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A review of *ex ante* and *ex post* materiality measures, and consequences and determinants of material disclosures in sustainability reporting

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Abstract

Purpose – The purpose of the review is to synthesize the research on materiality measures of sustainability reporting and highlight how preparers, users, auditors, regulators and other stakeholders assess or determine the materiality in sustainability reporting. The review further summarizes the findings on consequences and determinants of material disclosures in sustainability reporting. Several directions for future research are also discussed.

Design/methodology/approach – This study provides a systematic review of materiality measures developed in the context of sustainability reporting. This synthesis of the literature summarizes the existing methodologies of measuring materiality. It also evaluates the strength and limitations of existing methods and approaches of measuring materiality in sustainability disclosures.

Findings – We find that the *ex post* materiality measures are simplistic and unidirectional in nature and *ex ante* materiality measures lack external validity and are generally narrow in focus – for example, focused on single firms or industries. Another major limitation in the current literature is the absence of robust empirical investigation of double materiality in sustainability reporting and a vast majority of the measures are developed without stakeholder engagement. Lastly, we document that the findings on determinants of material disclosure are fragmented and inconclusive and that the literature on consequences of material disclosure is rather un-explored.

Originality/value – The study explains the connections and differences between the various materiality measures. We document that materiality is measured in two distinct ways, *ex ante* and *ex post* and often times without stakeholder engagement. Moreover, given that a vast majority of the measures rely on manual content analysis, we find that they suffer from reproducibility and scalability.

Keywords Literature review, Materiality, Sustainability, Materiality determinants, Materiality consequences

Paper type Literature review

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Introduction

Materiality in sustainability reporting has experienced a surge of interest from academics, standard setters and practitioners. The most recent debate centers around the choice between a single or double materiality approach to sustainability disclosure. North American standard setters, for example, the International Sustainability Standards Board (ISSB), lean toward the single materiality (i.e. financial materiality) which is anchored in its decision-usefulness for prospective investors, emphasizing the financial ramifications of disclosed data. Furthermore, in the single materiality approach, an issue is considered material if it is likely to affect the financial performance of the firm thus employing an outside-in perspective. In contrast, European Union (EU) regulators advocate for double materiality (i.e. financial materiality and impact materiality (European Commission, 2023) which obliges firms to evaluate both their financial and broader societal impacts during corporate sustainability decision-making processes (Abhayawansa, 2022; Jørgensen *et al.*, 2022). Thus, double materiality also takes an inside-out perspective where an issue is considered material not only based on its impact on the firm but also taking into account the firm's impact on the outside world.

The ethos of *materiality* has its roots in the early phases of financial accounting marketization (Frishkoff, 1970). As a result, financial accounting and auditing standard bodies, such as the Financial Accounting Standards Board (FASB), the International Accounting Standards Board (IASB), and the International Auditing and Assurance Standards Board (IAASB), have traditionally defined materiality within the scope of financial materiality, emphasizing single materiality. The influence of the single materiality perspective is also noticeable in the *materiality* definitions of some of the well-known sustainability accounting standard bodies like International Integrated Reporting Council (IIRC) and Sustainability Accounting Standards Board (SASB) with Global Reporting Initiative (GRI) being the exception and more inclined toward double materiality [1]. The double materiality, although conceptually intriguing, is relatively nascent in regulatory practice. A testament to its evolving significance is the EU's recent legislative measure, the Corporate Sustainability Reporting Directive (CSRD, EU 2022/2464), introduced in November 2022 and the subsequent delegated regulation (EU 2023/2772) of sustainability reporting through the European Sustainability Reporting Standards (ESRS) in July 2023 (European Commission, 2023) [2].

In essence, *materiality* refers to the degree of relevance of an (un)disclosed financial and non-financial information (e.g. sustainability) for users (e.g. shareholders and other stakeholders) in their decision-making processes. At firm-level, it is the preparers (i.e. management) who decide what information to disclose and what to omit, while auditors, during their audit process determine if management has omitted any material information in their annual reports. Historically, auditors were only required to audit financial information. However, with the implementation of the CSRD, they will be required to audit sustainability-related information as well. The materiality concept in accounting thus predominantly revolves around three groups: preparers, auditors and users. Each group often has its own interpretation and application, complicating the matter further (Hicks, 1964; Messier *et al.*, 2005). For instance, in sustainability reporting the decisions of preparers on what is materially significant can be influenced by strategic objectives, sometimes obscuring the true essence of the report (Cho *et al.*, 2012). Firms may also define materiality differently based on whether they follow an intrinsic, instrumental or integrated corporate sustainability strategy, affecting how material issues are identified and prioritized (Adolph and Beckmann, 2024). In fact, the transparency of sustainability reporting has been questioned, with critiques highlighting issues like irrelevant data disclosures and over-generalized content (Boiral and Henri, 2015; Dubbink *et al.*, 2008). Moreover, recent studies document that there are inconsistencies between firms' declarations and their actual

adherence to double materiality principles, highlighting a gap between policy and practice (Correa-Mejía *et al.*, 2024). This has led to the introduction of new measurement techniques and sustainability reporting standards in an attempt to elevate the quality of sustainability disclosures (Jørgensen *et al.*, 2022). Despite extensive research on sustainability, a specific focus on the materiality (irrespective of single or double materiality) of sustainability information remains rather under-explored (Fiandrino and Tonelli, 2021; Michelon *et al.*, 2022). Moreover, several studies and surveys, such as those by Ferrero-Ferrero *et al.* (2020) and Kitsikopoulos *et al.* (2018), have pinpointed significant gaps in current sustainability reporting practices. These gaps are rooted in three key challenges, elaborated on in the following paragraph.

First, there is a growing body of research that emphasizes the subjective and general nature of sustainability reporting and the potential for opportunistic use of sustainability reports for greenwashing (Kim and Lyon, 2014; Laufer, 2003). Second, parallel to this, other critical works that examine sustainability reports demonstrated how irrelevant and lacking (too general) the information is for stakeholders, highlighting the absence of specific, quantifiable metrics and heterogeneous indicators (Dubbink *et al.*, 2008; Kim and Lyon, 2014; Yilmaz *et al.*, 2008). It is argued that sustainability reports are primarily limited in their ability to determine which issues to measure and how to respond to these issues (Whitehead, 2017). The third important issue is the existing divergence between the domains of sustainability assessment, reporting, accounting and management control in both theory and practice among sustainability standards. This is a major barrier to comprehending the integration and a common understanding of sustainability at the firm level (Witjes *et al.*, 2017).

These complexities inevitably affect the authenticity and quality of the contents in sustainability reports (Hahn and Kühnen, 2013; Lock and Seele, 2016; Witjes *et al.*, 2017). Consequently, firms face a core challenge: their constrained ability to pinpoint material issues for diverse stakeholders and subsequently prioritize these matters in line with stakeholder expectations (Ferrero-Ferrero *et al.*, 2020; Torelli *et al.*, 2020). Experts, both from academia and industry, advocate for comprehensive materiality assessments to refine sustainability reporting and effective business strategies (Khan *et al.*, 2016; Rogers and Serafeim, 2019; Whitehead, 2017). As noted by Bartels *et al.* (2014), a materiality assessment transcends mere reporting, serving as the foundation for sustainability strategy, stakeholder engagement and performance management. Indeed, a recent review of the scholarly work on materiality in sustainability reporting by Fiandrino *et al.* (2022) highlights, among other important issues, the exponential growth in materiality research in the last two decades along with the diversity in how materiality is defined, measured and assessed.

Fiandrino's *et al.* (2022) review offers a commendable initial synthesis of emerging literature on materiality in nonfinancial reporting, emphasizing prevalent research methods and theoretical foundations. Yet, our review endeavors to offer a more comprehensive understanding of how materiality in the context of sustainability reporting is measured, evaluated and gauged by preparers, auditors and users. Exploring these research dimensions becomes even more pertinent against the backdrop of the ongoing discourse on single versus double materiality and regulatory reforms of sustainability reporting.

The remainder of the review is organized as follows: Section 2 outlines the review methodology and sample descriptives, Section 3 summarizes the overall findings of the review, Section 4 summarizes the various *ex ante* materiality measures, Section 5 summarizes the various *ex post* materiality measures, Sections 5 and 6 summarize the findings on consequences and determinants of materiality disclosures, respectively and Section 6 ends with concluding remarks and suggestions for future research.

