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Does disclosure in sustainability reports indicate actual sustainability performance?

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Abstract

This study investigates whether sustainability reports indicate corporate sustainability performance—in other words, the extent to which such disclosure is informative. To extract relevant information from sustainability reports, 51 sustainability indicators of practices were compiled from the literature and reporting guidelines on sustainability. These indicators were then scored for 331 companies based on the content of their sustainability reports. A factor analysis carried out on these indicators yielded five constructs: three for environmental sustainability and two for social sustainability. Bloomberg's environmental and social governance (ESG) ratings and Dow Jones Sustainability Indices (DSJI), which use private and public information from companies, served as proxies for actual sustainability performance. Upon testing, the constructs developed from the sustainability reports were found to explain the DJSI and ESG measures of sustainability significantly. Therefore, sustainability reports appear to indicate actual sustainability performance.

Keywords: sustainability performance; sustainability reports; content analysis; sustainability constructs; environmental sustainability; social sustainability

1 Introduction

Many companies disclose their sustainability activities through sustainability reports to inform investors and other stakeholders (Kolk, 2008; Cormier and Magnan, 2007). The question that arises is whether these sustainability reports provide any useful information on the companies' actual sustainability performance. One view is that companies provide shareholders an idea of their sustainability efforts through these reports, which are therefore useful in indicating performance. An opposing view is that companies use these reports mainly to influence stakeholder perceptions, without having to put much effort into sustainability, thus indulging in "greenwashing." In this view, companies' sustainability reports may not indicate their actual sustainability performance (Mahoney et al., 2013; Herbohn et al., 2014). The fact that sustainability reports are not audited like annual reports supports this view (e.g., Fernandez-Feijoo et al., 2016).

The research question in this study is, therefore, whether sustainability reports actually inform stakeholders about the sustainability performance of a company. The focus is on environmental and social dimensions, and the study does not address the economic dimension, which is consistent with the function of disclosure in sustainability reports as well as the focus of third-party reports concerning sustainability performance.

Following Searcy's (2012) survey on the design and implementation of corporate sustainability performance management systems, 51 sustainability indicators of practices were compiled from the literature and reporting guidelines on sustainability. Next, these indicators were scored on a 0–3 discrete scale in relation to the sustainability reports of 331 companies, and factor analysis was used to obtain preliminary constructs. To validate these constructs, confirmatory factor analysis (CFA) was used on data extracted from the same companies for a later year. Having obtained constructs for environmental and social sustainability, links to sustainability performance captured by Bloomberg's environmental and social governance (ESG) ratings and by inclusion (or not) in the Dow Jones Sustainability Indices (DSJI) were tested using regression and logistic regression analysis, respectively.

The analysis reported here obtained five constructs for sustainability: three for environmental sustainability and two for social sustainability. These constructs significantly explained the DSJI and ESG measures of sustainability performance, indicating that sustainability reports do indicate a company's actual sustainability performance.

The contribution of this study to the literature is threefold: *First*, a measurement model has been developed based on companies' sustainability disclosure. It was not obvious at the outset whether the text of sustainability reports would offer enough information to create meaningful constructs. This model differs from existing ones in that: (1) it is not purely based on GRI reporting guidelines, and; (2) it is constructed based on companies' disclosures concerning the adoption and the extent of implementation of operational practices, and not simply on counting words or sentences.

Second, much of the literature treats sustainability as a single concept (Pagell and Wu, 2009; Pullman et al., 2009; Marshall et al., 2015) or focuses only on environmental sustainability. Instead, in this study, environmental and social sustainability emerged as two clearly separate concepts (Seuring and Muller, 2008; Pagell and Gobelli, 2009; Ashby et al., 2012). This study provides constructs for social sustainability that emerge naturally from all the indicators we used. Researchers have studied social sustainability less than environmental sustainability due to the difficulty in measuring social practices (Mani et al., 2018; Huq and Stevenson, 2018; Marshall et al., 2015; Ashby et al., 2012) or have treated sustainability as a whole.

Third, this study helps to resolve the tension between institutional theory and signaling theory as to whether sustainability reports indicate actual sustainability performance. A significant positive link was found between the information disclosed and third-party rating, in line with signaling theory.

The results of the study also have managerial and research implications. Managers can use sustainability reports to obtain accurate knowledge of a company's sustainability efforts, rather than relying on third parties. Similarly, researchers can analyze sustainability reports, building on the set of indicators identified in this study, to test hypotheses entailing sustainability reporting and performance.

The rest of the paper is structured as follows. Section 2 reviews the literature to assess relevant theories and tensions within them and examines prior studies using sustainability reports. Section 3 describes the materials and methods used in this study, Section 4 provides the results, and Section 5 offers the conclusions.

