (2010), is described as the modernization or enhancement of technical or organizational goods, services, and processes that improve economic, environmental, and social performance in the short and long term. As a result, they have the potential to have good social and environmental consequences in the long run. Several patents are taken into account when calculating innovation performance, although generating new technology does not reflect its economic worth. Citations, as well as a large number of new products and patents, are important markers of technical innovation success (Acs et al., 2002). Jeong and Shin (2020) utilized the patents index to assess innovation success in their study on factors impacting corporate performance via sustainable innovation.

Earnings Quality

According to previous research, voluntary disclosures, such as sustainability reporting, can either replace or complement low-quality earnings and required financial reporting. As a result, this research confirms the complimentary link that high-profit firms tend to release more disclosures, which improves corporate reporting's trustworthiness and validity. To decrease earnings management and opportunistic behavior, Rezaee and Tao (2019) looked at the relationship between sustainability reporting quality and quantity earnings quality. Their findings show a positive link between the quantities of sustainability reporting and the quality of intrinsic earnings, but a negative relationship between the quality of sustainability reporting and the quality of intrinsic earnings. In addition, the significance of sustainability reporting quality in generating a favorable link between the quantity of sustainability reporting and the quality of revenues has been favorably assessed.

Economic performance

Tobin's q was utilized by Abdi et al. (2020) to represent a firm's performance to determine how the metric reacts to the firm's sustainability performance. The term "performance" in the study appears to be split into two distinct streams. First, this upbeat viewpoint asserts that environmental and social responsibility can coexist with increasing shareholder income and accomplishing larger societal objectives. According to Hill (2020), the adoption of sustainability

disclosure has an influence on investment returns by affecting company financial performance as well as the dangers presented to broader economic development and financial market stability. On the other side, some argue that these behaviors are frequently a reflection of internal management agency issues and hence problematic. It's been demonstrated in a few studies with mixed outcomes (Xie et al., 2019). According to certain studies, sustainability efforts have a beneficial impact on firm performance (Fatemi et al., 2018). Other studies, on the other hand, find that sustainability has an impact on a company's success (Lee et al., 2009). Taking a deeper look at the topic, a study of 132 experimental publications performed in response to Alshahi et al. (2018) research found that more than 78 percent of these studies demonstrate a favorable link between firm stability and company financial success. Lourenco et al. (2012) assessed a favorable link between these two categories based on this debate and comparative studies. It's also worth noting that long-term sustainability may boost profitability by improving stakeholder connections and lowering the cost of engaging with them, as well as increasing staff credibility and productivity.

Value Relevance

The ability to assess performance to explain changes in contemporaneous stock returns is known as value relevance. It's an estimate of how beneficial it is to measure performance while making stock investment decisions. Financial information, such as sales, earnings, stock book value, comprehensive income, and operating cash flows, has traditionally been the emphasis of information content. Non-financial elements have become an important component in influencing stock values, according to a new stream of information content. It is stressed that accounting data is not the sole element that accounts for differences in company market value. Non-financial information, like financial information, has an impact on market value and change. As a result, non-financial research's informative substance focuses more on corporate sustainability performance and its dimensions (Aureli et al., 2020). This hypothesis includes quantitative and qualitative criteria as a major component in understanding stock price movements at the same time (Jadoon et al., 2021).

Conceptual model of research
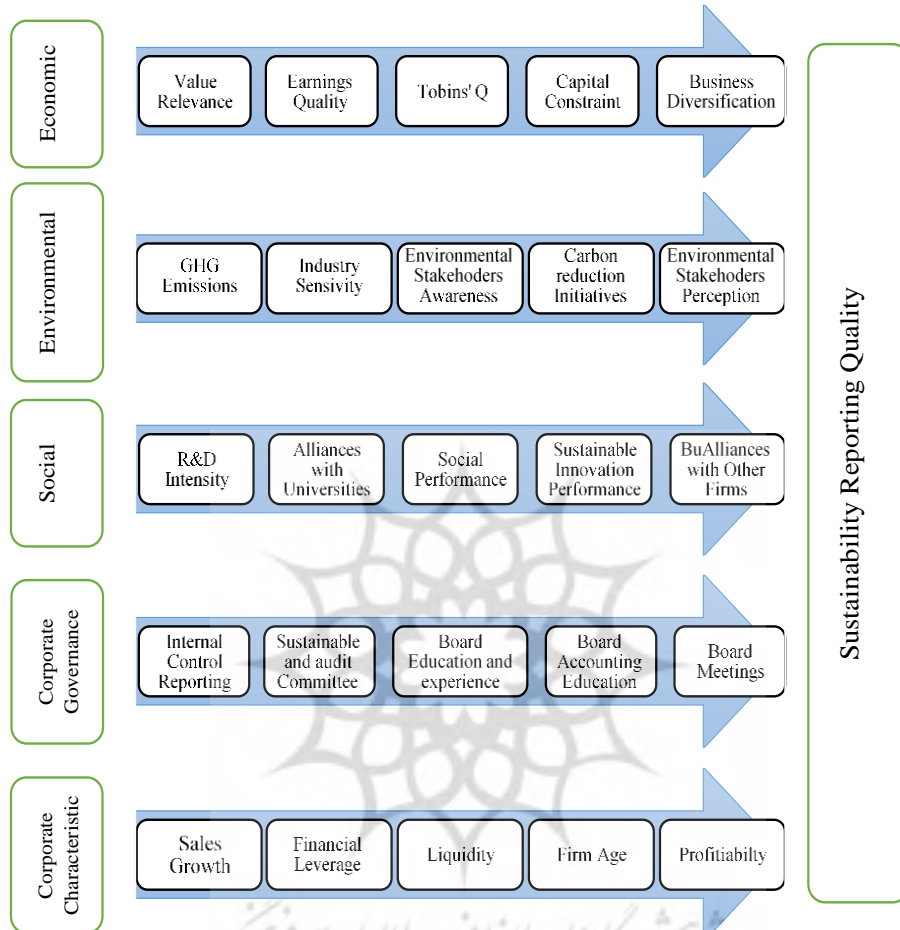
Figure 1. Conceptual framework of quality of sustainability reporting and the determinants