Review methodology

The main objectives of the review are as follows: (1) How is materiality measured in the context of sustainability reporting and (2) What are the consequences and determinants of materiality disclosures in sustainability reporting. To attain the objectives of the review we conducted a systemic review of the academic literature based on the guideline outlined in Kitchenham *et al.* (2009). Specifically, we use the following search query:

materiality and (sustain* or csr or non-financial or nonfinancial or esg)

We opted for Scopus as our primary search [3] platform because of its expansive reach covering a multitude of respected and well-established journals. To maintain the integrity and quality of our review, we decided to include only peer-reviewed journal articles, thereby excluding conference papers, book chapters and other types of publications. Our search was executed in April 2024, without setting any time frame limitations, enabling us to incorporate both pioneering and recent research contributions.

In the initial phase of our systematic literature review, a thorough screening process was conducted to filter out articles based on predefined inclusion and exclusion criteria, ensuring replicability and thoroughness in our methodology. Our first step involved analyzing abstracts to pinpoint articles that directly correlated with our review's objectives. We looked for studies that delve into the assessment, determination or measurement of materiality in sustainability disclosures or issues and studies that document the consequences and determinants of material disclosure. Following this, a comprehensive full-text screening of the shortlisted articles was undertaken to finalize the selection of the papers for inclusion in our review. Table 1 below summarizes the sample selection steps in this review. It may be noted here that a vast majority of the studies do not explicitly work with materiality in sustainability even though the term "material*" appears in the title, abstract or author keywords of the studies. Such studies are excluded from the review after reading the full text of those articles.

In Table 2 we summarize the distribution of the studies included in the review: in Panel A, over the year of publication; in Panel B, across the main methodological approach adopted to evaluate materiality and from whose perspective materiality is evaluated; and in Panel C, across the timing of materiality evaluation (i.e. the two dominant themes of *ex ante* and *ex post* materiality evaluation) and from whose perspective materiality is evaluated.

Overall findings

From the review of 39 articles included in this study, four themes/patterns emerged among the studies that worked with materiality in sustainability. The two dominant themes are *ex post* and *ex ante* evaluations of materiality. For the scope of this review, we differentiate between *ex post* and *ex ante* evaluation of materiality in sustainability in the following manner. *Ex post* evaluations gauge materiality in hindsight, scrutinizing which

Steps	Description	Articles
Step 1	Total search returns based on the keywords	122
Exclusion criteria	Articles that do not relate to assessment or measurement or determination of materiality in sustainability reporting or activities	9
Step 2	Excluded after screening abstract	21
Step 3	Excluded after screening full paper	53
	Number of articles included in the review	39

Source(s): Authors' own work

Table 1.
Sample selection for the review

Table 2.
Sample distribution

Panel A: Distribution of the articles included in the review across the four themes in terms of publication year

Year/Themes	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Ex ante	2	1	–	2	1	2	3	1	1	–	1	1	15
Ex post	–	–	1	1	3	1	4	3	3	3	3	1	23
Consequences	–	–	–	–	–	–	–	–	–	1	2	–	3
Determinants	–	–	–	–	1	1	2	3	–	1	–	1	9
Total	2	1	1	3	5	4	9	7	4	5	5	2	

Panel B: Distribution of the articles included in the review across the main methodological approach adopted to evaluate materiality and from whose perspective materiality is evaluated

Perspective/Methodology	Auditors	Managers	Specific stakeholder(s)	No specific stakeholder	Total
Archival or deterministic modelling	–	4	4	16	24
Case study, conceptual, observational or interviews	–	–	2	–	2
Experiment	2	–	2	–	4
Survey	–	1	1	–	2
Mixed[a]	–	5	2	4	11
Total	2	10	11	20	

[a]Some studies have employed more than one method to evaluate materiality, for example, content analysis along with survey, interview or multi-criteria decision analysis methods. For more detail classification, please refer to Table 3

Panel C: Distribution of the articles included in the review across the timing of materiality evaluation and from whose perspective materiality is evaluated

	Auditors	Managers	Specific stakeholder(s)	No specific stakeholder
Ex ante	2	7	4	2
Ex post	–	3	6	18

Source(s): Authors' own work

sustainability disclosures were material after their release. Studies on this theme predominantly evaluate sustainability disclosures or ESG ratings from various proprietary raters to assess or determine materiality. In assessing materiality purely based on disclosures in the sustainability reports, most studies generally rely on manual content analysis methods to capture the depth and breadth of information provided across a particular sustainability issue. Thus, measures constructed to evaluate materiality are often not validated against stakeholder expectations or prevailing standards, such as GRI, IR or SASB. A handful of these studies engage with stakeholders through surveys or interviews or any other means for external validation, while studies evaluating materiality based on ESG ratings predominantly use SASB materiality map to seek external validation of the materiality measures. On the other hand, *ex ante* evaluations aim to forecast materiality, i.e. attempting to identify sustainability issues that are deemed to be crucial for a specific firm or industry prior to their disclosure. Intriguingly, many *ex ante* measures are often formulated based on *ex post* sustainability disclosures. Nonetheless, studies of *ex ante* evaluations introduce many innovative ways for materiality evaluation and bring more nuanced approaches to evaluate materiality at micro-level. The next two themes are consequences and determinants of material disclosure. It may be noted here, most scholarly works that develop *ex post* materiality measure also study the determinants of material disclosure based on the materiality measure developed, thus scholarly works grouped under the two themes greatly overlap. In Table 3, we summarize the sample distribution across the four themes, the main methodological approach adopted to evaluate materiality and from whose perspective materiality is evaluated. In Table 4, the summary of the main results across the four themes is presented.

Ex ante materiality evaluations

Studies on *ex ante* measures of materiality are rather limited. Some of these measures are developed through deterministic modelling (e.g. Calabrese *et al.*, 2016; Corazza, 2018; Della Volpi and Paulino, 2018; Hsu *et al.*, 2013; Sanatkumar and Berka-Harnmeijer, 2024; Whitehead, 2017; Xu *et al.*, 2019) while other studies employ experiments to identify material issues for different groups (e.g. Moroney and Trotman (2016) for managers or preparers; Green and Cheng (2019) for auditors; Reimsbach *et al.* (2020) for employees and stock market participants. There are some studies that employ survey methods to identify material issues, e.g. Maama *et al.* (2022) from the perspective of minority shareholders, and Karim *et al.* (2013) from the perspective of managers.

Deterministic and archival based

Hsu *et al.* (2013) developed a materiality analysis method based on risk priority numbers (RPNs) for a failure modes and effects analysis (FMEA) and implement an analytic network process (ANP) to identify material sustainability issues. First, they interview managers to assign RPNs for sustainability issues for the FMEA model. The evaluation criteria for FMEA for various sustainability issues are: (1) the percentage of concerned stakeholders (Occurrence – O), (2) the level of concern to stakeholders (Detected – D) and (3) the impact of issues to strategic communication (Severity – S), where $RPN = O \times D \times S$. The criteria of occurrence and detection were then launched, based on the opinions of different stakeholders to translate stakeholder interests into a series of decisions on what to include and exclude in the sustainability report. Next, the decision-makers assign a pair-wise importance value to any two criteria at a time for a specific sustainability issue. Finally, the ANP method is employed to determine the relative weight (i.e. stakeholders' vs managers' opinion) for the different sustainability issues to identify the material sustainability issues.