2 Literature review

The sustainability performance of companies, indicating the companies' efforts and achievements regarding sustainability (Mahoney et al., 2013; Searcy, 2012; Clarkson et al., 2007), is of critical concern to investors and other stakeholders. Third parties rate the sustainability performance of companies using binary values of inclusion (whether the companies are included) in sustainable portfolios, or with ratings, to inform investors. Bloomberg, the Morgan Stanley Capital Index (MSCI), and Thomson Reuters, among others, provide information on sustainability disclosure using ESG scores. Financial companies also highlight the inclusion of companies in "sustainability" portfolios, such as the DSJI (López et al., 2007). These third parties seek private information from companies directly through surveys and interviews, apart from obtaining public information from diverse sources. Researchers frequently use the inclusion status or ratings from these third parties as measures of sustainability performance.

As noted in the previous section, there are opposing views in the literature on the value of such reports in indicating sustainability performance to investors and other stakeholders.

2.1 Literature based on signaling theory

Signaling theory addresses how corporate actors address information asymmetry through implementing corporate actions and policies (Hahn and Kuhnen, 2013). Specifically, firms are prepared to expend resources to indicate their initiatives to investors and other shareholders who cannot otherwise be directly aware (Connelly et al., 2011). This is particularly necessary in relation to what a company may be doing concerning sustainability because corporate sustainability efforts and outcomes are not readily apparent to shareholders (Cuadrado et al., 2017; Connelly et al., 2011; Lyon and Maxwell, 2011).

Drawing on signaling theory, scholars posit that firms with higher sustainability performance disclose their sustainability efforts more than other companies (Clarkson et al., 2007; Mahoney et al., 2013). In contrast, companies with poor sustainability performance are less willing to disclose their efforts (Cuadrado et al., 2017; Clarkson et al., 2011). The rationale behind this behavior is disclosing only when the benefits of disclosure exceed the related costs (Brooks and Oikonomou, 2018). Thus, sustainability reports help reduce asymmetry of information among shareholders and managers on sustainability performance (Isaksson and Steimle, 2009; Feijoo et al., 2014; Mahoney et al., 2013; Adams and McNicholas, 2006; Manetti, 2011).

Moreover, efforts have been made to use standardized ways to report, which enables stakeholders to obtain a better sense of companies' sustainability efforts and goals (Kozlowski et al., 2015). Certain guidelines, such as the Global Reporting Initiative (GRI) or the UN Global Compact (Vigneau et al., 2015; Bonson and Bendarova, 2015) now offer guidance on reporting on sustainability initiatives. Using such guidelines is likely to reinforce the reporting effects identified using signaling theory. In summary, signaling theory supports a *positive* link between sustainability disclosure and actual performance (Clarkson et al., 2007; Cormier and Magnan, 2007).

2.2 Literature based on institutional theory

In contrast, according to institutional theory, it is legitimacy that drives sustainability disclosure, pushing companies to use sustainability reports for "impression management" to improve the company's reputation through greenwashing (Gray et al., 1996; Solomon and Lewis, 2002; Kolk, 2008; Bebbington et al., 2008; Tate and Ellram, 2009; Lyon and Maxwell, 2011).

Although disclosure guidelines such as the GRI mitigate the risk of greenwashing, these guidelines primarily underscore different social and environmental sustainability practices (Roca and Searcy, 2012). Moreover, there is significant latitude in what guidelines companies can adopt (Moneva et al., 2006), so companies are selective—even strategic—about what they incorporate in their reports (Jenkins and Yakovleva, 2006; Chauvey et al., 2015; Herremans and Nazari, 2016).

2.3 Literature using sustainability reports

Research has been conducted on sustainability reports, but with a limited list of sustainability indicators (Berrone et al., 2013; Roca and Searcy, 2012; Adams and Frost, 2008; Daub, 2007; Tate et al., 2010). Studies that have conducted content analysis of sustainability reports have investigated the evolution of report content quality (Guidry and Patten, 2010; Kolk, 2004) or trends in sustainability reporting in industries (Jenkins and Yakovleva, 2006; Berthelot and Roberts, 2011; Roca and Searcy, 2012; Patten and Zhao, 2014) or countries (Gray et al., 1995).

Several voluntary guidelines have been released by institutions, such as the GRI, the UN Global Compact, and the ISO 26000 (Bonson and Bendarova, 2015), to provide companies with guidance on reporting their sustainability initiatives. Many studies have evaluated the degree to which a report conforms to GRI guidelines, while few studies have used indicators extending beyond those included in the GRI. This limited range of indicator use highlights an important gap as indicators play a critical role in communicating companies' sustainability goals (Kozlowski et al., 2015). Given the limited number of studies that have extended beyond the GRI in their use of indicators, this study aimed to explore the content of companies' disclosures more comprehensively, involving more than information derived from the GRI, to supplement the limited work that has been done so far.

