Sustainability Assurance Quality: Influences and Consequences

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Abstract

This research synthesises literature on sustainability assurance quality and develops a comprehensive framework of sustainability assurance quality indicators. The article begins by examining the definition of audit, sustainability assurance and audit quality. A systematic literature review was conducted, focusing on sustainability assurance quality literature published from 2004 to 2024 and seminal papers from the sustainability reporting and assurance fields. This review formed the basis for developing a framework of sustainability assurance quality indicators and the associated consequences of assurance quality. Finally, ideas for future research were explored. This article contributes to the sustainability assurance literature as one of the first articles to provide a comprehensive sustainability assurance quality framework that includes the consequences of different levels of sustainability assurance quality.

Keywords: sustainability assurance; sustainability assurance quality; sustainability assurance quality indicators; consequences of sustainability assurance quality; sustainability assurance providers.

1 Introduction

The dominant trend in sustainability reporting has been a focus on disclosure rather than sustainability assurance. In the European Union (EU), the Corporate Sustainability Reporting Directive (CSRD) provides enhanced reporting standards for social and environmental information. The standards were effective from January 2023 and require a wider range of large companies and listed small and medium enterprises (SMEs) to report on sustainability information (European Commission [EC], n.d.). The EC plans to implement a limited assurance standard by 1 October 2026 and a reasonable assurance standard by 1 October 2028 (Ramanauskaite et al., 2023). The Treasury of Australia has indicated that large Australian companies will gradually adopt mandatory climate disclosures starting in 2024 (Chartered Accountants Australia and New Zealand [CAANZ], 2023). The Financial Sector Amendment Act 2021 in New Zealand requires large financial institutions to make climate-related disclosures from January 2023, which must be assured independently. This is expected to impact about 200 New Zealand companies (Financial Market Authority [FMA], 2023; Ministry of Business, Innovation & Employment [MBIE], n.d.).

Prior literature has reviewed sustainability assurance, its determinants and consequences, the assurance market, and assurance practice (Cohen & Simnett, 2015; Farooq & de Villiers, 2017; Maroun, 2020; Venter & Eck, 2021). However, there has been limited research that has comprehensively addressed the indicators and consequences of sustainability assurance quality. Cohen and Simnett (2015) suggested a research agenda for Corporate Social Responsibility (CSR) and assurance that highlighted the relevance of measures of audit quality to CSR assurance quality. Farooq and de Villiers (2017) reviewed literature examining the sustainability assurance market from the assurer supply and client demand sides. However, this study did not determine whether the factors identified from the supply and demand sides are related to assurance quality. Maroun (2020) provided a model of CSR

assurance practice, which included determinants, an assurance model and outcomes. However, this CSR assurance practice model was constructed from the reporting entities' point-of-view and only provided a limited discussion of assurance quality in the assurance characteristics section. Venter and Eck (2021) categorised previous research into literature focused on the determinants and consequences of the decision to assure and the choice of the assurance provider. This research provided only a limited analysis of assurance quality, focusing on assurance quality as one of the consequences of the decision on sustainability assurance and the choice of assurance providers (Venter & Eck, 2021).

This article synthesises the literature on sustainability assurance quality to establish a framework that summarises the current understanding of the indicators of sustainability assurance quality and the consequences associated with different levels of assurance quality. Further, we examine opportunities for future research related to the measurement of sustainability assurance quality. To develop our framework, we began with Knechel et al.'s (2013) indicators of audit quality framework. This framework suggests audit quality is influenced by various indicators, which are categorised into four blocks: inputs, process, outcomes and context. This comprehensive framework of audit quality provides a foundation for identifying the indicators of assurance quality. Sustainability assurance and financial reporting auditing share a common underlying nature as they are both attestation engagements. In particular, assurance providers are not directly involved in generating sustainability reports but provide third-party assurance services on the credibility of sustainability reporting. Thus, we argue a framework for auditing quality can be adapted to create a framework of sustainability assurance quality indicators.

There are some differences between sustainability assurance and audit engagements, and this requires the development of novel indicators that influence sustainability assurance quality but do not necessarily apply to audit quality. Audit engagements are carried out within an

intricate ecosystem of stakeholders in the financial reporting environment, where each party plays a critical role (Knechel, 2021). Participants in sustainability assurance are significantly different from those in financial reporting. In financial reporting, the internal participants include internal process owners, management, internal control, internal audit, corporate governance mechanisms and auditors (Knechel, 2024). However, in sustainability reporting, these internal information owners would include staff involved with sustainability issues from marketing, supply chain, product, operations or human resource departments. Accordingly, the sustainability information they produce and the corresponding reporting processes differ significantly from financial reporting. Internal control systems need to be able to generate reliable reporting information for users. Internal auditors might engage in new tasks in this scenario. The board members, audit committee members and managers are expected to take on new responsibilities. In addition, some companies have established sustainability committees to oversee these matters. Furthermore, the corporate governance structures may also involve some adjustments to support accurate reporting and regulatory compliance.