Table 3. Distribution of studies included in the review across the four themes, the main methodological approach adopted to evaluate materiality, and from whose perspective materiality is evaluated

No	Study	Themes *Ex Ante* materiality evaluation	*Ex Post* materiality evaluation	Consequences of material disclosures	Determinants of material disclosures	Methodological approach to evaluate materiality	Perspective of materiality evaluation
1	Aras *et al.* (2017)	–	X	–	–	Content analysis and multi-criteria decision analysis	Stakeholders
2	Berquier and Gibassier (2019)	X	–	–	–	Observational and interviews	Manager and inhabitants
3	Beske *et al.* (2020)	–	X	–	–	Content analysis	Stakeholders
4	Boiral *et al.* (2020)	–	–	–	X	Interviews	Practitioners
5	Busch *et al.* (2022)	–	X	X		ESG ratings based	Investors
6	Calabrese *et al.* (2016)	X	–	–	–	Multi-criteria decision analysis	Managers
7	Calabrese *et al.* (2015)	–	X	–	–	Content analysis and survey	Customers
8	Clarvis *et al.* (2014)	X	–	–	–	Conceptual (framework building)	Investors
9	Corazza (2018)	X	–	–	–	Content analysis	Managers
10	Della Volpi and Paulino (2018)	X	–	–	–	Content analysis	Managers
11	Farooq *et al.* (2021)	–	X	–	–	Content analysis	Stakeholders
12	Fasan and Mio (2017)	–	X	–	X	Content analysis	Stakeholders
13	Gerwanski *et al.* (2019)	–	X	–	X	Content analysis	Stakeholders
14	Green and Cheng (2019)	X	–	–	–	Experiment	Auditors
15	Hassan *et al.* (2019)	–	X	–	–	Content analysis	Stakeholders
16	Hsu *et al.* (2013)	X	–	–	–	Interviews and multi-criteria decision analysis	Managers
17	Karagiannis *et al.* (2019)	–	X	–	–	Content analysis	Stakeholders
18	Karim *et al.* (2013)	X	–	–	–	Survey	Managers
19	Khan *et al.* (2016)	–	X	–	–	ESG ratings based	Investors
20	Maama *et al.* (2022)	–	X	–	–	Survey	Minority stakeholders
21	Maniora *et al.* (2018)	–	X	–	X	ESG ratings based	Investors

(*continued*)

Table 3.

No	Study	Themes *Ex Ante* materiality evaluation	*Ex Post* materiality evaluation	Consequences of material disclosures	Determinants of material disclosures	Methodological approach to evaluate materiality	Perspective of materiality evaluation
22	Mio *et al.* (2020)	–	X	–	X	Content analysis and interviews	Managers and stakeholders
23	Morgan *et al.* (2017)	–	X	–	–	Content analysis	Stakeholders
24	Moroney and Trotman (2016)	X	–	–	–	Experiment	Auditors
25	Ngu and Amran (2021)	X	–	–	–	Content analysis	Stakeholders
26	Pigatto *et al.* (2023)	–	X	–	–	Content analysis	Stakeholders
27	Pizzi *et al.* (2023)	–	X	–	–	Content analysis	Stakeholders
28	Pratoomsuwan and Chiaravutthi (2023)	X	–	X	–	Experiment	Investors
29	Puroila and Mäkelä (2019)	–	X	–	X	Content analysis	Stakeholders
30	Reimsbach *et al.* (2020)	X	–	–	–	Experiment	Investors and potential employees
31	Ruiz-Lozano *et al.* (2022)		X	–	X	Content analysis	Stakeholders
32	Sanatkumar and Berka-Harnmeijer (2024)	X	–	–	X	Interviews and multi-criteria decision analysis	Managers and stakeholders
33	Sepúlveda-Alzate *et al.* (2021)	–	X	–	–	Content analysis and principal component analysis	Managers and stakeholders
34	Setia *et al.* (2024)	–	X	–	–	Content analysis	Stakeholders
35	Tirado-Valencia *et al.* (2021)	–	X	–	–	Content analysis	Stakeholders
36	Torelli *et al.* (2020)	–	X	–	X	Content analysis	Stakeholders
37	Whitehead (2017)	X	–	–	–	Content analysis	Stakeholders
38	Xie *et al.* (2023)	–	X	X	–	ESG ratings based	Investors
39	Xu *et al.* (2019)	X	–	–	–	Multi-criteria decision analysis	Managers

Source(s): Authors' own work

Table 4. Thematic classifications, summary of methods, and main findings

Themes	Methods	Main findings
Ex post measure of materiality	Archival	*Ex post* materiality assessments employ content analysis predominantly, with variations in methodologies based on stakeholder engagement and ESG ratings. Approaches without stakeholder engagement, such as Fasan and Mio (2017) and Torelli *et al.* (2020), often utilize manual content analysis, assessing word count, relevance, or specific disclosure dimensions. Some, like Gerwanski *et al.* (2019), integrate materiality sections and comprehensive identification processes. Others, such as Aras *et al.* (2017) and Morgan *et al.* (2017), combine content analysis with entropy, TOPSIS, or frameworks such as FSSD and ISM. Indices by Beske *et al.* (2020) and Karagiannis *et al.* (2019) and the IIRC framework in Hassan *et al.* (2019) also showcase variations of content analysis-based materiality assessment. Approaches with stakeholder engagement include Calabrese *et al.* (2015) and Sepúlveda-Alzate *et al.* (2021), who incorporate customer and stakeholder feedback respectively. Pizzi *et al.* (2023) introduce dynamic materiality via social media interactions. ESG ratings-based studies, exemplified by Khan *et al.* (2016) and Busch *et al.* (2022), leverage ratings for materiality determination. Together, these studies offer comprehensive insights into *ex post* materiality, combining internal and external perspectives for a nuanced understanding of material issues
Ex ante measure of materiality	Deterministic Experiments Interviews Surveys (combinations of one or more) Materiality at aggregate level	The four categories of *ex ante* materiality assessment methods offer diverse insights and approaches for understanding and implementing materiality in sustainability reporting before the disclosure. Deterministic and archival based studies, exemplified by Hsu *et al.* (2013) and Calabrese *et al.* (2016), emphasize risk-based frameworks and fuzzy analytical hierarchy processes, showcasing the significance of objective, quantitative methods in anticipating material issues. Experiment-Based studies, as demonstrated by Moroney and Trotman (2016), Green and Cheng (2019), and Reimsbach *et al.* (2020), delve into the complexities of auditor judgments and stakeholder perceptions, underlining the need for strategic focus, strategy maps, and understanding diverse perspectives in a proactive manner. Survey based studies, like Karim *et al.* (2013), explore the role of firm size and stakeholder perspectives, spotlighting the influence of organizational characteristics and minority stakeholders in materiality determinations before disclosures. Materiality at aggregate level studies, such as Clarvis *et al.* (2014) and Berquier and Gibassier (2019), broaden the scope to country and city levels, introducing frameworks like E-RISC and highlighting the crucial interplay between environmental risks, governance mechanisms, and the overall context in advance of the reporting period. In synthesis, these *ex ante* categories collectively underscore the need for nuanced, context-specific materiality assessments before the reporting cycle, emphasizing the incorporation of quantitative, stakeholder-oriented, strategic, and micro- and macro-level considerations in comprehensive sustainability reporting frameworks

(*continued*)

Table 4.

Themes	Methods	Main findings
Consequences of materiality	Archival	*Ex post* materiality assessments, predominantly employing archival methods, yield crucial insights into the financial implications and investor responses to material CSR-related disclosures. Xie *et al.* (2023) reveal pricing anomalies linked to shareholder-related environmental risks, emphasizing shareholders' demand for higher returns in such scenarios. Pratoomsuwan and Chiaravutthi (2023) underscore the pivotal role of CSR materiality in investment decisions, with a clear preference for firms with material CSR over immaterial CSR. Their study also highlights that explicit materiality assessment influences investor judgments but lessens the impact when CSR issues are immaterial. Bush *et al.* (2022) contribute by demonstrating a positive correlation between continuous improvement in environmental ESG scores and future corporate financial measures. These collective findings emphasize the financial consequences of material disclosures and underscore the critical influence of materiality assessments on shaping investor perceptions and decisions
Determinants of materiality [further elaborated in Table 5]	Archival Experiments Surveys	Studies based on *ex post* materiality assessments, discourse of materiality determination process or the quality of materiality disclosure offer nuanced insights into the determinants of materiality disclosure. They are grouped in studies examining financial and accounting metrics, corporate governance, reporting characteristics, market factors, institutional and regulatory contexts, and business strategy reveal mixed results. Financial metrics, such as size and profitability, inconsistently explain material disclosure, suggesting potential endogeneity concerns. Corporate governance, reporting assurance, and ESG ratings exhibit varying relationships. Market factors, such as shareholding dilution, show negative associations, while industry competition and strategic orientations yield diverse outcomes. Additionally, the materiality determination process demonstrates inconsistencies across rating agencies, Integrated and Sustainability Reporting, and stakeholder perceptions. These findings underscore the intricacies of post-hoc materiality evaluations and call for a comprehensive understanding of determinants in sustainability reporting

Source(s): Authors' own work

Calabrese *et al.* (2016) developed a fuzzy analytical hierarchy process method for materiality assessment in sustainability reporting, purely from the perspective of the preparers. The model is developed based on GRI guidelines where decision makers are asked to pair-wise rank sustainability issues identified from GRI guidelines for their firm. The ranks are then normalized and a fuzzy AHP modelling is applied to identify the material issues. They validate their model by *ex post* analysis of sustainability reporting of an Italian SME operating in design, manufacturing and consulting for water projects and hydraulic components. They corroborate the validation through interviewing decision makers (e.g. CEO) of the firm. It may be noted that the feedback is based on preparers and does not incorporate stakeholders' perception of material issues. In similar a vein, Della Volpi and Paulino (2018) suggest an input and output model to identify material issues in the service industry. They adopt a three-stage modelling. In the first stage, a literature review is undertaken to compile data related to the environmental aspects of accommodation services. In the second stage, the concept of life cycle thinking is applied in order to systematize data obtained from the literature review and classify it according to inputs and outputs. In the third stage, a service triangle approach is applied in order to incorporate the elementary stages of the service provision and the environmental aspects associated with the materiality sources of accommodation.