Data analysis tool

To give relevant information for decision-making, the Delphi approach is employed. The most important decision-making indicators may be identified and screened using this method. Although the Delphi method is not a multi-criteria decision-making (MCDM) approach, it is frequently used to filter indications or achieve consensus on the relevance of indicators before MCDM techniques are applied. The collected criteria from the content analysis stage

were given to 40 experts before applying multi-criteria decision-making approaches in this study. Furthermore, they measured their point of view using a five-point Likert scale (strongly disagree to strongly agree) supplied to them online using the Porsa site (IranDoc). The implementation of the Delphi technique yielded a Cronbach's alpha coefficient of 0.94, indicating dependability. As a result of using the Delphi technique to filter the criteria, a total of six criteria for measuring the quality of sustainability reporting and 25 criteria for determinants were chosen. Decision-making is defined as selecting a solution from a set of options. The MCDM is a large selection of operations research that assists managers in making decisions based on several competing factors. Several indications or aims, which are often conflicting, are evaluated in such judgments. Multi-attribute decision making occurs when the attribute is an indication in MCDM. The weight of the criterion was determined using the AHP, ANP, and DEMATEL methods. When many criteria represent a goal, this is referred to as multi-objective decision making. SAW, TOPSIS, and VIKOR techniques are also offered to choose the best choice based on the decision matrix.

Fuzzy Analytic Hierarchy Process

The FAHP is a fuzzy logic-based approach for paired comparison matrix analysis. Expert competencies and mental capacities are utilized to draw comparisons in the traditional Analytic Hierarchy Process technique. However, it should be highlighted that the typical pairwise comparison does not fully reflect the manner of human reasoning. Fuzzy numbers are more compatible with verbal and, at times, confusing human emotions. As a result, it is preferable to make judgments in the actual world using fuzzy numbers. Van Laarhoven and Pedrycz, two Dutch scholars, presented the Fuzzy Analytic Hierarchy Process technique for the first time in 1983. This technique works by inserting Triangular Fuzzy Numbers (TFN) into a matrix of pairwise comparisons based on the smallest logarithmic squares. Because of the complexities of the processes in this approach, it is rarely used. Following that, several techniques for the fuzzy Analytic Hierarchy Process were suggested. In his book Fuzzy Multi-Criteria Decision Making, Kahraman Cengiz describes the Fuzzy Analytic Hierarchy Process (Habibi et al., 2014). Regarding Kahraman, the Buckley technique was employed in the current investigation (Tables 8 and 9).

Table 8. Example of pairwise comparison matrix based on Analytic Hierarchy Process (AHP)

Criteria$_{ij}$	A	B	C	D
A	1	A to B	A to C	A to D
B	(A to B)$^{-1}$	1	B to C	B to D
C	(A to C)$^{-1}$	(B to C)$^{-1}$	1	C to D
D	(A to D)$^{-1}$	(B to D)$^{-1}$	(C to D)$^{-1}$	1

Table 9. Random index (RI) scale for each matrix

N	1	2	3	4	5	6	7	8	9	10
RI$_m$	0	0	0.4890	0.7937	1.0720	1.1996	1.2874	1.3410	1.3793	1.4095
RI$_g$	0	0	0.1796	0.2627	0.3597	0.3818	0.4090	0.4164	0.4348	0.4455

Analytic Network Process based on Fuzzy DEMATEL

This is the MCDM approach, in which the network has replaced the hierarchical structure and supports the two-way interaction between the criteria and their internal linkages. The DEMATL technique is likewise based on pairwise comparisons, which, using expert judgment and graph hypothesis principles, turns the cause-effect correlations between criteria into a tangible structure. The DEMATL technique may be coupled with the Analytic Network Process approach since it determines the cause-and-effect linkages between variables. The amount of reliance on the criteria in the network approach is two-way, which is not the case in the DEMATL technique, and it is closer to the actual world. To correct this flaw in the network, the full DEMATL connection matrix (TC) was constructed for the weight of the criterion (Table 10).