External participants in sustainability reporting differ from those concerned with financial reporting. Investors and creditors interested in sustainability information often represent only a subset of shareholders or debt owners, typically those engaged in sustainable investing. There are also users who are interested in sustainability but not in the financial report. Moreover, the standards and regulations governing sustainability reporting and assurance are developed by various bodies with differing objectives and principles, resulting in the reporting entities' use of multiple reporting guidelines and assurance standards globally. This differs from the standardised nature of financial reporting and auditing. Additionally, stakeholders such as customers and suppliers may demand sustainability information tailored to their specific needs, while non-government organisations (NGOs) and political or

environmental activists often pressure companies to disclose and assure sustainability information in various subject matters. Lastly, external assurance providers who interact with all the external and internal stakeholders are critical in the sustainability reporting ecosystem. In most countries, sustainability assurance providers include accounting firms, specialist consultants, certification bodies, business and engineering consultants, individuals, government bodies and agencies, and NGOs (CorporateRegister, 2008). The competition between accounting and non-accounting assurance providers has shaped the market for sustainability assurance (Boiral et al., 2019; Farooq & de Villiers, 2018). Sustainability assurers are adopting different assurance standards, such as ISAE 3000, ISAE3410, AA1000AS and ISO 14064-3 (Boiral et al., 2019a; Farooq & de Villiers, 2018; Zhou, 2022) with different ethics requirements imposed by different professional bodies. These differences create potential differences in the assurance quality provided. Given these distinctions, examining the influences and consequences of sustainability assurance quality within this sustainability reporting ecosystem is essential.

In this research, we systematically reviewed papers on sustainability assurance quality published in academic journals from 2004 to 2024 with A*, A and B ratings in the Australian Business Deans Council Journal Quality List (2022). The review followed the guidelines and checklist of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). After rounds of search and selection, 91 papers were included in our review.

Based on the literature review, indicators related to sustainability assurance quality were organised into four categories: inputs, process, outputs, and context, based on the approach of Knechel et al. (2013). Additionally, sustainability performance, financial performance, and other consequences associated with levels of assurance quality were grouped into a new category termed consequences.

Our review found in the input category, subject matter expertise, audit expertise, industry specialisation, adherence to ethical and independence standards, and professional scepticism are all essential. Similarly, various inputs from clients are also important. We found company characteristics (size, profitability, leverage ratio), corporate governance characteristics (size, diversity, independence, expertise), and management or board member incentives (sustainability-related compensation schemes) impact sustainability assurance quality, but the results are mixed. In addition, assurer and client inputs interact and can influence other categories. In the process category, the level of stakeholder engagement, judgment bias occurring in multidisciplinary teams, materiality assessment and assurance provider-client negotiations are important. Stakeholder engagement is a practical channel to reduce the audit expectation gap and improve perceived assurance quality by stakeholders. Academic research argues that stakeholder engagement is critical, but this is not reflected in every assurance standard and is not consistently implemented in practice. The output category includes sustainability reporting, restatements of sustainability reports and annual financial reports with sustainability information. These output reports all need more investigation regarding their associations with other assurance quality indicators and their consequences. The context category simultaneously influences both the inputs and process categories. It includes audit fees, non-audit fees, assurance fees, assurance firms' size, reputation, assurance providers' tenure, regulation and the ecosystem of sustainability reporting. Research has found consequences can be associated with sustainability assurance quality, including sustainability performance-related consequences and financial performance-related consequences. In addition, these consequences may have a two-way association with the level of sustainability assurance quality.

This research contributes to the literature on sustainability assurance quality by, first, developing a comprehensive framework of indicators grouped into four categories of

assurance quality, together with a new fifth category identifying the consequences of different levels of assurance quality. This framework synthesises existing literature on sustainability assurance quality and identifies the critical indicators influential to assurance quality. The framework also separates the outcomes category from Knechel et al. (2013) into outputs and consequences. Second, this research contributes to the literature on the measurements of sustainability assurance quality. We summarise existing measurements of sustainability assurance quality according to the indicators in our framework. For different types of sustainability reporting, relevant measures are identified, discussed and compared. To our knowledge, this is one of the first articles that compares different measurements of sustainability assurance quality and summarises the characteristics, strengths, and weaknesses of various inputs and outputs measurements. Third, this research contributes to the literature by identifying potential future research avenues for academics. The indicators of assurance quality and the various consequences will interest regulators, standard setters, sustainability reporting and assurance reporting users and academics.

The remainder of the article is structured as follows. The next section examines the literature on auditing, audit quality and sustainability assurance. Section 3 explains the research methodology. Our framework and findings are presented in Section 4 based on our synthesis of the sustainability assurance quality research. Section 5 contains a discussion and future research avenues. Section 6 concludes the article.

2 Literature Review

Before delving into the discussion on sustainability assurance quality, we first discuss the connections of audit and sustainability assurance, the definition of audit quality and the development of the audit quality framework to the sustainability assurance quality framework.

2.1 Financial Reporting Audit and Sustainability Assurance

Financial reporting audit and sustainability assurance are closely connected but different types of assurance engagement. An audit engagement is a reasonable assurance engagement performed by a professional accountant in public practice that involves providing an opinion on whether the financial statements have been prepared, in all material aspects in compliance with the relevant financial reporting framework (IESBA, 2023). Sustainability assurance is defined by ISSA 5000 (IAASB, 2024, p.10) as: "An engagement in which a practitioner aims to obtain sufficient appropriate evidence in order to express a conclusion designed to enhance the degree of confidence of the intended users about the sustainability information. Each assurance engagement is either a reasonable assurance engagement… or a limited assurance engagement…" From the International Federation of Accountants (IFAC) standards definition, we know assurance engagement is the overarching activity that contains attestation and direct engagement, with reasonable and limited assurance levels (Knechel et al., 2007). Accordingly, we plot the locations of audit and sustainability assurance in assurance dimensions in Figure 1.

(Insert Figure 1)

Figure 1 shows that assurance dimensions contain four quadrants. Financial reporting audit, as a type of attestation engagement with a reasonable assurance level, is allocated in the top right quadrant of the assurance dimensions. Sustainability assurance, also as an attestation engagement but with either a reasonable or limited assurance level, is across two quadrants and located in the right quadrants of the assurance dimensions.