Whitehead (2017) identifies material issues in the context of the wine industry in New Zealand. They perform a meta-analysis on 13 source documents [4] from the stakeholder perspective of five different groups: scientific, regulatory, consumer, societal and business/industry. They find natural capital to be the most material issue for the wine industry. Using a similar methodological approach, Corazza (2018) illustrates a tool (CSR4UTOOL) primarily developed for SMEs to self-assess sustainability issues that can be considered material for their stakeholders. As *a priori*, the material information is classified by benchmarking GRI model (3.1 version and related sector supplements), GBS (national Italian sustainability reporting standard), GRI INGO, AA1000 Stakeholder engagement, OECD guidelines, UN Global Compact, Italian NPOs Agency reporting guidelines, SA8000, ISO 14001, ISO 26000 and the EMAS scheme. The tool is developed as a web application that can *ex ante* facilitate SMEs to identify material issues for their stakeholders while it can be also used *ex post* to evaluate sustainability performance.

Xu *et al.* (2019) incorporate risk assessment in materiality analysis and develop a life cycle assessment (LCA) model to prioritize resource allocation among supply chain stages from two distinct perspectives (e.g. deep-versus broad-structure supply chain) for mitigating supply chain sustainability risk. In the US context, they use the apparel sector as an example of deep-structure supply chain where production at sub-stages takes place sequentially, and the automotive sector as the broad-structure supply chain where production at various lower-stages is carried out simultaneously to meet a higher-stage production. The model evaluates supply chain sustainability risk in three steps. In the first step, major stages of the supply chain are mapped, which requires a comprehensive understanding of the supply chain context. In the second step, supply chain sustainability risk is quantified using risk assessment space analysis (i.e. risk based on three dimensions comprising operational, social and environmental risks) and materiality analysis (i.e. risk based on two dimensions comprising location-based risk that is the potential risk relevant to the supplier's location and activity-based risk that is the potential risk relevant to the manufacturing activity). The third step is not systematically articulated but focuses on how businesses, depending on their priorities, improve on the risks quantified in step two by (re)allocating resources to the various supply chain stages identified in the first step.

Sanatkumar and Berka-Harnmeijer (2024) use multi criteria decision analysis (MCDA) to evaluate and prioritize environmental, social and economic goals by integrating them into the decision-making process across different corporate scenarios. Through action research,

MCDA was applied to three used cases within the corporations, where it facilitated the development of decision models by collaborating with relevant staff. These models enabled the ranking of sustainability issues based on a comprehensive set of criteria and measures, which were tailored to reflect the unique goals and challenges of each scenario. The implementation of MCDA proved effective in uncovering and weighing the potential impacts and trade-offs of various sustainability initiatives. It also promoted a more inclusive stakeholder engagement process, which was instrumental in challenging and refining the traditional focus on cost minimization.

Experiment based

Moroney and Trotman (2016) set up a 2 x 2 x 2 experimental design with two within-subjects manipulation (i.e. materiality in financial and water disclosures), while risks of breaching a contract and community impact were each manipulated at two levels between subjects. Participants comprised 82 auditors from three Big 4 accounting firms, of whom 48 were managers and 34 were seniors with an average audit experience of 5.2 years. They find that auditors' assessments of financial and non-financial (water) materiality are significantly different. This difference is significantly greater when there is no risk of breaching a contract than when there is a risk of breaching a contract.

Green and Cheng (2019) also use auditors as participants with a 2 x 2 x (2) experimental design where they manipulate two independent variables. The first independent variable is their client firm's strategic focus manipulated with strategic focus on supply chain management versus customer service. Their second independent variable is the absence or presence of a strategy map. In their set-up, the within-subject independent variable manipulation relates the materiality assessments on NFPI relevant to a customer service focus versus supply chain focus strategy. A total of 77 auditors from Big 4 audit firms took part in the experiment with an average audit experiment of 4.83 years. The results show that, while setting materiality thresholds, auditors do not consistently distinguish strategically relevant versus irrelevant nonfinancial performance information. They also find that the presence of a strategy map has a mediating effect. For example, a misstated nonfinancial performance information of both high and low strategic relevance is assessed to be more material than the low strategic relevance nonfinancial performance information in the absence of a strategy map, compared to the presence of a strategy map NFPI.

Reimsbach *et al.* (2020) implement a 2 x 2 full-factorial between-subjects experimental design. Participants comprised 129 capital market participants and 121 potential employees and were assigned randomly to one of the four experimental groups. They find that nonfinancial information is more material for potential employees than for capital market participants. Moreover, capital market participants assess nonfinancial information about energy to be more material than nonfinancial information about biodiversity. While, for potential employees, the perceived relevance of receiving nonfinancial information on the energy topic was statistically indistinguishable from receiving information on the biodiversity topic. Finally, the differences in materiality level of energy versus biodiversity are larger in the case of a strong change in nonfinancial performance for capital market participants.

Survey based

Karim *et al.* (2013) investigate how firm size and public/private affiliation affect voluntary disclosure decisions concerning quantitatively immaterial nonfinancial information. They employ a survey with 24 cues (equal number of positives and negatives) which are potentially identified as material by securities and exchange commission (SEC). A total of 136 managers participated in the survey and were asked to decide which of the 24 cues

should be disclosed voluntarily. They find that managers of larger firms recommend disclosing more items than managers of smaller firms. They do not find any significant difference in materiality thresholds of private versus public firm managers, and public firm managers have statistically equivalent qualitative materiality thresholds. They argue that private firm managers strategically disclose most cues as they imitate a legitimizing behavior due to SEC and financing concerns.

Materiality at aggregate level

Materiality evaluations are as important at macro level as at micro level, if not more so. Not many studies evaluate materiality at macro level (e.g. country-, region-, city-levels, etc.) A handful of studies that do evaluate materiality at macro level include Clarvis *et al.* (2014) and Berquier and Gibassier (2019).

Clarvis *et al.* develop a framework (E-RISC) to assess the materiality of environmental risks for the sovereign bond market. The E-RISC focuses on country level across four dimensions (e.g. resource balance, trade risk, degradation risk and financial resilience) and 20 indicators. The framework allows users to assign weights to the 20 indicators, based on relative importance and helps to identify and quantify linkages between tangible environmental risks and macroeconomic factors that are deemed to affect sovereign credit risk. Therefore, the framework allows users to make a deterministic assessment of how environmental risks can be factored into investment decisions in the sovereign bond market and thus may be considered an *ex ante* materiality measure.

Berquier and Gibassier (2019) focus on city level using a longitudinal case study approach to follow the process through which a city and its residents tackle climate change. It is an observational study that highlights the importance of appropriate development and execution of governance mechanisms needed in shaping policies for and behaviors of its residents, knowledge creation and use of information and communication to attain the stated objectives. The study also identifies two important discourses, namely "model city" and "good citizen," where the identity of the "model city" was created by giving visibility to important environmental factors and to institutional actors' resolve and motivation. The identity of the "good citizen" was created through inclusiveness and engagement. The study thus identifies important *ex ante* factors that are conditional for obtaining material sustainable actions.