Table 10. Example pairwise comparison matrix based on DEMATEL technique

Criteria$_{ij}$	A	B	C	D
A	0	A on B	A on C	A on D
B	B on A	0	B on C	B on D
C	C on A	C on B	0	C on D
D	D on A	D on B	D on C	0

Research Findings

Descriptive statistics of experts and results of Delphi method

The primary goal of this research is to demonstrate the model for assessing the quality of sustainability reporting and the factors that influence it. As a consequence, in the first step, the criteria and effective elements were identified, extracted, and first refined for this goal. Then, using the Likert attitude scale, 40 experts were given six criteria for evaluating the quality of sustainability reporting and 43 criteria for effective elements on the list via the Irandoc site and software named Porsa (Tables 11 and 13). These findings were used in subsequent phases.

Table 11. Descriptive statistics of experts participating in the Delphi screening stage (40 people)

Main Category		Subcategory	Number	Percent
Gender		Man	34	0.850
		Woman	6	0.150
Degree of education		PhD	31	0.775
		Master	9	0.225
Field of Study		Accounting	32	0.800
		Management and Economic	4	0.100
		Other	4	0.100
Occupation	Academics	Full Professor	2	0.050
		Associate Professor	7	0.175
		Assistant Professor	19	0.475
		Instructor	2	0.050
	Other		10	0.250
Professionals		CPA	5	0.125
		Justice Experts	1	0.025

Table 12. Sustainability Reporting Quality's Measures according to content analysis and Delphi survey

SRQ Measures:	Sign	Weights
Disclosure checklist according to reporting and disclosure in Iran	C_1	0.17143
GRI Foundation Reporting Principles Checklist	C_2	0.17117
GRI Standards Disclosure Checklist for Sustainability Reporting Checklist	C_3	0.16938
Sustainability Reporting Assurance coding based on auditing firms or accounting firms	C_4	0.16698
Deloitte Audit Model (Background, Content, Form, and Assurance & Reliability)	C_5	0.16565
If the firm prepare the sustainability report, equal 1; zero otherwise	C_6	0.15539

Table 13. Sustainability Reporting Quality's Determinants according to content analysis and Delphi survey

Row	Dimensions	Questions	Criteria	Weights	Rank	Sign
1	Environmental	Q 8	Carbon performance (Outcome-based measurement): GHG Emissions	0.02565	1	C_2
2		Q 6	Industry Sensitivity: A high pollution industry (chemical, oil, gas and pharmaceutical)	0.02557	2	C_3
3		Q 5	Environmental Awareness: initiatives' reports to reduce, reuse, substitute, or phase-out TCS	0.02490	3	C_4
4		Q 3	Carbon performance: Process-based measurement Carbon Reduction Initiatives	0.02466	4	C_5
5		Q 2	Investor Perceptions: Certain environmental crucial legal information (litigations, lawsuits, arbitrations)	0.02377	5	C_6
11	Social	Q 4	R&D investment: R&D intensity	0.02457	1	C_7
12		Q 5	Firms' cooperation with universities: Alliances with universities	0.02433	2	C_8
13		Q 7	Social Performance: CSR expenditures	0.02399	3	C_9
14		Q 3	Firms' sustainable innovation performance: patent	0.02398	4	C_{10}
15		Q 2	Firms' cooperation with other firms: Alliances with other firms	0.02365	5	C_{11}
6	Economic	Q 2	Value Relevance	0.02370	1	C_{12}
7		Q 1	Earnings Quality	0.02339	2	C_{13}
8		Q 5	Firms 'Economic Performance: Tobin's Q Index	0.02290	3	C_{14}
9		Q 4	Capital Constraints	0.02267	4	C_{15}
10		Q 3	Business Diversification	0.02228	5	C_{16}
16	Corporate Governance	Q 6	Internal Controls disclosure	0.02671	1	C_{17}
17		Q 7	Existence of sustainability, Environmental, CSR, Risk, Reward, and Audit committees	0.02619	2	C_{18}
18		Q 1	Board Higher Education and Experience	0.02465	3	C_{19}
19		Q 4	Board Financial education	0.02435	4	C_{20}
20		Q 9	Board Meeting: Number of board meetings per year	0.02402	5	C_{21}

21	Corporate characteristics	Q 4	Sales Growth :Growth Opportunities	0.02 532	1	C 22
22		Q 3	Financial Leverage: Total Debts/ Total Assets	0.02 450	2	C 23
23		Q 7	Liquidity: Current Ratio= CA/CB	0.02 431	3	C 24
24		Q 1	Firm Age: The number of years since incorporation to date	0.02 385	4	C 25
25		Q 2	Profitability: ROA, ROE, P/E, CFO/Net Income	0.02 361	5	C 26

Results of the Fuzzy Analytic Hierarchy Process (FAHP)

AHP's computation is dependent on the decision-initial maker's assessment, which is represented via a pairwise comparison matrix. As a result, any mistakes or inconsistencies in comparing the parts have an impact on the final computation result. The discrepancy rate in this approach suggests that the data obtained can be believed from each expert's standpoint. In Table 13, the experts' inconsistency rates are less than 0.1, indicating pairwise comparisons are reliable. Expert views were combined once the discrepancy rate was calculated (Tables 13 - 16).