Studies that have extended beyond the GRI include Tate and Ellram (2010), who analyze sustainability reports using content analysis with automated software, to uncover supply chain sustainability themes, which are compared against companies' geographic location and revenues. Montabon et al. (2007) also conduct content analysis on corporate sustainability reports, based on a set of 20 environmental management practices (excluding social sustainability practices) identified from the literature and not based on the GRI, to examine the relationship between these practices and four measures of firm performance.

Aside from possible issues arising due to the limited number of indicators used, there is also the question of how analysis was carried out. Several previous studies have measured companies' level of disclosure through simply counting the number of relevant words, sentences, or pages in sustainability reports on different themes (Cowen et al., 1987; Patten, 1991, 1992; Roca and Searcy, 2012; Deegan, 2002; Milne and Adler, 1999; Hackston and Milne, 1996; Patten and Zhao, 2014). The drawback of counting space allocations for certain words or themes is that such an approach fails to capture the information in the reports. In a similar vein, some researchers have used computer-aided text analysis to uncover supply chain sustainability themes (e.g., Tate et al., 2010). However, many sustainability reports present information graphically, which limits the use of computer-aided text analysis.

Therefore, this investigation was not confined to GRI indicators but involved an analysis of sustainability reports in terms of the information contained in them, rather than just their word counts or than conducting computer-aided text analysis. To this end, an extensive list of operational practices was synthesized from the relevant operations literature and reporting guidelines to identify the most relevant factors according to the content of sustainability reports.

A 0–3 scoring system was used, as has been done in similar studies implementing content analysis.

In summary, researchers using signaling theory and those using institutional theory present conflicting views on whether sustainability reports indicate actual sustainability performance. Thus, there is a need to investigate the link between disclosure and actual sustainability performance, something the literature has not addressed. This study attempts to address this gap and to overcome the methodological weaknesses in the literature in relation to the use of content analysis concerning sustainability reports.

3 Materials and Methods

Content analysis was used on sustainability reports, without recourse to software for computer-aided text analysis, for three reasons: (1) information specific to the chosen indicators was sought, instead of simply adding up the number of words or sentences; (2) companies can and do present the relevant information in figures and tables, something text-based software would not be able to handle; and (3) there is currently no suitable dictionary of keywords given the variety of reporting styles and despite certain guidelines. To choose indicators, sources in the literature, the GRI, the Kinder Lydenberg Domini (KLD) index, and the UN Global Compact were used. The content of sustainability reports was used to score these indicators, using a 0–3 scale, to obtain a more informed understanding of the quality of the reports rather than merely counting the number of words or sentences.

The following steps were followed (Shah and Ward, 2007; Sahi et al., 2017):

Step 1: *Scale development*: Indicators were compiled from the literature and relevant guidelines reflecting operational practices for environmental and social sustainability.

Step 2: *Scale domain and sampling frame, and scale refinement*: Using these indicators, the content of 331 sustainability reports from 2013–14 was analyzed, and each item was scored between 0 and 3 based on the extent of implementation of the relevant practice as disclosed in the report. The list of items was refined by dropping indicators that were rarely reported by companies.

Step 3: *Construct development*: Exploratory factor analysis (EFA) was then used to identify constructs for sustainability. To identify reliability, CFA was also used, with the same measurement model using sustainability reports for the same companies from 2015–16.

Step 4: *Testing*: These constructs were then used to explain performance as measured through inclusion in portfolios such as the DSJI or through ratings such as the ESG.

Each step is described in more depth in subsections 3.1–3.4.

3.1 Scale development

A total of 39 environmental and 12 social sustainability indicators were compiled from the literature, the GRI, the KLD index, and the UN Global Compact sustainability reporting guidelines (**Tables 1, 2**). Environmental practices involve resource conservation, reduction of waste consumption, and reductions in the use and production of dangerous substances (Montabon et al., 2007; Shrivastava, 2007; Pullman et al., 2009; Gimenez et al., 2012). Social sustainability practices refer to companies' accountability to society and encompass themes related to the elimination of poverty and diseases, equal and universal access to health services, universal access to education, and social welfare (Closs et al., 2011; Haugh and Talwar, 2010; Sarkis et al., 2010). Social sustainability practices also involve improving employee satisfaction (Khan et al., 2019).