***Ex post* materiality evaluations**

The majority of the studies that seek to determine materiality *ex post* heavily rely on content analysis method. The studies are generally archival in nature and often test the determinants of materiality disclosures proxied by the materiality measure developed *ex post*. Within this broad category, the depth and breadth of materiality-related information in sustainability disclosures often serve as the basis for content analysis-based measures. There are three variations of the materiality measures developed, based on content analysis: (1) studies that solely rely on the depth and breadth of the disclosures in sustainability reporting and do not validate the measure through stakeholder engagement, (2) studies that explicitly include stakeholder perception through direct engagement to validate the measures and (3) studies that implicitly include stakeholder perception, e.g. cross-matching with ESG ratings or materiality issues identified by standards such as GRI, IR, SASB, etc.

Approaches without stakeholder engagement

Fasan and Mio (2017) are one of the first researchers to propose such a content analysis-based measure and many have built on their work, albeit with minor modifications. Notably, these

measures hinge on manual content analysis, which inherently limits scalability. Fasan and Mio (2017) rely on manual content analysis in developing the following materiality measures:

(1) Word count of "material"/"materiality" in connection with non-financial reporting or to materiality determination process.

(2) Relevance of materiality disclosure: a categorical variable on a scale of 0–5, depending on the depth and breadth of materiality information disclosed [5].

Building on the groundwork of Fasan and Mio's (2017) framework, several other studies have introduced their own adaptations (e.g. Farooq *et al.*, 2021; Ngu and Amran, 2021; Pigatto *et al.*, 2023; Ruiz-Lozano *et al.*, 2022; Torelli *et al.*, 2020) and followed the second construct of materiality, the "relevance of materiality disclosure" of Fasan and Mio (2017), with some minor modifications. For example, scoring on a scale of 1–6, reference to stakeholder related information in materiality disclosures, etc. Gerwanski *et al.* (2019) also build on Fasan and Mio (2017) with significant modifications to the measure. Their study offered a considerably altered approach. Their metric accounted for the presence of a distinct materiality section, the comprehensiveness of the identification process description, details on various materiality facets, time horizons, materiality matrices and discussions around risks, opportunities and mitigation strategies.

Aras *et al.* (2017) complement the content analysis method of materiality evaluation with two additional methods, namely entropy and TOPSIS. Specifically, they first set four sustainability indicators – economic, environment, social and governance. In the next step, they apply the content analysis method to extract disclosures across the four sustainability indicators (events) – they define as the criteria values. A decision matrix is then applied based on entropy to extract weights for different disclosures (categories) within each event in subsequent steps. The assumption is that categories of event may have unequal frequencies or probabilities. Finally, they apply the TOPSIS method, which is a multi-criteria decision-making method, to rank the entropy weights. They primarily aim to measure sustainability performance; however, an alternative interpretation can be material disclosure across the sustainability indicators. In a similar vein, albeit using a different methodology, Morgan *et al.* (2017) analyze publicly available data from large UK retailers to systematically evaluate their initiatives designed to minimize consumer emissions. Their assessment is rooted in understanding the material impact of these initiatives in the context of sustainable consumer behavior. They sequentially use two frameworks: a modified version of The Framework for Strategic Sustainable Development (FSSD) to evaluate if retailers' initiatives were likely to be successful in meeting their sustainability objectives, and a modified version of Individual Social Material (ISM) to assess what context of consumer behavior is targeted (e.g. individual, social or material). The FSSD is operationalized at five levels: if the retailers define a clear scope (systems level) and desired outcome (success level), and if it agrees with the strategy (strategic guidelines level). The final levels are: the actions undertaken to achieve the objectives (actions level) and the monitoring and learning while operationalizing the actions (tools level). ISM evaluates if the firm initiatives are targeted at individuals directly or the societal norms and conventions or products or infrastructure.

Beske *et al.* (2020) also developed a disclosure index based on manual content analysis. Their index has the following dimensions: (a) definition of the materiality analysis, (b) the aspects/topics reported and (c) the methods used to identify (c1) stakeholders and (c2) aspects/topics. Karagiannis *et al.* (2019) investigate the sustainability issues disclosed by airports and build their materiality measure in the following manner. For a sample of 33 reports from their initial sample of 55 airports, they first identify the total number of material issues reported in all 33 reports and subsequently construct a measure for each airport

through relative frequency, i.e. the number of material issues reported by an individual airport relative to the total number of material issues identified for the sample of 33 reports. Mio *et al.* (2020) also implement a relative frequency-based measure to classify material issues for an Italian insurance firm. They first use an auto code function in a proprietary software to auto code their sample of firm specific documents that deal with nonfinancial topics and is not produced by a single firm function into themes. Next, by investigating the keywords within those themes they connect the 20 predefined material issues. This process essentially identifies the most frequently used words under a predefined number of themes (in this case, 20 material issues). They validate the results from content analysis with semi-structured interviews with managers.

Hassan *et al.* (2019) build on the IIRC framework and use a content analysis method to construct their materiality score, while focusing on higher education institutions in the UK. They construct the score based on the presence/absence and depth of information provided across eight IIRC issues, i.e. organizational overview and external environment, governance, business model, risk and opportunities, strategy and resource allocation, performance, outlook and basis of preparation and presentation. They weight the disclosure index across the eight issues as follows: no disclosure = 0, descriptive disclosure without any link to strategy, governance, performance and prospect = 1, descriptive disclosure and link with all strategy, governance, performance and prospect compared with historic position = 2, descriptive disclosure linked with all strategy, governance, performance and prospect compare with historic, present and future position = 3. A higher total score indicates a better alignment with the IIRC framework. Along similar lines, Tirado-Valencia *et al.* (2021) focus on public entities and use content an analysis and construct measure, namely "integrated thinking" across five dimensions based on sustainability disclosure – connectivity, external focus, integrated planning, effective governance and integrated communication. The five dimensions are motivated by the IIRC reporting framework and are further divided and scored across 16 variables that essentially measure the depth and breadth of disclosure across the five dimensions, and one variable that considers the length of the reports. In a similar vein, Setia *et al.* (2024) developed an index to differentiate between financial materiality and impact (or double) materiality by hand-mapping GRI's G4 Guidelines with the UN Sustainable Development Goals. Their sample consisted of 40 firms from the International Integrated Reporting Council's Pilot Program Business Network, spanning the years 2015–2017. A distinguishing feature of the Setia *et al.* (2024) study is that their approach distinguishes between financially-material and impact-material sustainability-related information. They find that despite the IR Framework's emphasis on financial materiality, impact-material disclosures, especially those related to environmental aspects, were more prominently reported than those on financial aspects. This indicates a richer, multi-dimensional approach to materiality, where industry sensitivity and national legal frameworks influence the balance of disclosures.

Approaches with stakeholder engagement

The studies discussed hitherto do not engage with stakeholders to verify if the measured materiality is indeed considered material by various stakeholders. One exception is Calabrese *et al.* (2015) who incorporate customer feedback in the process of evaluating material disclosures by firms. Specifically, they developed a three-step model to evaluate materiality disclosure based on customer feedback. In the first step, they measure CSR commitment based on firms' disclosure in sustainability reporting. In the second step, they survey customers for feedback on firms' disclosed CSR commitments. In the third step, they propose that the materiality dealignment is the gap between customer needs and firm commitments. Sepúlveda-Alzate *et al.* (2021) also incorporate stakeholder feedback in their

principal component analysis to build their materiality measure. They first manually identify sustainability-related issues disclosed by firms in their reporting. In the next step, they independently ask firms and stakeholders to rank/prioritize each of the sustainability issues identified at three levels: low (1), medium (2) or of high (3) importance. Maama *et al.* (2022) employ a survey among minority stakeholders (e.g. small shareholders, staff, students and community members) and ascertain materiality in disclosures by assessing if the information needs of the various stakeholders were fulfilled by the sample firms. Specifically, they include 36 firms listed in the Ghana Stock Exchange and classify their reports of 2017 and 2018 based on GRI guidelines. While the study is more descriptive in nature, it operationalizes a useful method of materiality determination based on information needs of minority stakeholders.