The outcomes of the FAHP application are also shown in Table 17. In this procedure, several ways of analysis are utilized, one of the most well-known of which is the Buckley geometric mean approach. GRI's principles for sustainability reporting checklist was ranked first based on these findings. The GRI's sustainability reporting standards came second. If the company prepares the sustainability report, it receives a score of 1; otherwise, it receives a score of 0. The Disclosure checklist, on the other hand, was placed fifth in terms of reporting and disclosure in Iran, and the Deloitte Auditing Institute's model was ranked sixth (Tables 16 - 17).

Table 14. Consistency rate (CR) of expert pairwise comparisons using AHP technique

Expert	1	2	3	4	5	6	7	8	9	10
CR^m	0.032	0.035	0.026	0.042	0.032	0.049	0.035	0.033	0.044	0.028
CR^g	0.087	0.078	0.063	0.080	0.094	0.095	0.086	0.070	0.097	0.055

Table 15. Matrix of the geometric mean of experts

Criteria	C₁			C₂			C₃			C₄			C₅			C₆		
	L	M	U	L	M	U	L	M	U	L	M	U	L	M	U	L	M	U
C₁	1.00	1.00	1.00	0.56	0.82	1.15	0.55	0.72	0.94	0.73	0.99	1.31	0.73	1.03	1.39	0.52	0.66	0.84
C₂	0.87	1.23	1.78	1.00	1.00	1.00	0.80	1.23	1.73	0.92	1.34	1.83	1.23	1.97	2.63	0.98	1.39	1.73
C₃	1.06	1.38	1.83	0.58	0.81	1.25	1.00	1.00	1.00	0.84	1.23	1.66	1.07	1.69	2.22	0.69	1.04	1.47
C₄	0.77	1.01	1.38	0.55	0.75	1.08	0.60	0.81	1.20	1.00	1.00	1.00	0.92	1.08	1.32	0.64	0.75	0.91
C₅	0.72	0.97	1.37	0.38	0.51	0.81	0.45	0.59	0.93	0.76	0.92	1.08	1.00	1.00	1.00	0.49	0.61	0.81
C₆	1.19	1.51	1.92	0.58	0.72	1.02	0.68	0.96	1.45	1.10	1.34	1.57	1.23	1.64	2.06	1.00	1.00	1.00

Table 16. Ranking matrix of quality measurement criteria for sustainability reporting based on Buckley method

Criteria	C1			C2			C3			C4			C5			C6			Geo - mean			DeFuzzyzzy	Weights	Rank
	L	M	U	L	M	U	L	M	U	L	M	U	L	M	U	L	M	U	L	M	U			
C₁	1.00	1.00	1.00	0.56	0.82	1.15	0.55	0.72	0.94	0.73	0.99	1.31	0.73	1.03	1.39	0.52	0.66	0.84	0.08	0.14	0.23	0.15	0.14	5
C₂	0.87	1.23	1.78	1.00	1.00	1.00	0.80	1.23	1.73	0.92	1.34	1.83	1.23	1.97	2.63	0.98	1.39	1.73	0.12	0.22	0.36	0.23	0.22	1
C₃	1.06	1.38	1.83	0.58	0.81	1.25	1.00	1.00	1.00	0.84	1.23	1.66	1.07	1.69	2.22	0.69	1.04	1.47	0.11	0.19	0.32	0.20	0.19	2
C₄	0.77	1.01	1.38	0.55	0.75	1.08	0.60	0.81	1.20	1.00	1.00	1.00	0.92	1.08	1.32	0.64	0.75	0.91	0.09	0.15	0.24	0.16	0.15	4
C₅	0.72	0.97	1.37	0.38	0.51	0.81	0.45	0.59	0.93	0.76	0.92	1.08	1.00	1.00	1.00	0.49	0.61	0.81	0.08	0.12	0.21	0.13	0.12	6
C₆	1.19	1.51	1.92	0.58	0.72	1.02	0.68	0.96	1.45	1.10	1.34	1.57	1.23	1.64	2.06	1.00	1.00	1.00	0.12	0.19	0.31	0.20	0.19	3

Table 17. FAHP Results (Sustainability Reporting Quality Assessment Measures)