Sustainability assurance engagement is different from audit engagement in three key points. First, the assurance level is different. In audit engagement, the assurance level is all at a reasonable level, while in sustainability assurance engagement, the assurance level can be at

either a reasonable or a limited level. Second, the subject matter information asserted by management is different. One is financial reporting, and the other is various sustainability matters, including climate-related information, GHG emissions, corporate social responsibility, biodiversity, modern slavery and other environmental or social information. Third, in most countries, sustainability assurance can be conducted by professionals from various backgrounds, whereas financial reporting assurance is restricted to auditors.

2.2 Auditing Quality and Sustainability Assurance Quality

Although auditing quality has been extensively discussed in the literature, we do not have an agreed definition of it. One well-cited definition is by DeAngelo (1981, p. 186), that "[t]he quality of audit services is defined to be the market-assessed joint probability that a given auditor will both (a) discover a breach in the client's accounting system, and (b) report the breach". These two components of audit quality are developed into two desired attributes of auditors: they should have the competence to discover misstatements and be independent in reporting them (Watkins et al., 2004). However, this definition did not consider other components that might influence audit quality. In a seminal paper by DeFond and Zhang (2014), the authors defined audit quality in relation to financial statement quality. They argued a higher level of audit quality is a "greater assurance that the financial statements faithfully reflect the firm's underlying economics, conditioned on its financial reporting system and innate characteristics" (DeFond & Zhang, 2014, p. 281). They suggested an audit quality framework where audit quality is contingent on the audit supply and client demand, and both are influenced by regulatory intervention. In the audit supply and client demand, the key influential factors are divided into incentives and competencies. However, this framework did not consider the auditing process involved after both clients' and auditors' inputs, which will also influence the auditing quality.

Knechel et al. (2013) presented a framework for auditing quality, which identified various indicators of audit quality. In this framework, four categories of indicators related to audit quality are inputs, process, outcomes, and context. Among the inputs, professional scepticism, knowledge and expertise, and auditor judgement can improve audit quality, while pressures or retention will reduce quality. Process is a novel and critical component of this framework. This category contains audit judgement, production, risk assessments, analytical procedures, audit-client negotiations and controls. Audit inputs influence the audit process. The outcomes are influenced by the process and contain both negative and positive outcomes. For example, negative outcomes are restatements and litigation, and lacking these adverse outcomes is regarded as high quality. On the other hand, positive outcomes are issuing going concern opinions and adopting accounting conservatism. These are proxies for high auditing quality. The context category simultaneously influences both inputs and process. It contains audit partner compensation, abnormal audit fees, non-audit fees, audit fee premiums, auditor tenure and market perceptions of audit quality. This is a comprehensive framework to discuss the indicators involved in audit quality, though it lacks the indicators related to audit quality from clients' input.

Considering the connections and differences between audit and sustainability assurance, we suggest Knechel et al. (2013) indicators of audit quality framework can be a suitable starting point for discussing sustainability assurance quality.

2.3 Sustainability Assurance and Sustainability Assurance Quality

Sustainability assurance has been relatively well-discussed in the literature compared with sustainability assurance quality. To explore the indicators and consequences of sustainability assurance quality, we start with sustainability assurance research, which provides insights on factors related to assurance quality. Most studies in sustainability assurance literature have focused on the determinants and consequences of assurance, and the choice of assurance

providers (Casey & Grenier, 2015; Clarkson et al., 2019; Peters & Romi, 2015; Simnett et al., 2009; Zhou et al., 2016). A study by Hay et al. (2023) shows that previous studies regarding the determinants of assurance and choice of assurance providers are very inconsistent and have mixed results. The authors explained the weak evidence arose because overall results were dispersed, and the measurements of the variables in the studies were inconsistent. Also, it could be the case that no strong, consistent relationships have been established yet. Thus, the association between these company-level, industry-level and country-level characteristics and sustainability assurance quality, and the association between sustainability assurance quality and its related consequences, need further investigation.

3 Methodology and Sample Selection

We systematically reviewed papers on sustainability assurance quality published in academic journals from 2004 to 2024 with A*, A and B ratings in the Australian Business Deans Council Journal Quality List (2022). The review followed the guidelines and checklist of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). We identified relevant articles from the Web of Science and Business Premium databases and Google Scholar. Keywords were used to search for literature on sustainability assurance quality, CSR assurance quality, ESG assurance quality, social and environmental assurance quality, environmental assurance quality, greenhouse gas or GHG assurance quality, and climate disclosure assurance quality. The eligibility criteria for the review of papers on the research topic are shown in Table 1.

(Insert Table 1)

In the first round word searching, WoS and EBSCO returned 1,416 articles. However, after a manual keyword matching, those not relevant to sustainability assurance, e.g. quality assurance and accounting education, were excluded. At the same time, articles from C-level

journals were also excluded. This left 53 articles from A* journals, 115 articles from A journals and 79 articles from B journals. After reading the abstract and main findings of the papers, 128 articles were excluded, leaving 17 articles from A*, 25 articles from A and 6 articles from B journals. For each important indicator of assurance quality identified in the search, we also used the indicators and consequences as a keyword, combined with sustainability assurance quality, to search for further relevant articles. Another 44 articles are added, including 20 articles from A*, 14 articles from A, 6 articles from the B journal and 3 working papers. Overall, there are 91 papers included in the review. The flow diagram of identifying, screening and including articles is presented in Figure 2.