Pizzi *et al.* (2023) provide an alternative measure of materiality evaluation by including stakeholders' perception in the process of materiality determination, which they frame as dynamic materiality. Their proxy for material disclosure is the extent of stakeholder engagement with a specific CSR disclosure. They measure the extent of stakeholder engagement through "favorites" and "retweets" of firms' tweets on X (formerly Twitter). They also move away from evaluating traditional dissemination of nonfinancial information in CSR reports to sustainability disclosures through social media platforms, specifically Twitter, in the context of the COVID-19 pandemic. The study also highlights how firms are adapting their accountability practices and how they communicate with stakeholders in response to emerging challenges, such as COVID-19 pandemic.

ESG ratings-based approaches

One of the first studies to use ESG ratings to evaluate materiality is Khan *et al.* (2016) who construct the materiality measure based on the ESG rating provided by MSCI (formerly KLD and GMI). They define materiality as the difference between ESG strength and ESG concerns of a particular sustainability issue identified as material by SASB for a particular industry. Therefore, whether a sustainability issue is deemed material for a particular firm is determined by its industry classification. This materiality measurement approach was also adopted by others, e.g. Busch *et al.* (2022) and Maniora (2018). A rather intuitive approach materiality assessment from ESG ratings is developed by Busch *et al.* (2022). They specifically zoom in on the environmental scores provided by ISS-oekom and MSCI ESG IVA. Their materiality measure is the continuous improvement for the ESG ratings along the environment dimension where the continuous improvement is measured in two variants, at aggregate and individual environmental dimensions level. The two variants are: (1) difference between the change in score between two years and the change in score between two years plus a tally on cumulative improvement over the years, and (2) average change in score over the years.

Consequences of material disclosures

In an archival setup, Xie *et al.* (2023) use Refinitv- and SASB-based E score to test if pricing anomalies exist, based on the E scores and find the presence of financial materiality risk, and that shareholders expect higher return if exposed to shareholder-related environmental risk. In other words, investors consider firms not engaging in material environmental management a significant risk and ask for compensation for their exposure to this environmental risk. Pratoomsuwan and Chiaravutthi (2023) implement a 2 x 2 between-subject experiment with 136 participants who are finance-related professionals, with the largest proportion being financial analysts, credit rating analysts and investment bankers. They test the influence of explicit assessment and CSR materiality on professional investors'

investment decisions. They find that investors' willingness to invest is greater in material CSR compared to immaterial CSR. The assessment of willingness to invest in a firm's stock is not affected by the presence or absence of explicit materiality assessment. However, explicit assessment significantly removes the effect of CSR performance on the investor's investment judgment when CSR issues are immaterial. Finally, Busch *et al.* (2022) show that continuous improvement on environmental ESG score is positively associated with future accounting and market-based corporate financial measures.

Determinants of material disclosures

In this section, we summarize the findings on the determinants of materiality disclosure. These studies investigate determinants of material disclosure based on *ex post* measures, discourse of the materiality determination process or the quality of materiality disclosure. We group these determinants into financial and accounting metrics, corporate governance and leadership, reporting characteristics, market and investment factors, institutional and regulatory context, industry specifics and business strategy. The sample period of these studies covers the period from 1991 to 2017, across multiple countries, and encompasses both longitudinal and cross-sectional analyses. A summary of findings from eight out of ten studies in this theme is presented in Table 5. Among these, Maniora (2018) uses an ESG based measure of materiality and the remaining seven studies (e.g. Fasan and Mio, 2017; Farooq *et al.*, 2021; Gerwanski *et al.*, 2019; Hassan *et al.*, 2019; Ngu and Amran, 2021; Torelli *et al.*, 2020; Ruiz-Lozano *et al.*, 2022) use a depth and breadth of information-based measure utilizing content analysis of CSR reporting-based approach.

Financial and accounting metrics are often used as control variables in the literature and include abnormal accruals, leverage, profitability and firm size. These factors are mostly found to be insignificant as determinants of material disclosures. For example, Ruiz-Lozano *et al.* (2022) documented firm *size* to positively affect material disclosures in the Spanish setting while the other six studies (e.g. Maniora, 2018; Fasan and Mio, 2017; Gerwanski *et al.*, 2019; Hassan *et al.*, 2019; Ngu and Amran, 2021; Torelli *et al.*, 2020) found *size* having no significant effect on material disclosure. Farooq *et al.* (2021) found leverage to be negatively associated with material disclosure in the Gulf cooperation council countries, while three studies, e.g. Maniora (2018) in the US-setting; Ngu and Amran (2021) in the Malaysian-setting and Torelli *et al.* (2020) in the Italian-setting, found leverage to be insignificant. Fasan and Mio (2017) and Farooq *et al.* (2021) found profitability to be positively associated with material disclosure in countries participating in the IIRC pilot program and GULF cooperation council respectively, but four studies in other setting found *profitability* to be insignificant, e.g. Gerwanski *et al.* (2019) in a European and South African setting; Maniora (2018) in a US-setting; Ngu and Amran (2021) in a Malaysian-setting and Torelli *et al.* (2020) in an Italian-setting. The mixed results thus indicate firm fundamentals do not consistently explain material disclosure and that there are endogeneity concerns partly from the perspective of measurement errors. Similar reasoning applies to other factors studied as determinants of material disclosure. For instance, corporate governance and leadership factors studied in the literature (e.g. presence of audit committee, board gender diversity, board independence, board size, frequency of board meetings, Big 4 audit, stakeholder engagement); reporting characteristics measured as assurance of CSR reports, ESG rating, prior experience in reporting and readability of reports; institutional (e.g. GDP, governance quality, regulatory quality, voice and accountability index) and regulatory context (e.g. GRI, IIRC Directive, NFRD Directive) also provide mixed results – either insignificantly or positively related to material disclosure. Among market-based measures, shareholding dilution was documented by Gerwanski *et al.* (2019) to be negatively associated with material disclosure, while other measures, such as Dow Jones Sustainability Index and Tobin's Q

Determinants	Relationship	Sample coverage	Time-horizon	Study
Financial and Accounting Metrics				
Abnormal accruals	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
Firm age	positive	UK higher education institutions	2013–2016	Hassan *et al.* (2019)
Funding – endowments	not sig.	UK higher education institutions	2013–2016	Hassan *et al.* (2019)
	negative			
Funding – public Growth	not sig.	UK higher education institutions	2013–2016	Hassan *et al.* (2019)
Liquidity	not sig.	UK higher education institutions	2013–2016	Hassan *et al.* (2019)
Leverage	not sig.	USA	1991–2014	Maniora *et al.* (2018)
	negative	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)
	not sig.	Malaysia	2015	Ngu and Amran (2021)
	not sig.	Italy	2017	Torelli *et al.* (2020)
Return on assets	not sig.	USA	1991–2014	Maniora *et al.* (2018)
	positive	IIRC pilot program	2012–2013	Fasan and Mio (2017)
	positive	Gulf cooperation council countries Italy	2013–2017	Farooq *et al.* (2021)
	not sig.		2017	Torelli *et al.* (2020)
Return on equity	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
	not sig.	Malaysia	2015	Ngu and Amran (2021)
Size	not sig.	USA	1991–2014	Maniora *et al.* (2018)
	not sig.	IIRC pilot program	2012–2013	Fasan and Mio (2017)
	positive	UK higher education institutions	2013–2016	Gerwanski *et al.* (2019)
	not sig.	Europe and South Africa	2013–2016	Hassan *et al.* (2019)
	not sig.	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)
	not sig.	Malaysia	2015	Ngu and Amran (2021)
	not sig.	Italy	2017	Torelli *et al.* (2020)
	positive	Spain	2017	Ruiz-Lozano *et al.* (2022)
Corporate Governance and Leadership				
Audit committee	not sig.	Spain	2017	Ruiz-Lozano *et al.* (2022)
Board gender	not sig.	IIRC pilot program	2012–2013	Fasan and Mio (2017)
diversity	positive	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
Board independence	not sig.	IIRC pilot program	2012–2013	Fasan and Mio (2017)
	positive	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)
	positive	Malaysia	2015	Ngu and Amran (2021)
Board size	positive	IIRC pilot program	2012–2013	Fasan and Mio (2017)
	not sig.	UK higher education institutions	2013–2016	Hassan *et al.* (2019)
	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
	not sig.	Malaysia	2015	Ngu and Amran (2021)

Table 5.
Summary of determinants of material or materiality related disclosures based on past literature

(*continued*)