SRQ Measures:	Sign	Weights	
		Delphi	FAHP
GRI Foundation Reporting Principles Checklist for defining reporting quality	C_2	0.17136	0.21526
GRI Standards Disclosure Checklist for Sustainability Reporting Checklist	C_3	0.17377	0.18936
The Al-shaer's model (2020)	C_6	0.15422	0.18709
The model used by Rezaee and Tao (2019); Al-shaer (2020)	C_4	0.16453	0.14593
Disclosure checklist according to reporting and disclosure in Iran	C_1	0.16973	0.13920
Deloitte Auditing Institute's Model	C_5	0.16638	0.12316

Analytic Network Process technique based on Fuzzy DEMATEL Result

We suggest utilizing two multi-criteria decision-making approaches in the second stage: the fuzzy DEMATEL method for identifying internal connections between model components and the ANP method for weighting model criteria. This research also suggests the creation of a fuzzy inference system. The quality of sustainability reporting is evaluated using a systematic qualitative assessment approach described in this study. In such an examination, this approach can help select the most important elements. The total degree of quality reporting of any firm's sustainability may be assessed based on these variables. Tables 18 to 21 also included the findings of the DANP method. Internal connections based on the intensity of the threshold retrieved from the final DEMATEL matrix are also shown in Table 22. The coefficients in models No. 1 and 2 that are extracted from Tables No. 20 - 22

Model No. 1: Effective dimensions in the quality of sustainability reporting

$$\gamma = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_3 x_4 + \beta_4 x_5$$

$$Y_D = 0.04018 x_1 + 0.03991 x_2 + 0.03859 x_3 + 0.03773 x_4 + 0.03525 x_5$$

Model No. 2: Factors Affecting the Quality of Sustainability Reporting

$$\gamma = \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3 + \alpha_3 x_4 + \alpha_4 x_5$$

$$Y_C = 0.04111 x_1 + 0.04104 x_2 + 0.04091 x_3 + 0.04060 x_4 + 0.04059 x_5$$

Table 18. DEMATEL initial matrix of expert opinions merged with arithmetic mean

Criteria a_{ij}	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{20}	C_{21}	C_{22}	C_{23}	C_{24}	C_{25}	C_{26}
C_1	0.0	3.4	3.2	3.3	3.0	3.1	2.7	2.9	2.8	3.0	2.8	3.1	3.2	3.2	2.9	2.9	3.0	2.6	2.2	2.2	2.5	2.5	2.4	2.5	2.3	2.6
C_2	3.4	0.0	3.3	3.0	3.0	2.9	2.5	2.5	2.7	2.6	2.8	2.7	2.7	2.7	2.7	2.7	2.5	2.2	2.1	2.1	2.2	2.0	2.1	2.0	1.8	2.0
C_3	3.2	3.4	0.0	3.4	3.3	3.2	2.8	2.7	2.9	2.9	2.9	2.9	2.7	2.7	2.6	2.5	2.8	2.6	2.4	2.4	2.4	2.1	2.0	2.1	1.9	1.8
C_4	3.3	3.2	3.4	0.0	3.5	3.5	3.3	3.3	3.2	3.3	3.3	2.9	2.9	2.9	2.7	2.7	2.7	2.4	2.4	2.3	2.2	2.0	2.0	2.0	1.9	1.9
C_5	3.0	3.2	3.3	3.5	0.0	3.2	2.7	2.7	2.7	2.7	2.8	2.5	2.7	2.6	2.4	2.4	2.5	2.2	2.1	2.1	2.1	2.0	2.0	1.8	1.7	1.8
C_6	3.1	3.1	3.2	3.5	3.2	0.0	3.2	3.0	3.1	3.0	3.2	2.6	2.7	2.7	2.5	2.4	2.7	2.4	2.4	2.3	2.2	2.1	2.2	2.1	1.9	2.1
C_7	2.9	2.8	2.8	3.3	2.7	3.2	0.0	3.1	3.1	3.1	3.0	2.8	3.1	3.0	2.7	2.7	3.1	2.8	3.0	2.9	2.8	2.6	2.4	2.3	2.4	2.7
C_8	3.0	2.8	2.7	3.3	2.7	3.0	3.1	0.0	3.2	3.3	3.1	2.8	2.7	2.8	2.8	2.6	2.5	2.5	2.4	2.3	2.7	2.5	2.6	2.4	2.5	2.5
C_9	2.9	3.0	2.9	3.2	2.7	3.1	3.1	3.2	0.0	3.2	3.2	3.1	3.5	3.5	2.9	3.1	3.2	2.7	2.5	2.7	2.3	2.4	2.4	2.5	2.3	2.3
C_{10}	3.1	2.9	2.9	3.3	2.7	3.0	3.1	3.3	3.2	0.0	3.4	3.1	3.2	3.3	3.2	3.0	3.3	3.1	2.9	2.9	2.8	2.7	2.4	2.3	2.3	2.5
C_{11}	2.9	3.0	2.9	3.3	2.8	3.2	3.0	3.1	3.2	3.4	0.0	3.0	2.9	3.3	3.0	2.8	2.9	2.7	2.6	2.6	2.5	2.6	2.6	2.7	2.2	2.4
C_{12}	3.4	2.7	3.0	3.0	2.6	2.6	2.8	2.8	3.1	3.1	3.0	0.0	3.6	3.7	3.5	3.4	3.4	3.0	3.0	2.9	2.7	2.6	2.4	2.5	2.2	2.3
C_{13}	3.4	2.8	2.9	3.0	2.7	2.7	3.1	2.7	3.5	3.2	2.9	3.6	0.0	3.7	3.4	3.2	3.3	3.1	2.9	2.8	2.7	2.6	2.5	2.7	2.3	2.4