Table 1. Summary of environmental sustainability indicators

Environmental sustainability indicators	**Selected references***
Reduce carbon footprint	Ageron et al. (2012); Khan et al. (2019)
Reduce fuel consumption	Goose (2013)
Reduce greenhouse gas (GHG) emissions	Halldorsson et al. (2009); Khan et al. (2019)
Reduce NOx and Sox emissions	Wagner et al. (2002)
Toxics release inventory	Klassen and McLaughlin (1996)
Response to oil spills	Klassen and McLaughlin (1996)
Assess/evaluate suppliers	Sancha et al. (2015); Gimenez and Sierra (2013)
Collaborate with suppliers	Gimenez and Sierra (2013); Seuring and Muller (2008)
Procure environmentally sustainably	Closs et al. (2011); Carter and Rogers (2008)
Source locally	Chopra and Sodhi (2004); Carter and Jennings (2004)
Reduce waste production	Roca and Searcy (2012); Rao and Holt (2005)
Reduce water consumption	Roca and Searcy (2012); Closs et al. (2011)
Reduce packaging	Carter and Rogers (2008)
Reduce consumption of materials	Closs et al. (2011); Carvalho et al. (2011)
Reduce energy consumption	Roca and Searcy (2012); Montabon et al. (2007)
Plant trees	Rondinelli and Berry (2000); GRI (2013)
Harvest water	Sodhi (2015)
Use renewable energy	GRI (2013)
Account for biodiversity	Carter and Rogers (2008); Closs et al. (2011)
Co-locate the operations	Chopra and Sodhi (2004); Rao and Holt (2005)

Decentralize/localize physical assets in multiple locations	Chopra and Sodhi (2004)
Conduct product lifecycle assessment (LCA)	Linton et al. (2007); Azapagic et al. (2004)
Use alternative modes of transportation	Goose (2013); Rao and Holt (2005)
Certify to ISO 14001 standard	Khan et al. (2019); Carter and Rogers (2008); Sarkis (2001)
Do product stewardship	Vachon and Klassen (2008)
Use eco-friendly materials (non-toxic)	Khan et al. (2019); Rao and Holt (2005); Zhu and Sarkis (2004)
Conduct green/environmental conscious manufacturing	Sarkis (2001); Srivastava (2007)
Conduct reverse logistics	Carvalho et al. (2011); Sarkis (2001)
Being lean	Ageron et al. (2012); Shah and Ward (2007)
Use eco-friendly routes	Rao and Holt (2005)
Remanufacture	Linton et al. (2007); Montabon et al. (2007)
Utilize increased transportation capacity	Halldorsson et al. (2009)
Vertically integrate operations	Carter and Rogers (2008); Carvalho et al. (2011)
Reduce replenishment frequency	Carvalho et al. (2011); Melnyk et al. (2010)
Comply with transportation safety	Closs et al. (2011); Goose (2013)
Recycle waste	Closs et al. (2011)
Use recycling waste	Lozano and Huisingh (2011)
Reuse materials/resources/products	Hassini et al. (2012); Shrivastava (2007)
Use recyclable/ed materials	Carvalho et al. (2011); Goose (2013)

**See supplementary information for a more detailed list of references.*

Table 2. Summary of social sustainability indicators

Social sustainability indicators	**Selected references***
Engage employees	Carter and Rogers (2008); Azapagic et al. (2004)
Implement community activities	Khan et al (2019); Carter and Jennings (2004); Roca and Searcy (2012)
Minimize (eliminate/eradicate) child labor	Closs et al. (2011); Mani et al. (2018)
Commit to employees	Mani et al., 2018; GRI (2013)
Use health-and-safety programs	Roca and Searcy (2012); Halldorsson et al. (2012)
Diversity for employees	Closs et al. (2011); Mani et al. (2018)
Establish supplier code of conducts	Gimenez et al. (2012); Closs et al. (2011)
Source responsibly	Ashby et al. (2012); Rao and Holt (2005)
Train on anti-corruption	Mani et al. (2018)
Train and educate employees	Lozano and Huisingh (2011); Hackston and Milne (1996); Khan et al. (2019)
Adopt safer warehousing conditions	Carter and Rogers (2008); Melnyk et al. (2010)
Ensure better working conditions	Melnyk et al. (2010); Mani et al. (2018)

** See supplementary information for a more detailed list of references.*

3.2 Scale domain, sampling frame and scale refinement

A total of 331 sustainability reports from 2013–14 (and from 2015–16 for confirmatory tests) were obtained from the Sustainability Disclosure Database (https://database.globalreporting.org). Of these 331 companies, 117 were American or Canadian and 214 were European. These regions were chosen based on their common policies and practices (Soana, 2011), and reports written only in English were retrieved to facilitate content analysis.