(Insert Figure 2)

The number of studies reviewed by year and journal rating is presented in Table 2. It shows the publication regarding sustainability assurance quality is increasing significantly from 2015 with seven papers in A* level journals that year, and reaching a peak in 2019 with 11 papers published in high quality journals. After that, the number of published papers per year slightly decreases and remains stable at around seven article per year.

(Insert Table 2)

During the selection period, our reviewed articles also include papers that discuss the sustainability reporting quality for those reports that are assured. DeFond and Zhang (2014, p. 282) suggested "…financial reporting quality (FRQ) is a function of audit quality (AQ), the quality of the firm's financial reporting system (R) and its innate characteristics (I)." We argue that in sustainability assurance, the relationship between assurance quality and sustainability reporting quality is similar to that in auditing, which means sustainability reporting quality (SRQ) is also a function of sustainability assurance quality (SAQ), the quality of the sustainability information reporting system (SIRS) and its innate characteristics

(IC). However, as most sustainability reporting is currently subject to voluntary assurance, not all reports are assured. Therefore, our review only includes studies that look at sustainability reporting quality and focus on reports that have been assured.

4 Findings

The framework for indicators of sustainability assurance quality and the consequences of levels of sustainability assurance quality developed based on our review of the literature. The indicators are organised into four categories: inputs, process, outputs, and context, based on the approach of Knechel et al., (2013). The consequences block is an innovation introduced in this framework based on our analysis. It contains sustainability performance, finance and market performance, and other consequences associated with the level of sustainability assurance quality. The framework is presented in Figure 3. Increasing the quality of one category will improve the quality in the following category, which follows the direction of the arrows. We will discuss each category of assurance quality and the consequences accordingly in the following sections.

(Insert Figure 3)

4.1 Inputs

In the inputs category, indicators are classified into two groups: assurance providers' inputs and clients' inputs. They include competence, characteristics and incentives from the related parties.

4.1.1 Assurance Providers' Inputs

Literature and assurance standards suggest many attributes that assurance providers should have when conducting sustainability assurance. Knechel et al. (2006) executed a survey that identified some key attributes demanded by clients when they judge the suitability of assurance providers. The attributes include confidentiality, expertise, professional reputation,

independence, objectivity, integrity and costliness. ISSA 5000 (IAASB, 2024) outlines the following competence and capabilities that should be possessed by an engagement team, which include experience in sustainability assurance, understanding of professional and legal requirements, expertise in sustainability matters and IT tools, the ability to exercise professional scepticism and judgement, understanding firm procedure and knowledge of the relevant industry. Among the attributes discussed in the literature, we suggest the critical inputs from assurance providers include subject matter expertise, audit expertise, industry specialisation, fundamental principles of ethics and independence, and professional scepticism.

Subject Matter Expertise

Both assurance standards and existing research agree that subject matter expertise is critical in sustainability assurance. ISSA 5000 (IAASB, 2024) stated that sustainability assurance engagements may involve a wide range of sustainability matters, and performing the assurance requires specialised skills and knowledge that might need support from internal or external experts. Specifically, according to ISAE 3410 (IAASB, 2012), in GHG assurance engagement, subject matter and technical expertise such as engineering and environmental science are required for the need to estimate the scientific uncertainties in the measurement and reporting of GHG, which is related to the material issues in the report. Previous literature points out that auditors should have the knowledge required to make the new assurance subject auditable (Power, 1996, 1999) and subject matter is a key element in sustainability assurance (Wallage, 2000). Specifically, when Big 4 firms extend their auditing services to sustainability assurance, which is a practice that applies auditing to a new subject matter (O'Dwyer, 2011). However, interview results showed that from sustainability assurance providers' perspectives, only 50% of the interviewees think subject matter expertise is required for assurance providers (Boiral et al., 2020). Thus, the extent of the subject matter

comprehension by the assurance providers is crucial, and research has tried to further investigate the association between subject matter expertise and assurance quality.

Existing research investigating the association between subject matter expertise and assurance quality mainly uses professions to proxy for subject matter expertise. Some research groups accounting companies and consultant companies, or accounting, consulting and certification bodies as professional assurance providers compared to other non-professional assurance providers (e.g. NGOs and academic organisations), and they find these professional providers are associated with higher sustainability assurance quality (Dalla Via & Perego, 2020; Hummel et al., 2019; Perego & Kolk, 2012; Zorio et al., 2013). Other studies comparing Big 4 accounting firms with other assurance providers have yielded mixed results. Some research has found that Big 4 firms provide the highest sustainability assurance quality, followed by non-Big 4 accounting firms and then non-accounting firms (Al-Shaer & Zaman, 2016, 2018), while others find lower quality in assurance reports issued by Big 4 firms (Rossi & Tarquinio, 2017). Moreover, some research suggests that accountants use less diverse assurance methods, and their average assurance report quality scores are lower than non-accounting providers in the U.K. and Germany (Gürtürk & Hahn, 2016). Meanwhile, non-accounting assurance providers, such as engineering consultancies or certification bodies, distinguish themselves through their professional affiliations. These affiliations serve as an endorsement of their knowledge and expertise in specific subject matters (Channuntapipat et al., 2020). It is not clear which profession has more subject matter expertise and is provided with higher sustainability assurance quality.

Audit Expertise

Another competence worth further investigation in relation to assurance quality is audit expertise. This expertise is only possessed by accounting assurance providers. The association between audit expertise and sustainability assurance quality are rooted in a

spillover effect view. When the assurance provider is also the auditor of the company, they might generate extensive information about the company and have knowledge of the spillover effect when engaging in sustainability assurance (O'Dwyer, 2011; Ruiz-Barbadillo & Martínez-Ferrero, 2020). It has been documented that companies assured by accounting firms that also audited their financial statements are associated with better assurance quality, and this association was enhanced when the assurers have industry specialisation (Ruiz-Barbadillo & Martínez-Ferrero, 2020).