Criteria a_{ij}	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26
C14	3.5	2.8	2.9	3.0	2.7	2.7	3.0	2.8	3.5	3.3	3.3	3.7	3.7	0.0	3.4	3.1	3.1	2.9	3.0	2.9	2.7	2.3	2.4	2.4	2.1	2.3
C15	3.3	2.8	2.9	2.9	2.4	2.5	2.7	2.8	2.9	3.2	3.0	3.5	3.4	3.4	0.0	3.2	3.3	3.2	3.1	3.1	3.0	2.6	2.7	2.6	2.3	2.4
C16	3.3	2.8	2.7	2.8	2.4	2.4	2.7	2.8	3.1	3.0	2.8	3.4	3.2	3.1	3.2	0.0	2.9	2.8	2.7	2.8	2.7	2.6	2.5	2.6	2.3	2.4
C17	3.2	2.7	2.9	2.7	2.5	2.7	3.1	2.6	3.2	3.3	2.9	3.4	3.3	3.1	3.3	2.9	0.0	3.3	3.0	3.0	2.9	3.0	2.9	2.9	2.6	2.8
C18	2.9	2.5	2.7	2.4	2.2	2.4	2.8	2.5	2.7	3.1	2.7	3.0	3.1	2.9	3.2	2.8	3.3	0.0	3.2	3.2	3.1	2.9	2.9	2.8	2.8	2.8
C19	2.5	2.3	2.5	2.4	2.1	2.4	3.0	2.5	2.5	2.9	2.6	3.0	2.9	3.0	3.1	2.7	3.0	3.2	0.0	3.1	3.1	3.0	2.8	2.6	2.8	3.2
C20	2.5	2.3	2.5	2.3	2.1	2.3	2.9	2.4	2.7	2.9	2.6	2.9	2.8	2.9	3.1	2.8	3.0	3.2	3.1	0.0	2.9	3.2	3.1	3.1	2.8	3.1
C21	2.7	2.4	2.5	2.2	2.1	2.2	2.8	2.3	2.3	2.8	2.5	2.7	2.7	2.7	3.0	2.7	2.9	3.1	3.1	2.9	0.0	2.5	2.4	2.4	2.1	2.4
C22	2.7	2.2	2.1	2.1	2.0	2.1	2.6	2.7	2.4	2.6	2.6	2.6	2.6	2.3	2.6	2.6	3.0	2.9	3.0	3.2	2.5	0.0	2.7	2.5	2.4	3.0
C23	2.6	2.2	2.0	2.0	2.0	2.2	2.4	2.5	2.4	2.4	2.6	2.4	2.5	2.4	2.7	2.5	2.9	2.9	2.8	3.1	2.4	2.7	0.0	3.0	2.3	3.1
C24	2.7	2.2	2.1	2.1	1.8	2.1	2.3	2.6	2.5	2.3	2.7	2.5	2.7	2.4	2.6	2.6	2.9	2.8	2.6	3.1	2.4	2.5	3.0	0.0	2.4	3.3
C25	2.5	2.0	1.9	1.9	1.7	1.9	2.4	2.4	2.3	2.3	2.2	2.2	2.3	2.1	2.3	2.3	2.6	2.8	2.8	2.8	2.1	2.4	2.3	2.4	0.0	3.0
C26	2.8	2.2	1.8	2.0	1.8	2.1	2.7	2.5	2.3	2.5	2.4	2.3	2.4	2.3	2.4	2.4	2.8	2.8	3.2	3.1	2.4	3.0	3.1	3.3	3.2	0.0