The sample covered a wide variety of sectors, with stratified sampling aimed across 18 sectors that were determined through aggregating the 38 industries into which the Sustainability Disclosure Database classifies companies. While there were more reports for some sectors and fewer for others, the overall sample comprised sustainability reports of companies from a diverse set of sectors (**Table 3**).

Table 3: Industry sectors of the companies in the study sample

Industry sector	**Number of companies in the sample**
Agriculture	3
Automotive	9
Aviation	5
Chemicals	17
Commercial services	34
Computers	10
Construction	14
Energy and utilities	35
Equipment	30
Financial services	33
Food and beverages	35
Paper	9
Health care	21
Household and personal	12
Metals and mining	24
Retailers	17
Telecommunications	10
Other	13
Total	**331**

Each of the 51 indicators was scored manually in relation to these sustainability reports as follows: a score of 0 for an item not referred to in a report; a score of 1 when the report only briefly mentioned something pertinent to the item or provided only qualitative statements; and a score of 2 when the report provided detailed information with some numerical support. Less frequently, a score of 3 was given when a report provided extensive numerical support with data on goals achieved or fully accomplished. This scoring system is similar to that used by Wiseman (1981) and other researchers using GRI indicators, although sometimes (albeit rarely), a 0–4 scoring system has been used (Morhardt et al., 2002; Skouloudis and Evangelinos, 2009; Leszczynska, 2012; Roca and Searcy, 2012; Manetti; 2011; Daub et al., 2007; Clarkson et al., 2007). To ensure reliability in the coding, the same text was coded twice at 12-month intervals to minimize potential coding errors. Two coders scored the reports both times to ensure inter-rater reliability.

For scale refinement, seven indicators were first deleted that were not mentioned in the sampled company reports. Twelve further indicators were also deleted that had a broad range (0–2 or 0–3) comprising ten or more standard deviations, which occurred when nearly all the relevant observations had only one score and just one or two had a different score. The remaining indicators are listed in **Table 4**.

Table 4. The 32 indicators retained after scale refinement

Indicator	Mean	Std. Dev.
Reduce energy consumption	1.92	0.93
Conduct community support activities	1.82	1.06
Health & Safety	1.59	1.05
Minimize water use	1.55	1.14
Minimize waste use	1.46	1.14
Reduce greenhouse gas (GHG) emissions	1.37	1.19
Encourage employee diversity	1.34	0.84
Train employees	1.24	0.94
Reduce carbon footprint	1.15	1.16
Recycle waste	0.89	1.09
Use renewable energy	0.71	0.93
Reduce other gases	0.57	1.00
Assess/evaluate suppliers	0.53	0.82
Reduce consumption of resources	0.52	0.91
Reuse materials	0.52	0.90
Certify to ISO14000	0.48	0.77
Use recyclable materials	0.48	0.81
Engage employees	0.47	0.83
Account for biodiversity	0.42	0.71
Source responsibly	0.37	0.68
Train on anti-corruption	0.36	0.65
Reduce fuel consumption	0.35	0.81
Establish supplier codes of conduct	0.34	0.55
Procure sustainably	0.30	0.65
Reduce packaging	0.26	0.65
Recycle water	0.23	0.62

Collaborate with suppliers	0.23	0.47
Source locally	0.20	0.53
Reduce spills	0.19	0.59
Use alternative fuels	0.11	0.45
Conduct product lifecycle assessment (LCA)	0.11	0.36
Commit to employees	0.06	0.35

Certain practices predominated in companies' sustainability reports. In particular, over 70% of the companies in the sample reported on *health & safety*; *diversity for employees*; *reduce carbon footprint*; *reduce energy consumption*; *reduce greenhouse gas emissions*; *minimize waste*; *minimize water use*; and *train employees*. The corresponding indicators reflect the most established corporate initiatives in relation to sustainability.

3.3 Construct development

Following Sahi et al. (2017) and Shah and Ward (2007), EFA was first conducted with varimax rotation using the 32 indicators as the scale in an initial phase. EFA was used on all the 32 indicators together, although it would have been possible to run EFA separately on the environmental and social indicators. Running a single EFA enabled an exploration of whether social and environmental sustainability practices would be clearly distinguishable or whether separate analyses with the two sets of indicators should be run. The findings confirmed that a single EFA could be run. A threshold of 0.4 for indicator loadings was imposed. Subsequently, CFA was used to confirm the model extracted through EFA (**Appendix**).

3.4 Testing

The next step in the study was to examine the link with other established measures of sustainability performance. For this, measures of performance need to be selected as well as models to link the constructs for disclosure developed above with these measures.