Research studies suggest that integrated reporting (IR) audit expertise might be associated with sustainability assurance quality. It has been found that among the top 100 companies in South Africa, those with combined assurance (CA) approaches are associated with less information asymmetry (Zhou et al., 2019). Some non-accounting assurers were concerned that accounting practitioners might take the market share of integrated reporting assurance from them, as they thought they lacked competitive advantages in assuring these reports (Channuntapipat et al., 2020). Integrated reporting audit expertise appears to influence assurance quality. However, further research is necessary to substantiate this relationship.

Industry Specialisation

Some research studies suggest that, similar to auditing quality, the industry specialisation of assurance providers is related to sustainability assurance quality. Fernandez-Feijoo et al. (2016) initially analyse the various industry specialisations and country dominance among accounting assurance companies. A global study with a sample of 242 companies (disclose and assure sustainability reports) from 2007 to 2014 has found that the assurance provider's industry specialisation is positively associated with sustainability assurance quality (Martínez-Ferrero et al., 2018). This association was stronger when the providers were accounting firms. Martínez-Ferrero and García-Sánchez (2018) also find that industry specialisation is associated with an increased likelihood of offering a limited or moderate

level of assurance. Pham et al. (2024) examine the climate-related expertise of accounting assurance providers and find that auditor partners who have expertise in climate-related issues are associated with higher-quality climate risk disclosures. In addition, industry specialisation enhances the association between subject matter expertise and disclosure quality (Pham et al., 2024). In these studies, industry specialisation is measured by the market share of the assurance providers' clients in an industry or the number of clients within an industry that a provider has (Martínez-Ferrero et al., 2018; Martínez-Ferrero & García-Sánchez, 2018; Pham et al., 2024).

Fundamental Principles of Ethics and Independence

The accounting profession is governed by ethical principles, but other assurance providers from different professions may not work under the fundamental principles of ethics. ISAE 3000 and ISSA 5000 suggest that non-accounting background assurance providers can adopt these assurance standards when they conduct assurance. Though the International Code of Ethics for Professional Accountants are now applicable to assurance providers beyond accountants, IAASB does not have the legal authority to require other professions to obey the obligations suggested in the IESBA codes.

Limited research has investigated the ethics of assurance providers in relation to sustainability assurance quality. Green and Taylor (2013) conduct a survey and find ethics is the top factor perceived by all stakeholders that relates to better assurance quality. Through content analysis, Boiral and Heras-Saizarbitoria (2020) find that most sustainability assurance reports failed to address the independence of assurance providers and conflict of interest, let alone the absence of a commercial relationship with the clients. The authors argue that assurance engagements inherently involve commercial relationships, which should be explicitly explained in the assurance report. Because commercial contracts between assurance providers and clients may influence the auditors' independence (Boiral et al., 2019b). Though

most assurance statements mention they comply with the principle of independence associated with AA1000AS or ISAE 3000, the percentage of reports that address specific codes of ethics, e.g. IFAC codes of ethics or in-house codes of ethics, is still lower than 30% (Boiral & Heras-Saizarbitoria, 2020). In addition, the evolving nature of sustainability assurance requires assurance providers to pursue long-term relationships with clients, which might increase the risk of losing independence (Boiral et al., 2019b). However, some assurance providers think the long-term relationship increased familiarity, which is perceived as a signal for their successful achievements in assurance services (Boiral & Heras-Saizarbitoria, 2020).

Professional Scepticism

Both sustainability assurance standards and literature agree on the importance of professional scepticism regarding assurance quality, but existing literature lacks evidence of its influence on assurance quality. ISSA 5000 (2024) states professional scepticism involves being vigilant to inconsistencies in the evidence, doubts about the reliability of the information, indications for additional procedures beyond ISSA 5000 requirements, and conditions pointing to potential misstatement or fraud. Huggins et al. (2011) suggest higher levels of professional scepticism are required where the GHG statement will unavoidably influence the financial statement auditing. Another study has found evidence in assurance statements indicating that certain assurance providers do employ professional scepticism in the assurance practice (Boiral et al., 2019a).

The measurements of assurance providers' inputs are summarised in Appendix II Table 1.

4.1.2 Client Inputs

Client inputs are discussed in three aspects: company characteristics, corporate governance characteristics and incentives for the management and board members.

Company Characteristics

Existing literature mainly examines the association between company-level or industry-level characteristics and the decision of assurance or the choice of assurance providers (Casey & Grenier, 2015; Clarkson et al., 2019; Gipper et al., 2024; Peters & Romi, 2015; Simnett et al., 2009; Zhou et al., 2016). They suggest that assurance can enhance the reporting credibility, and some company characteristics may influence their requirement for high quality assurance services.

In company-level determinants, size is found to be positively associated with the likelihood of having sustainability reports assured either in global sample research (Simnett et al., 2009; Zhou et al., 2016), or in the U.S. sample study (Casey & Grenier, 2015). However, other determinants' influences are mixed. Profitability is found to have no association with sustainability reports assurance (Casey & Grenier, 2015; Simnett et al., 2009), while another research study focuses on the assurance of GHG information, revealing a positive association between them (Zhou et al., 2016). Similarly, the leverage ratio is found to have no association with the likelihood of assurance using global samples (Simnett et al., 2009; Zhou et al., 2016). However, among the U.S. companies, a negative association between leverage ratio and assurance is documented (Casey & Grenier, 2015). Thus, the influence of profitability and leverage on the decision of whether to have assurance is unclear. Other company-level characteristics, such as high CSR commitment, CSR strengths, CSR concerns, global presence and high customer awareness, are found to be positively associated with the likelihood of assurance (Casey & Grenier, 2015; Clarkson et al., 2019).