Table 19. Results of Fuzzy DEMATEL Technique

Sign		Criteria	d_i		c_i		d + r		d - r		Rank							
											d		r		d + r		d - r	
G	C1	Sustainability Reporting Quality	12.142	12.142	12.855	12.855	24.997	24.997	-0.713	-0.713	11	3	1	1	6	1	25	6
D1	C2	GHG Emissions	11.013		11.771		22.784		-0.758		24		17		19		26	
	C3	Industry sensitivity	11.489		11.747		23.235		-0.258		18		18		17		24	
	C4	Environmental Awareness	11.991	11.400	12.113	11.627	24.104	23.027	-0.123	-0.228	14	5	11	5	12	5	23	5
	C5	Carbon Reduction Initiatives	10.924		10.944		21.868		-0.021		25		25		25		22	
	C6	Investor Perceptions	11.581		11.562		23.143		0.019		17		19		18		21	
D2	C7	R&D investment: R&D intensity	12.321		12.239		24.560		0.082		9		10		10		14	
	C8	Alliances with universities	12.025		11.964		23.989		0.061		13		13		13		17	
	C9	Social Performance: CSR expenditures	12.429	12.363	12.367	12.300	24.796	24.663	0.063	0.064	7	2	7	3	8	3	16	4
	C10	Sustainable innovation performance	12.710		12.647		25.357		0.064		2		3		2		15	
	C11	Alliances with other firms	12.329		12.281		24.610		0.049		8		9		9		19	
D3	C12	Value Relevance	12.608		12.508		25.117		0.100		5		6		5		8	
	C13	Earnings Quality	12.706	12.505	12.606	12.380	25.312	24.885	0.099	0.124	3	1	4	2	3	2	9	1
	C14	Economic	12		12		25		0.		4		5		4		2	

Sign		Criteria	d_i		c_i		d + r		d - r		Rank d		Rank r		Rank d + r		Rank d - r	
G	C1	Sustainability Reporting Quality	12.142	12.142	12.855	12.855	24.997	24.997	-0.713	-0.713	11	3	1	1	6	1	25	6
	14	Performance: Tobin's Q Index	.643		.512		.155		131									
	C15	Capital Constraints	12.527		12.366		24.893		0.162		6		8		7		1	
	C16	Business Diversification	12.039		11.909		23.947		0.130		12		14		14		3	
	C17	Internal Controls Reporting	12.756		12.665		25.421		0.090		1		2		1		11	
	C18	Sustainability, audit and Risk Committees	12.161		12.040		24.201		0.120		10		12		11		4	
D4	C19	Board Education and experience	11.923	11.997	11.810	11.892	23.732	23.889	0.113	0.106	16	4	16	4	16	4	6	2
	C20	Board Accounting Education	11.932		11.819		23.751		0.113		15		15		15		5	
	C21	Board Meetings	11.215		11.123		22.338		0.092		20		21		21		10	
	C22	Growth Opportunities : Sales Growth	11.232		11.146		22.378		0.086		19		20		20		12	
	C23	Financial Leverage	11.050		10.993		22.043		0.057		23		22		24		18	
D5	C24	Liquidity	11.066	10.940	10.980	10.863	22.046	21.804	0.086	0.077	22	6	24	6	23	6	13	3
	C25	Firm Age	10.256		10.212		20.468		0.044		26		26		26		20	
	C26	Profitability	11.098		10.986		22.083		0.112		21		23		22		7	

Table 20. Results of ranking effective dimensions in the quality of sustainability reporting
based on fuzzy DANP technique

Sign	Dimensions	Weight	Rank
D_2	Social	0.04018	1
D_3	Economic	0.03991	2
D_4	Corporate Governance	0.03859	3
D_1	Environmental	0.03773	4
D_5	Corporate Characteristics	0.03525	5

Table 21. Results of ranking the effective criteria in the quality of sustainability reporting
based on fuzzy DANP technique

Sign	Criteria	Weight	Rank
C_{17}	Internal Controls Reporting	0.04110	1
C_{10}	Sustainable innovation performance: patent	0.04104	2
C_{13}	Earnings Quality	0.04091	3
C_{14}	Firms' Economic Performance: Tobin's Q Index	0.04060	4
C_{12}	Value Relevance	0.04059	5
C_9	Social Performance: CSR expenditures	0.04013	6
C_{15}	Capital Constraints	0.04013	7
C_{11}	Alliances with other firms	0.03985	8
C_7	R&D investment: R&D intensity	0.03972	9
C_4	Environmental Awareness	0.03931	10
C_{18}	Sustainability, audit and Risk Committees	0.03907	11
C_8	Alliances with universities	0.03883	12
C_{16}	Business Diversification	0.03865	13
C_{20}	Board Education and experience	0.03835	14
C_{19}	Board Education and experience	0.03832	15
C_2	GHG Emissions	0.03819	16
C_3	Industry sensitivity	0.03812	17
C_6	Investor Perceptions	0.03752	18
C_{22}	Growth Opportunities :Sales Growth	0.03617	19
C_{21}	Board Meetings	0.03609	20
C_{23}	Financial Leverage	0.03567	21
C_{26}	Profitability	0.03565	22
C_{24}	Liquidity	0.03563	23
C_5	Carbon Reduction Initiatives	0.03552	24
C_{25}	Firm Age	0.03314	25

Table 22. Matrix of internal relations between the effective factors based on the threshold value (average) of the total matrix (T), value one means the existence of a relationship and value zero means no relationship

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26
C1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
C2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C3	1	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
C4	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
C5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C6	1	0	0	1	0	0	1	0	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0
C7	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
C8	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
C9	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
C10	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
C11	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
C12	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
C13	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
C14	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
C15	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
C16	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0
C17	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
C18	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0
C19	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0
C20	1	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
C21	1	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
C22	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0

Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26
22																										
C23	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C24	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
C25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C26	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Conclusion

The GRI's reporting Principles for Sustainability Reporting Checklist rated top among experts in assessing the quality of sustainability reporting, according to pairwise comparisons based on the FAHP methodology. In answer to the research question, whether the provided information is accurate and detailed, represents the good and negative aspects of the organization's performance, and is prepared and accessible in an understandable manner, according to the GRI's sustainability reporting principles. As a consequence, stakeholders can have a more accurate and rational assessment of the organization's performance. Furthermore, consistency in selection, compilation, and reporting enables stakeholders to examine changes in the organization's performance over time and compare it to the performance of other companies. If the information in the report is a third-party guarantee, and the findings are delivered to stakeholders as soon as possible. In that scenario, their worth and significance will be validated, allowing them to make more educated judgments. Sustainability reporting quality Criteria were extracted from Daub (2007); Amran et al. (2014); Gao et al. (2016); Al-shaer and Zaman (2016); Munshi and Dutta (2016); Krivacic (2017); Ching et al. (2017); Diouf and Bioral (2017); Ho and Loh (2018); Rezaee and Tao (2019); Bakar, Ghazali, and Ahmad (2019); Moses et al. (2020); Garcia et al. (2020); Khan et al. (2020); Badia et al. (2020); Al-shaer, (2020); Adoui (2020); Jadoon et al. (2021) studies. As a result, these criteria may be recommended for further study in Iran to evaluate the quality of sustainability reporting.

According to the FDANP findings, internal controls reporting was identified as one of the variables influencing the quality of sustainability reporting by research experts. Internal control reporting is one of the influencing elements on the components of sustainability reporting, including

corporate governance, corporate social responsibility, and corporate environment, according to a study performed by Li et al. (2020); Cigdem et al. (2018); Huang and Huang (2020). As a consequence, the findings of the study are consistent with those of the previous studies. Climate change, population expansion, lifestyle changes, and customer needs for new goods all allow companies to explore innovation as a means of achieving long-term success. As a result, one of the decisive variables is the performance of sustainable innovation. The assessment used in this study is based on Jeong and Shin's research in this area (2020). According to previous research, voluntary disclosures, such as sustainability disclosures, can either replace or complement lower-quality profits and required financial reporting. As a result, this research confirms the complimentary connection that high-profit firms publish more disclosures, increasing the trustworthiness and reputation of corporate reporting. Our findings are consistent with those of Rezaee and Tao (2019); Al-shaer (2019; 2020).

The parameters impacting the quality of sustainability reporting, internal controls reporting, sustainable innovation performance, and earnings quality have the highest influence and interaction in the network in internal relations analysis. The factors of sustainability reporting quality, internal controls reporting, and sustainable innovation performance, on the other side, have had the greatest influence. Capital restriction, economic performance, and business variety were also found as causative factors. On the other side, as effect factors, the variables of industry sensitivity, sustainability reporting quality, and decrease of greenhouse gas emissions are included. Experts recognize the significance of internal controls reporting, sustainable innovation performance, and earnings quality characteristics, and have identified them as the most significant criteria in assessing the quality of sustainable reporting. Furthermore, they raised to worry about liquidity, carbon reduction initiative factors, and the firm's age, all of which they deemed irrelevant in the value.

These criteria were extracted from Iatridis (2013); Harris (2014); Munshi and Dutta (2016); Diouf and Bioral (2017), Haque (2017); khosroshahi and vatankhah (2017); Alfarooque and Ahulu (2017); Locar et al. (2019); Rezaee and Tao (2019); Wasara and Ganda (2019); Orazalin and Mahmood (2018); Nilipour et al. (2020); Moses et al. (2020); Hill, (2020); Jeong and Shin (2020); Khan et al. (2020); Huang and Huang, (2020); Al-Shaer, (2020); Nguyen, (2020); Khan, R, et al., (2020); Giron et al. (2020); Ruhana and Hidayah, (2020); Vitolla et al. (2020); Ahmadyan and ghasemi (2021); Hamidi, (2021) studies.

As a result of the research findings, policymakers are encouraged to create standards for audited internal control reports to be prepared and published with other annual reports. The measure of sustainable innovation performance is another element impacting the quality of sustainability reporting. To attain this level of success, firms must collaborate more closely with colleges and other companies. Invest in research and development to create knowledge-based and creative value chain processes. As a result, they will gain a competitive edge and be free of capital limitations. Because the current study is a database (rather than a database), one of its drawbacks is the difficult access to specialists, particularly recognized faculty members of institutions who are frequently involved in administrative issues.

Other important factors, such as technological advancements, financial and legal changes, should be included in future research. In the business community, financial technology, often known as fintech, refers to companies that use technology to improve the efficiency of financial services. Another innovative application of technology is regulatory technology, which allows for efficient and low-cost legislation and regulatory compliance. Furthermore, in the future study, they may use real data to demonstrate the network's underlying interconnections using a quantitative method.

Declaration of Conflicting Interests

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