Determinants	Relationship	Sample coverage	Time-horizon	Study
Board meeting	not sig.	IIRC pilot program	2012–2013	Fasan and Mio (2017)
	positive	Malaysia	2015	Ngu and Amran (2021)
Big 4 audit	not sig.	USA	1991–2014	Maniora *et al.* (2018)
Stakeholder engagement	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
	positive	Italy	2017	Torelli *et al.* (2020)
Reporting Characteristics				
Assurance	positive	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
	not sig.	Italy	2017	Torelli *et al.* (2020)
	positive	Spain	2017	Ruiz-Lozano *et al.* (2022)
ESG rating	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
Prior reporting	positive	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
	not sig.	Italy	2017	Torelli *et al.* (2020)
Readability	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
Market and Investment Factors				
Cost of financing	not sig.	USA	1991–2014	Maniora *et al.* (2018)
Dow Jones Sustainability index	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
FTSE MIB index	not sig.	Italy	2017	Torelli *et al.* (2020)
Institutional	not sig.	USA	1991–2014	Maniora *et al.* (2018)
ownership	not sig.	Spain	2017	Ruiz-Lozano *et al.* (2022)
Market-to-book	not sig.	USA	1991–2014	Maniora *et al.* (2018)
	not sig.	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)
Shareholding dilution	negative	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
Tobin's Q	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
Institutional and Regulatory Context				
GDP growth	not sig.	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)
GDP	not sig.	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)
Governance quality	positive	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)
GRI	positive	Italy	2017	Torelli *et al.* (2020)
	positive	Germany	2017	Beske *et al.* (2020)
	positive	Spain	2017	Ruiz-Lozano *et al.* (2022)
IIRC Directive	positive	UK higher education institutions Italy	2013–2016	Hassan *et al.* (2019)
	not sig.		2017	Torelli *et al.* (2020)
Mandatory reporting	not sig.	Europe and South Africa	2013–2016	Gerwanski *et al.* (2019)
Regulatory quality	not sig.	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)
Voice and accountability index	positive	Gulf cooperation council countries	2013–2017	Farooq *et al.* (2021)

(*continued*)

Table 5.

Determinants	Relationship	Sample coverage	Time-horizon	Study
Industry Specifics				
Industry	not sig.	Spain	2017	Ruiz-Lozano *et al.* (2022)
Industry competition	not sig.	USA	1991–2014	Maniora *et al.* (2018)
Sensitive industry	not sig.	Malaysia	2015	Ngu and Amran (2021)
	negative	Italy	2017	Torelli *et al.* (2020)
Business Strategy				
Strategy	negative	USA	1991–2014	Maniora *et al.* (2018)
Prospector	negative	USA	1991–2014	Maniora *et al.* (2018)
Defender	not sig.	USA	1991–2014	Maniora *et al.* (2018)

Note(s): [positive] indicates positive relationship significance at 5% level; [negative] indicates negative relationship significance at 5% level; [not sig.] indicates no significance relationship at 5% level
Source(s): Authors' own work

Table 5.

(Gerwanski *et al.*, 2019), FTSE MIB Index (Torelli *et al.*, 2020), Market-to-book (Maniora, 2018; Farooq *et al.*, 2021) and cost of financing (Maniora, 2018), showed an insignificant relationship. Maniora (2018) included business strategy-related factors for a sample of US firms and found that prospector firms have a negative relationship and defender firms have an insignificant relationship with material disclosure. However, at aggregate, business strategy has no significant relationship with material disclosure. Finally, material disclosure does not vary significantly across industries or due to industry competition. However, sensitive industries have mixed results – either insignificantly or negatively related.

In addition to the studies presented above, Boiral *et al.* (2020) found that the materiality-determination process and interpretation of materiality are not consistent across rating agencies. Mio *et al.* (2020) documented that integrated reporting and sustainability reporting results in different material issues. Finally, Puroila and Mäkelä (2019) find that an important determinant of sustainability issue is the type of stakeholder and not stakeholders as a single-entity, and there is a great divergence between the stakeholders and the business on the importance of various sustainability issues.

Together, the studies included in this review highlight the complex nature and importance of the double materiality approach in determining sustainability issues. Firstly, not all sustainability issues are equally important to all stakeholders. Secondly, the importance of a particular sustainability issue often varies distinctively for the stakeholders as a group and the firm. For example, Puroila and Mäkelä (2019) document that stakeholders like the government are interested in "impact investment" while media and suppliers are not; NGOs and the government is interested in issues like "employment of marginalized and Indigenous groups" while media and suppliers are interested in "diversity and inclusion" from different perspectives; suppliers are more interested in "sustainable sourcing", NGOs are more interested in "increased donor competition" and government and regulators are more interested in issues like "natural capital and environmental policies" and "environmental performance," respectively; lastly, for government and NGOs "supporting economic growth" is important, however, not for the other stakeholders included in their study. On the other hand, Reimsbach *et al.* (2020) documented that investors' magnitude of relevance for a sustainability issue (energy vs biodiversity) was contingent on the risk or financial impact while prospective employees were indifferent (statistically) regarding the two topics. In the context of the wine industry in New Zealand, Whitehead (2017) finds that climate change and other environmental issues are the most important issues for

stakeholders while socio-economic issues such as labor conditions and governance-related issues in general are not. Climate change was also shown to be an important sustainability issue for local government bodies in the context of "Smart City" by Berquier and Gibassier (2019) but not for its inhabitants (i.e. citizens), primarily due to increased intervention in citizens' daily lives. On the other hand, several studies documented the misalignment of firms' and stakeholders' assessment of the relevance of a sustainability issue. For example, in terms of the firm's identification or disclosure and the information needs for stakeholders (e.g. Calabrese *et al.* (2015) for customers; Maama *et al.* (2022) for non-shareholding stakeholders) and in terms of the importance of a particular sustainability issue for the firm and other stakeholders (e.g. Puroila and Mäkelä (2019)). One potential way for firms to address the divergences and lack of univocality of sustainability issues is through a systematic "impact assessment" of various sustainability issues for the relevant stakeholders that the double materiality approach promises (European Commission, 2023).

Concluding remarks and suggestions for future research

Purpose and scope of the review

This review explored how materiality in sustainability disclosures is gauged, defined and executed by preparers, auditors and users as documented in the extant scholarly work. While materiality has recently emerged as a focal point of discussions in the context of sustainability, particularly within the single and double materiality debates, its empirical examination in sustainability reporting remains in its infancy, highlighting a significant gap in current research. Furthermore, even if incorporated, empirical evidence suggests that the adoption of double materiality principles is often superficial among European firms. A study of firms indexed in the Dow Jones Sustainability Index revealed that many do not adhere to the stringent requirements of double materiality, posing a risk to the credibility of sustainability initiatives and the Sustainable Finance policy in Europe (Correa-Mejía *et al.*, 2024). This finding emphasizes the urgency for empirical research that can inform more robust regulatory frameworks and assurance practices, ensuring that firms move beyond mere compliance toward genuinely integrating sustainability into their core strategies.

In summary, this review further highlights that even though some advancement has been made in the area of materiality analysis in sustainability, empirical investigation of double materiality is almost non-existent. Moreover, empirical analysis of materiality in sustainability is rather fragmented and provides an inconclusive view. Our subsequent discussions elaborate on these observations.

Predominant finding, emerging concerns and research gaps

Most of the materiality measures developed in the literature are too simplistic and unidirectional in nature. For instance, the prevalent *ex post* materiality measure as devised by Fasan and Mio (2017), its subsequent adaptations (e.g. Beske *et al.*, 2020; Farooq *et al.*, 2021; Gerwanski *et al.*, 2019; Hassan *et al.*, 2019; Maama *et al.*, 2022; Ngu and Amran, 2021; Pigatto *et al.*, 2023; Ruiz-Lozano *et al.*, 2022; Torelli *et al.*, 2020) and word-frequency based measures implemented by Karagiannis *et al.* (2019) and Mio *et al.* (2020) predominantly ignore the double materiality perspective and often overlook the diverse stakeholder expectations as highlighted by Puroila and Mäkelä (2019) and others. While a few exceptions exist, such as Calabrese *et al.* (2016), their purview remains limited to a singular stakeholder group. Measures grounded in ESG ratings, like those by Khan *et al.* (2016) and others, tend to prioritize investors, sidelining other stakeholders. Moreover, industry-specific material disclosure variations, the influence of firm age, or the pervasive issue of 'greenwashing' are seldom incorporated into these measures. The current measures' inherent limitations

underscore the need for multi-faceted metrics that are scalable, discerning and take a double materiality approach in a more nuanced sense. That is, measures that do not solely rely on the depth and breadth of disclosure, ignoring the real impacts of a firm's sustainability efforts.