3.4.1 Choice of sustainability performance measures

Two measures were selected – inclusion (or not) in the Dow Jones Sustainability Index and Bloomberg's Environmental Social Governance (ESG) scores. Technically, both DJSI and Bloomberg ESG are measures of *disclosure of sustainability performance*, rather than of *sustainability performance* per se. However, both are subject to high levels of verification, the information collected being highly granular and verifiable. This implies veracity, which is why many researchers use these indices are as a proxy for sustainability performance itself and not just its disclosure (Searcy and Elkhawas, 2012: p.81; López, et al. 2007; and Artiach et al. (2010). By contrast, the constructs developed earlier using sustainability reports use information that is unaudited, voluntary and not cross-checked or verified in any way, or even easily verifiable. (More details can be found online in the supplementary information file.)

The DJSI was chosen because of its reputation for comprehensiveness (Statman, 2006) and top-rated credibility in industry (Searcy and Elkhawas, 2012). The DJSI employs RobecoSAM's Corporate Sustainability Assessment analysis, which integrates around 600 data points into one average score for each company. The score determines whether a company should be included in the DJSI portfolio.

For ratings, as opposed to inclusion in a sustainable portfolio of stocks, ESG scores from Bloomberg, which indicate performance on various sustainability issues on a 0–100 scale, were obtained (Eccles et al., 2014). Bloomberg ESG data cover 120 environmental, social and governance indicators, including environmental protection, diversity and inclusion, emissions, waste consumption, supply chain, and human rights (Huber et al., 2017).

A decision was made not to use the KLD data because, with those data, each company obtains a score between -2 to 2 for each of six categories, and the benefits of summing these to obtain a single score are unclear. Other limitations have also been reported (Chatterji et al., 2009; Chen and Delmas, 2011).

3.4.2 Test models using DSJI and ESG performance data

For each of the constructs obtained from EFA, a variable summing the items' standardized values was used, each weighted by the corresponding factor loading coefficient (DiStefano et al., 2009). Binomial logistic regression was then performed to test the link between the five sustainability variables corresponding to the five constructs with a company's inclusion (or not) in the DJSI. For the ESG rating, regression analysis was used to test the relation between the ESG score and the five variables.

4 Results

Social and environmental sustainability practices were found to be clearly separable, indicating that social and environmental sustainability are distinct concepts. In the factor analysis, the

Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy equaled 0.68 ($p < 0.01$), exceeding the threshold of 0.6 that indicates sampling adequacy without needing any remedial action. Furthermore, the components obtained explained 38.5 % of the total variance.

Next, the findings for constructs for environmental disclosure (sub-section 4.1), for social sustainability disclosure (sub-section 4.2), and of tests of the link to sustainability performance as reported by third parties (sub-section 4.3) are presented.

4.1 Constructs for environmental sustainability

EFA using the varimax rotation produced three components with eigenvalues greater than 1.0 that were consistent with the scree plot image (explaining 28% of the total variance). The KMO test equaled 0.66 ($p < 0.001$). The three components were: (1) *environmental protection* (Cronbach's $\alpha = 0.551$), (2) *reduction of material consumption* ($\alpha = 0.636$), and (3) *supply chain practices* ($\alpha = 0.516$) (**Table 5**). The fact that a supply-chain-related construct emerged from the EFA is interesting, and it emphasizes the significant effects of the supply chain on environmental sustainability (Morali and Searcy, 2013; Carter and Rogers, 2008; Gimenez and Sierra, 2013).

Table 5. Environmental sustainability practices: EFA results

Practices	Environmental protection	Resource conservation	Supply chain
Account for biodiversity	.665		
Source locally	.445		
Reduce other gases	.543		
Reduce spills	.585		
Recycle water	.471		
Certify to ISO14000	.445		
Reduce greenhouse gas (GHG) emissions		.707	
Minimize waste		.661	
Minimize water use		.621	
Reduce energy consumption		.560	
Assess suppliers			.603

Collaborate with suppliers	.501
Procure sustainably	.432
Reduce packaging	.510
Use recyclable materials	.498
Conduct product lifecycle assessment (LCA)	.411

A threshold of 0.4 was used for loading, and the three components correlated below 0.2, indicating discriminant validity. Moreover, the three components had several high loadings, providing evidence of convergent validity.