The association between industry-level determinants (e.g. environment-sensitive industries) and decisions on sustainability reports assurance seem to be constrained by the country context. Simnett et al. (2009) find that mining, utilities and finance industries are more likely to have their sustainability reports assured globally. In Portugal, utilities and finance

industries are more likely to have their reports assured, and companies in technology and telecommunications are also found to have a higher likelihood of assurance (Branco et al., 2014). However, in the U.S. context, finance and utility industries are not associated with having sustainability reports assured (Casey & Grenier, 2015). The authors assert it is because the regulatory governance in the U.S. is more stringent and that the oversight of regulation substitutes for independent assurance in enhancing the credibility of sustainability reports. The country-level determinants, such as stakeholder-oriented countries and strong legal systems, are associated with the decision to have sustainability reports assured (Simnett et al., 2009), while it is suggested that company-level determinants, such as corporate governance (Zhou et al., 2016), or some industry-level peer pressure (Gipper et al., 2024) may interact with the country-level determinants of the demand for assurance.

Similar associations are found between these levels of determinants and the choice of assurance providers. Some find that high-leverage companies tend to engage with non-accounting assurance providers globally (Simnett et al., 2009), and specifically in the U.S., highly leveraged companies are not associated with assurance providers from accounting firms (Casey & Grenier, 2015). Some research find that companies with large assets, low leverage, high CSR commitment, and location in stakeholder-oriented countries are more likely to select accounting firms as assurance providers (Al-Shaer & Zaman, 2018; Clarkson et al., 2019; Simnett et al., 2009). But in the U.S. context, the association between company size and choice of accounting firms as assurance providers no longer hold (Casey & Grenier, 2015), and also in the U.S. context, CSO experts prefer engaging with consultants over internal assurers (Peters & Romi, 2015). Though the choice of assurance providers can be in some extent treated as different levels of assurance quality, the association between the characteristics of the companies and the assurance quality could be further explored.

Corporate Governance Characteristics

Existing literature explores the relationship between the characteristics of corporate governance and assurance quality, resulting in various findings.

Size

Several research studies find that board size is positively associated with the decision of assurance (Al-Shaer & Zaman, 2018; Liao et al., 2018; Peter & Romi, 2015). Additionally, some studies support a positive association between board size and the likelihood of choosing Big 4 firms as assurance providers (Al-Shaer & Zaman, 2018; Alsahali et al., 2024). Moreover, research also indicates that board size is associated with more assurance standards referenced in assurance reports (Al-Shaer & Zaman, 2018). However, another study finds no significant association between board size and sustainability reporting quality, though this finding may be limited by the use of a single-year data sample (Amran et al., 2014).

One study finds that audit committee (AC) size is associated with assurance quality (Raimo et al., 2021), while others do not find associations between audit committee size and the decision of assurance, assurance quality or sustainability reporting quality (Al-Shaer & Zaman, 2018; Haji & Anifowose, 2016; Peter & Romi, 2015; Zaman et al., 2021).

Diversity

Some research studies find a higher proportion of female directors is associated with both the likelihood of having sustainability reports assured and the choice of accounting background assurance providers (Alsahali et al., 2024; Liao et al., 2018). However, regarding assurance quality, the role of diversity is mixed. With UK FTSE 350 companies, a study reveals that board gender diversity and sustainability report quality are positively associated, and this association is more enhanced with female independent directors (Al-Shaer & Zaman, 2016). However, with sample companies from Asia-Pacific countries, a study documents that gender

diversity in the board of directors (BOD) is not significantly associated with sustainability reporting quality (Amran et al., 2014).

Independence

Some research supports the association between board independence and assurance in stakeholder-oriented countries (Martínez-Ferrero & García-Sánchez, 2017), while in shareholder-oriented countries, e.g. the U.S., this association does not exist (Peter & Romi, 2015). In addition, the separation of the CEO and chair of the BOD is associated with the likelihood of having sustainability reports assured (Liao et al., 2018). Furthermore, independent directors are also more likely to choose the accounting profession as assurance providers (Martínez-Ferrero & García-Sánchez, 2017), and CEO separation influences the choice of assurance providers (Alsahali et al., 2024). However, another study indicates that independence of BOD is not significantly associated with sustainability reporting quality in Asia-Pacific countries (Amran et al., 2014).

Regarding the independence of audit committee, most studies agree it is positively associated with sustainability reporting quality or assurance quality (Al-Shaer & Zaman, 2018; Appuhami & Tashakor, 2017; Raimo et al., 2021; Zaman et al., 2021), while one study in South Africa context suggests that independence of audit committee has no association with integrated reporting quality (Haji & Anifowose, 2016).

Expertise

Research on whether financial expertise is associated with sustainability reporting quality has not had aligned results. Most research studies do not find evidence between the financial expertise of audit committee members and sustainability reporting quality (Appuhami & Tashakor, 2017; Haji & Anifowose, 2016; Raimo et al., 2021), while one study has found finance expertise increase reporting credibility (Al-Shaer & Zaman, 2018). Additionally,

Zaman et al. (2021) find that the industry expertise of audit committee members is associated with assurance quality.