Compared to *ex post* measures, *ex ante* measures are more nuanced but lack robust validation. For instance, both Hsu *et al.* (2013) and Whitehead (2017) incorporate stakeholder perspectives within their devised materiality measures, albeit using distinct research methodologies. In contrast, Calabrese *et al.* (2016) prioritizes the viewpoint of preparers, and Della Volpi and Paulino (2018) emphasize the lifecycle perspective, sidestepping direct stakeholder considerations. However, a notable limitation across these studies is the narrow focus of the developed materiality measures; the methodologies established by Hsu *et al.* (2013), Calabrese (2016) and Della Volpi and Paulino (2018) are each anchored to a singular firm, while Whitehead (2017) is concentrated on a specific industry. A more general model is proposed by Xu *et al.* (2019) from a supply-chain perspective; however, their approach does not provide adequate guidance on how to prioritize risk and materiality in various supply-chain stages. Given this, it is imperative to test the applicability of the developed measures across varied settings, potentially broadening the spectrum of stakeholders and accommodating diverse industry nuances. Furthermore, auditors' evaluation of materiality perspective in the context of sustainability is seldom measured.

Our propositions and suggestions are well supported by the experimental studies that have illuminated compelling insights into the nuances of (im)material classification. Notably, Moroney and Trotman (2016) and Green and Cheng (2019) highlighted the dynamic shifts in auditors' materiality judgments when juxtaposing financial with nonfinancial items, particularly under the shadow of information asymmetry. Reimsbach *et al.* (2020) further delineate the contrasting valuation of financial and non-financial materiality across distinct stakeholder groups, such as investors and employees. This thread is mirrored in survey-based research; Maama *et al.* (2022) underscore the heterogeneity in materiality judgments across minority shareholders, while Karim *et al.* (2013) emphasize that managerial disclosure recommendations bear a relationship to firm size. On the other hand, Puroila and Mäkelä (2019) document that specific sustainability issues are prioritized differently within stakeholder groups and further highlight the mismatch of firm versus stakeholders' importance of a particular sustainability issue. To add to that, the materiality determination process and interpretation of materiality are not consistent across rating agencies (Boiral *et al.*, 2020), nor across different reporting frameworks (Mio *et al.*, 2020). Collating these insights, it becomes evident that materiality thresholds exhibit profound variability across and within the domains of users, preparers, auditors and standard setters. This accentuates the imperative for a more granular exploration into the informational needs of these diverse actors, enhancing our holistic comprehension of materiality thresholds in sustainability reporting. The findings also underscore an increasing need for sophisticated, multi-dimensional measures to gauge material disclosures more effectively and consistently.

As a closing note, it is pivotal to highlight the double materiality facet – one of the most debated nuances in sustainability disclosure. As established in the preceding discussions, current discourses emphasize the unidirectional nature of present materiality measures. This poses a critical lacuna, as empirical endeavors delving into sustainability reporting from a double materiality vantage remain scant, urging for further scholarly pursuit in this arena. For example, research on double materiality can benefit from developing materiality measures that incorporate various stakeholders' assessment of both firms' sustainability efforts and disclosures from the "impact materiality" perspective. That is, not just focus on the disclosures or talks but also on the actions, i.e. the magnitude and relevance of the sustainability efforts by firms. Materiality measures that incorporate the decision-making process of the management (e.g. if and how various stakeholders are engaged in identifying material sustainability issues and their potential impacts) will also improve the qualitative

characteristics of future measures. Such materiality measures are also likely to enhance the auditing of sustainability information in light of the CSRD. It is partly surprising that studies evaluating auditors' materiality assessment of sustainability-related information *ex post* are non-existent. We note that the auditors were not mandatorily required to express audit opinions on sustainability disclosure in the pre-CSRD period, nonetheless, assurance of such information was prevalent. We expect future research in that line of inquiry to grow in the post-CSRD era.

Notes

1. The US Supreme Court defines an information as material if there is "a substantial likelihood that the disclosure of the omitted fact would have been viewed by the reasonable investor as having significantly altered the 'total mix' of information made available" (426 U.S. 438, June 14, 1976). This definition has served as the legal standard of materiality since 1976, although accounting standard setters and regulators historically relied on their own definitions of materiality. For example, FASB defines materiality as "The omission or misstatement of an item in a financial report is material if, in the light of surrounding circumstances, the magnitude of the item is such that it is probable that the judgment of a reasonable person relying upon the report would have been changed or influenced by the inclusion or correction of the item" (FASB, 1980). IASB through amendments to International Accounting Standards (IAS) 1 and 8 in October 2018 defines materiality as "Information is material if omitting, misstating or obscuring it could reasonably be expected to influence the decisions that the primary users of general purpose financial statements make on the basis of those financial statements, which provide financial information about a specific reporting entity" (IASB, 2018). The IAASB defines materiality as "Misstatements, including omissions, are considered to be material if they, individually or in the aggregate, could reasonably be expected to influence the economic decision of users taken on the basis of the financial statements (IAASB, 2008)." On the other hand, materiality definition of the three most recognized standard setters in sustainability reporting is: (1) IIRC: In the realm of *ex ante* materiality determination, IIRC focuses on the strategic foresight. It encourages organizations to foresee which resources and relationships are most relevant to their future success and their capacity to create value. This forward-looking approach allows for early identification of potential risks and opportunities (IIRC, 2020); (2) GRI: GRI's framework involves a proactive stakeholder engagement process. Prior to reporting, organizations are encouraged to interact with stakeholders to ascertain which sustainability topics are of utmost importance to them. This iterative dialogue serves as an *ex ante* mechanism to shape the reporting content and prioritize issues (GRI, 2024); (3) SASB: SASB's *ex ante* materiality perspective is rooted in financial materiality. The Board encourages firms to forecast how certain sustainability topics may have direct financial implications in the future, even if they do not have so currently. By analyzing future trends, market demands and regulatory landscapes, firms can make informed decisions on what topics are likely to be material in upcoming years (SASB, 2022).
2. The ESRS are drafted by European Financial Reporting Advisory Group (EFRAG) and double materiality is defined as "Double materiality has two dimensions, namely: impact materiality and financial materiality." Impact materiality is defined as "A sustainability matter is material from an impact perspective when it pertains to the undertaking's material actual or potential, positive or negative impacts on people or the environment over the short-, medium- or long-term. Impacts include those connected with the undertaking's own operations and upstream and downstream value chain, including through its products and services, as well as through its business relationships. Business relationships include those in the undertaking's upstream and downstream value chain and are not limited to direct contractual relationships." While financial materiality is defined as "The financial materiality assessment corresponds to the identification of information that is considered material for primary users of general-purpose financial reports in making decisions relating to providing resources to the entity. In particular, information is considered material for primary users of general-purpose financial reports if omitting, misstating or obscuring that information could reasonably be expected to influence decisions that they make on the basis of the undertaking's sustainability statement" (European Commission, 2023). Evaluation of the various definitions of materiality is beyond the scope of this review and has been discussed elsewhere (*see* Abhayawansa, 2022; Clark, 2021; Cooper and Michelon, 2022).

3. Some of the most commonly used terminologies in the literature for sustainability are corporate social responsibility (CSR), environment, social and governance (ESG), non-financial and corporate sustainability.
4. Including UNEP yearbook of sustainability issues, OECD eco labels, a survey on perception of sustainability issues by SustainAbility-GlobeScan, ITC standards map, report on wine sustainability by CEEV, research on sustainability issues of NZ wine industry by NZSD, Deloitte Millennial Survey on perception of society on sustainability, WWTG sustainability matrix and Life cycle assessment of wine making based on the work of Ardente *et al.* (2006).
5. Where "0" if there is no reference to materiality; "1" if a report only states that a materiality principle was followed; "2" if the report includes a brief discussion of what is considered to be material; "3" if the report communicates what material issues emerged from the analysis, i.e. beyond the discussion of what is material; "4" if the process of materiality determination and the results are described in a greater detail; and "5" if the report devotes significant attention to the materiality issue – *which is of course a very subjective judgement*.

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