CFA indicated that the three-factor model adequately fit the data (X^2 (df) = 241.10 (104), X^2/df = 2.31, RMSEA = 0.063, SRMR = 0.081, CFI = 0.724, TLI = 0.938, and CD = 0.79) (**Table 6**). The ratio of the chi-square distribution to the degrees of freedom fell within the recommended range of 1.0–2.0. Convergent validity was indicated through: (a) indicators loading positively and significantly ($p < 0.001$) on their respective constructs over 0.3 (Yusoff et al., 2011), and (b) standardized coefficients for all items with *t* values greater than 2. Internal consistency was reflected in composite reliability (CR) of 0.57 for *environmental protection*, 0.64 for *resource conservation*, and 0.53 for *supply chain* constructs.

An additional test for discriminant validity was also implemented to check if all the study scales exhibited sufficient levels of uni-dimensionality, reliability, and validity. This was done through checking whether the squared root of average variance extracted (AVE) for each of the two constructs was greater than the correlation between them and less than 0.5 for either (Fornell and Larcker, 1981; Shah and Ward, 2007). For the three environmental sustainability constructs, the AVE test was met (**Table 6**). The three-factor measurement model fit significantly better than the constrained one-factor model, indicating that environmental sustainability was a multidimensional concept.

Table 6. Constructs for environmental sustainability: CFA results

Construct	Indicator	Loading	Average variance extracted (AVE)
Environmental protection	Reduce other gases emissions	0.47***	0.20

	Reduce spills	0.40***	
	Source locally	0.32***	
	Account for biodiversity	0.61***	
	Recycle water	0.30***	
	Certify to ISO14000 standard	0.43***	
Resource conservation	Reduce greenhouse gas (GHG) emissions	0.48***	0.31
	Minimize water use	0.58***	
	Reduce energy consumption	0.60***	
	Minimize waste use	0.57***	
Supply chain	Assess/evaluate suppliers	0.53***	0.16
	Collaborate with suppliers	0.36***	
	Procure sustainably	0.29***	
	Reduce packaging	0.52***	
	Use recyclable materials	0.37***	
	Conduct product lifecycle assessment (LCA)	0.30***	
EnvProtection * ResourceCons		0.43***	
EnvProtection * Supply chain		0.20*	
ResourceCons * Supply chain		0.40***	

*p < 0.05, **p < 0.01, ***p < 0.001

To ensure consistency and replicability of this study's results, data for the same companies were collected for a later year (2015–16) and the CFA repeated, with similar results (**Appendix**).

4.2 Constructs for social sustainability

Using varimax rotation, EFA indicated two components. Eigenvalues greater than 1.0 were consistent with the scree plot image underpinning social sustainability, explaining 49% of the total variance. The KMO test equaled 0.67 ($p < 0.001$). The first component indicated was *labor practices*, an integral element of social sustainability (Mani et al., 2018). The second component indicated was *labor engagement*, referring to engagement of labor from within local communities. Indicators with a loading below 0.4 were not reported (**Table 7**). Cronbach's α for *labor engagement* was found to be 0.344, which was rather low, perhaps owing to only three component indicators being involved, whereas that for *labor practices* was 0.606. The two factors correlated at a level below 0.20, providing evidence of discriminant validity. All indicators loaded significantly on their corresponding constructs, and their loadings (except *Establish supplier codes of conduct*) exceeded 0.50, indicating convergent validity.

Table 7. Social sustainability practices: EFA results

	Labor practices	Labor engagement
Health & Safety	.689	
Encourage employee diversity	.634	
Establish supplier codes of conducts	.438	
Train on anti-corruption	.569	
Train employees	.732	
Engage employees		.675
Commit to employees		.671
Conduct community support activities		.661

In terms of CFA, the two-factor correlated model adequately fit the data (X^2 (df) = 26.47 (20), X^2/df = 1.32, RMSEA = 0.031, SRMR = 0.044, CFI = 0.96. TLI = 0.95, and CD = 0.79). The chi-square test was not statistically significant, indicating a good model fit, and the ratio of the chi-square distribution to the degrees of freedom fell between 1 and 2. Convergent validity tests were generally positive: (1) the indicators loaded positively and significantly on their respective constructs ($p < 0.01$) with a value exceeding 0.3 (factor loading of one item, *Establish supplier codes of conduct*, was low, but this item was retained (Narasimhan et al., 2006)); (2) the standardized coefficients for all indicators had *t*-values larger than 2. CR values of 0.61 for *labor practices* and 0.41 for *labor engagement* indicated internal consistency. Based on AVE values, the two-factor measurement model for social sustainability had a better fit than the constrained one-factor model, indicating social sustainability had multiple dimensions (**Table 8**).