Investigations on the role of sustainability expertise are limited. Some studies document that when the environmental committee members possess sustainability expertise, the companies tend to have their sustainability reporting assured, are more likely to select accounting providers as their assurors (Peters & Romi, 2015), and disclose more items in the sustainability assurance reports (Rossi & Tarquinio, 2017). Other studies reveal that the existence of a CSR committee is positively associated with both sustainability reporting quality (Amran et al., 2014) and the quality of sustainability assurance reports (Rossi & Tarquinio, 2017).

Other Corporate Governance Characteristics

Existing research studies also explore other characteristics of corporate governance in association with sustainability assurance quality. They find the frequency of BOD meetings influences the choice of assurance providers (Alsahali et al., 2024). In addition, the meeting frequency of AC are positively associated with both integrated reporting and CSR disclosure quality (Al-Shaer & Zaman, 2018; Appuhami & Tashakor, 2017; Haji & Anifowose, 2016), and the higher meeting participation ratio of the AC members is associated with assurance quality improvement (Zaman et al., 2021). A study further examines the overall AC effectiveness, AC authority, and finds they all have positive influences on integrated reporting quality (Haji & Anifowose, 2016). Some researchers quantify composite variables which measure the quality of the BOD and the quality of AC, and find that quality of BOD is positively associated with integrated reporting quality but not assurance quality, while the quality of AC is not associated with integrated reporting quality but it influences the assurance quality (Wang et al., 2020).

Some research studies further investigate the association between executive positions and sustainability assurance quality. The Chief Sustainability Officer (CSO) is positively associated with having sustainability reports assured (Peters & Romi, 2015; Thun & Zulch, 2022), and such association is more salient when the officer has subject matter expertise (Peters & Romi, 2015). However, in another study, such an association fails to build (Rossi & Tarquinio, 2017). Regarding the role of other executives, one study reveals that when the Chief Financial Officer (CFO) takes the responsibility of CSO, more quantity of information is disclosed in sustainability reporting, while if the CEO takes this position, such an association no longer exists (Thun & Zulch, 2022). Researchers also find that a CFO's foreign study or work experience and professional experience in accounting-related work are associated with the assurance of sustainability reporting (Khalid et al., 2022).

Some literature examines the interaction effects between various corporate governance committees. One study suggests AC has incremental effects on the assurance credibility, as it shows interaction effects with the sustainability committee in terms of reporting credibility (Al-Shaer & Zaman, 2018), while another study suggested that the audit committee plays a substitution role on CSR committees on the decision of CSR reporting assurance (Uyar et al., 2023).

Some literature suggests that the degree of involvement of the internal audit function (IAF) staff may influence sustainability assurance quality. Because IAF staffs have advantages in familiarity with the business (Engelbrecht et al., 2018), and they have the potential to improve the integrated reporting as internal auditors may help check the accuracy of the data, assess risks, support corporate control and risk management, and provide internal assurance (Ackers, 2016; Engelbrecht et al., 2018). A survey study finds that the quantity of issues reported in sustainability reporting is positively associated with the degree of internal audit involvement in sustainability assurance (Soh & Martinov-Bennie, 2018). In addition, the

longer existence of IAF is positively associated with involvement in social issues, while an immature IAF is positively associated with environmental issues (Soh & Martinov-Bennie, 2018). However, the working results of these internal auditors are not observable to external stakeholders, and some internal auditors might lack the skills to provide internal assurance on sustainability matters (Engelbrecht et al., 2018). Another study finds no association between the internal audit function and assurance quality (Rossi & Tarquinio, 2017).

Incentive for the Management and Board Members

A study covering Fortune Global 500 ranking companies shows that the occurrence of incentives related to sustainability performance in executive compensation schemes is positively associated with assurance quality (Dalla Via & Perego, 2020). However, they did not examine other incentives of the executives, such as age, tenure or power. Khoo et al. (2022) find some reputation incentives from the BOD in terms of having sustainability reports assured. We suggest incentives from Chief Sustainability Officers (CSO), Chief Finance Officers (CFO), board members, and company owners in terms of pursuing higher assurance quality also need more investigation.

The measurements of client inputs are summarised in Appendix II Table 2 (untabulated).

4.1.3 Summary

In the inputs category, indicators as subject matter expertise, audit expertise, industry specialisation, size of companies and corporate governance have some empirical evidence supporting their critical influence on assurance quality. But which professions of assurance providers have more subject matter expertise is unclear. Meanwhile, other factors, such as fundamental principles of ethics, professional scepticism, companies' profitability, leverage ratio, industry, corporate governance committee members' diversity, independence, expertise and degree of involvement, are recognised as influential on assurance quality with mixed

results, which require further investigation to establish empirical evidence. Of note, assurance providers' inputs and clients' inputs may have an interactive effect on sustainability assurance quality.

4.2 Process

Several elements in the process category have been identified in the literature as critical to assurance quality. They are stakeholder engagement, multidisciplinary teams, materiality, and assurance provider-client negotiation.

4.2.1 Stakeholder Engagement

The literature has suggested that increasing stakeholder engagement in the assurance process is beneficial to enhance the completeness and credibility of sustainability reports and assurance (Bellucci et al., 2019; Edgley et al., 2010; Xiao & Shailer, 2022). Adams and Evans (2004) argue that to reach the above aim, the scope of assurance, the appointment of assurance providers, and the examination of the independence of the providers should all be determined by stakeholders. Assurance providers see stakeholder engagement as critical in the assurance process, as the accountant assurers believe it will enhance reporting quality (Edgley et al., 2010). Similarly, consultant assurers underscore the benefits of improving credibility and trust with stakeholders (Edgley et al., 2010). Interviews conducted with sustainability officers highlight the importance of building strong collaborations with stakeholders to achieve desired sustainability reporting outcomes (Bellucci et al., 2019). However, conflicts of interest and opposing perspectives from different stakeholder groups may result in lower assurance levels (Adams & Evans, 2004; Bellucci et al., 2019; Edgley et al., 2010). The process of stakeholder engagement is a dialogue that companies need to engage in to collect different perspectives from stakeholders (Bellucci et al., 2019), but this

diversity of opinion may act as an obstacle to stakeholder inclusivity (Edgley et al., 2010). It seems still unclear whether the benefits of stakeholder engagement outweigh its weaknesses.