Table 8. Social sustainability: CFA results

Construct	Indicator	Loading	AVE
Labor practices	Health & Safety	0.54***	0.25
	Establish supplier codes of conduct	0.33***	
	Train employees	0.64***	
	Train on anti-corruption	0.43***	
	Encourage employee diversity	0.50***	
Labor engagement	Conduct community activities	0.35***	0.20
	Engage employees	0.59**	
	Commit to employees	0.36***	
Labor practices* Labor engagement		0.20*	

*p < 0.05, **p < 0.01, ***p < 0.001

4.3 Test results for the link between reporting constructs and performance

The variables corresponding to the individual constructs, *labor engagement*, *resource conservation*, and *supply chain* differentiated positively and significantly between those companies that were included in the DJSI from those that were not (**Table 9**). In addition, *labor practices* significantly explained the ESG scores (**Table 10**). Taken together, the information extracted from the sustainability reports in these five sustainability constructs explained the inclusion or otherwise of a company in the DSJI and also its ESG rating.

Table 9. Logistic regression: DJSI inclusion against the five sustainability reporting variables

Predictor variables	DJSI inclusion
Labor engagement	1.026**
Labor practices	1.125

Materials	1.121***
Supply chain	0.924**
Protection	0.036
Pseudo R^2	0.105
LR chi^2	39.74***

**p < 0.01, ***p < 0.001

Table 10. OLS regression: ESG scores against the five sustainability reporting variables

Predictor variables	Bloomberg ESG score
Labor engagement	2.746
Labor practices	21.990***
Materials	-2.036
Supply chain	7.095
Protection	-1.919
F	3.98***
R^2	0.18

**p < 0.01, ***p < 0.001

Therefore, the results demonstrated that public disclosure by companies does inform actual sustainability performance, as measured by third parties using private and public sources. Given that scoring took into account only what companies were reporting, these results could also be interpreted as implying that sustainable companies tend more to disclose their sustainability practices (Verrechia, 1993; Al-Tuwaijri et al., 2004).

5 Conclusion

This study investigated whether companies' publicly disclosed information in their sustainability reports accurately indicates their sustainability performance. To measure disclosure, indicators were obtained from diverse sources and then scored on a 0–3 scale for 331 companies, through content analysis of their sustainability reports. To measure sustainability performance, the status of the companies in terms of their inclusion (or not) in the DJSI portfolio and their ESG rating by Bloomberg was used. A significant positive link was then found between the information disclosed and third-party rating, in line with signaling theory.

There are limitations of this study that further research can address in the following ways:

(1) A larger sample of companies and from a more extensive set of countries would give greater confidence in the measurement model.

(2) A broader set of third-party performance indices should be used, especially given that the different indices measure or emphasize different aspects of sustainability.

(3) Given that different practices are important for different industries, industry contingency needs to be studied.

(4) Researchers can assess whether the scale can be shortened to 0–2 for simplicity or expanded to 0–4 for greater variance.

(5) Given that what companies have not reported was not addressed in this study—some third-party providers give a negative score when a company does not report on an indicator—further research needs to address this aspect.

(6) Further research is needed on *reflective* versus *formative* constructs in this area, given that third-party ratings appear to be formative.

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Appendix: Confirmatory Factor Analysis with 2015-16 data

Table A1. CFA results for social sustainability

Construct	Indicator	Loading
Labor practices	Health &Safety	0.45***
	Train employees	0.62***
	Train on anti-corruption	0.46***
	Diversity for employees	0.47***
	Establish supplier code of conducts	0.33***
Labor engagement	Conduct community support activities	0.31**
	Engage employees	0.60***
	Commit to employees	0.33*
Labor practices* Labor engagement		0.20*

The structural model for 2015-16 data indicates a good fit; X^2 (df)= 23.04 (19), X^2/df =1.21, RMSEA=0.025, SRMR= 0.036, CFI=0.97. TLI=0.96, CD=0.77.

Table A2. CFA results for environmental sustainability

Construct	Indicator	Loading
Environmental protection	Recycle water	0.38***
	Reduce spills	0.28***
	Source locally	0.34***
	Reduce other gases	0.43***
	Account for biodiversity	0.55***
Resource conservation	Reduce GHG emissions	0.51***
	Minimize water use	0.54***
	Reduce energy consumption	0.61***
	Minimize waste use	0.59***
Supply chain	Assess/ evaluate suppliers	0.50***
	Collaborate with suppliers	0.32***
	Procure sustainably	0.18***
	Reduce packaging	0.49***
	Use recyclable materials	0.36***
	Conduct product LCA	0.37***
EnvProtection * ResourceCon		0.43***
EnvProtection * Supply chain		0.29**
ResourceCon* Supply chain		0.48***

The structural model for the new data indicates a good fit; X^2 (df)= 210.163 (101), X^2/df =2.08, RMSEA=0.057, SRMR= 0.062, CFI=0.77. TLI=0.73, CD=0.91.