Stakeholder engagement is not a principle in all assurance standards and reporting guidelines reviewed. AA1000AS is a stakeholder-oriented standard, and its three main principles emphasise determining material issues with stakeholder engagement, including stakeholders during the assurance process and responding to stakeholders' concerns (Bepari & Mollik, 2016). However, ISSA 5000 mainly focus on investors and such a principle is not included. One of GRI's principles of the content of reports is stakeholder inclusiveness and responsiveness (Boiral et al., 2019a), but such a principle is not found in TCFD guidelines.

In some circumstances, assurance providers have been found to indirectly or directly participate in stakeholder engagement activities (Edgley et al., 2010). Some sustainability assurance providers have proactively welcomed a "stakeholder panel" to be involved in the assurance process (O'Dwyer, 2011). However, studies examining the extent of stakeholder engagement in sustainability assurance reports find that, through the years, assurance reports seldom address stakeholders. This has resulted in the scope, assurance levels and materiality issues being mostly determined by management (Bepari & Mollik, 2016; O'Dwyer & Owen, 2007). A global study on assurance reports for the mining and energy industries found no evidence of the potential involvement of stakeholders in the assurance process of sustainability reports (Boiral et al., 2019a).

4.2.2 Multidisciplinary Teams

The composition of a multidisciplinary team may influence the process of sustainability assurance (Boiral & Heras-Saizarbitoria, 2020; Ekasingh et al., 2019; Huggins et al., 2011; Kim et al., 2016). ISSA5000 (2024) recognises that sustainability assurance engagements cover various sustainability matters demanding specialised skills that are beyond the range of

knowledge that most practitioners possess. Accordingly, experts, either internal or external, are often required to be involved to support the engagement team in specific areas. While assurance providers value multidisciplinary teams and independent experts for high-quality assurance, preparers prefer in-house capabilities (Green & Taylor, 2013). Despite their importance, less than 25% of A+ GRI assurance statements (2006–2015) mentioned such teams, though their presence has increased over time (Boiral & Heras-Saizarbitoria, 2020). Multidisciplinary teams' professional judgement can be influenced by members' backgrounds; for example, biases may arise between science and accounting professionals (Kim et al., 2016). In Australia, educational diversity within teams has been found to be linked to better information elaboration and team effectiveness (Ekasingh et al., 2019). Typically, GHG assurance teams in an accounting firm include accounting leaders and members from environmental, engineering, and accounting fields (Huggins et al., 2011). However, broader team compositions in other organisations remain underexplored because such information is not transparently released in assurance statements (Boiral & Heras-Saizarbitoria, 2020). In addition, the expertise and the extent of expertise these members have are also ambiguous (Boiral & Heras-Saizarbitoria, 2020).

4.2.3 Materiality

Materiality is crucial to assurance quality as it guides the audit process by ensuring sustainability reports address key company impacts and stakeholder concerns (Boiral et al., 2019a). Interviews show different opinions between accounting and consulting background assurance providers when they define a materiality level in sustainability assurance (O'Dwyer, 2011). However, there is no further investigation into the difference in their approaches in determining materiality level and what influence it has on the assurance process and overall assurance quality. Some researchers suggest that the determination of materiality issues and levels should consider stakeholders' concerns (Bepari & Mollik, 2016).

However, the assessment methods for materiality are often unclear in assurance statements, and failure to assess properly may undermine credibility and risk greenwashing (Boiral et al., 2019a). Another issue in this field is double-materiality, in which audit procedures can be met with obstacles as well as potential benefits (Appelbaum et al., 2024).

4.2.4 Assurance Provider-Client Negotiation

The relationship between assurance providers and clients is a crucial topic. In the inputs category, when discussing the independence of assurance providers, one concern is that the interaction between assurance providers and clients may influence assurance providers' independence. In the assurance process, many negotiations occur. Several research studies find that there is managerial capture in the assurance process (Ball et al., 2000; Boiral et al., 2019b; Farroq & deVelliers, 2019; Hummel et al., 2017). Specifically, the commercial pressures influence the engagement contracts negotiation and lead to assurance providers compromising the quality of assurance to satisfy clients and competing with other assurance providers with low assurance fees (Boiral et al., 2019b). Researchers also suggest that the verification process is symbolic. Because the information provided by clients is filtered with good news in the voluntary reporting context (Boiral et al., 2019b). How assurance providers obtain balanced information and make a holistic evaluation of it depends on the negotiation ability of the assurance providers when they interact with clients.

4.2.5 Summary

We note stakeholder engagement has been discussed widely in the sustainability assurance scenario, though not extensively employed in practice. Other indicators, such as multidisciplinary teams, materiality, and assurance provider-client negotiation, require further investigation. The articles discuss process are summarised in Appendix II Table 3.

4.3 Outputs

Outputs are composed of all related reports, which include sustainability assurance reports, stand-alone sustainability reports, integrated reports, and annual financial reports with sustainability information.

4.3.1 Sustainability Assurance Reports

The quality of sustainability assurance reports is used as a proxy for assurance quality in both qualitative and quantitative studies. Ball et al. (2000) start the analysis of the assurance reports quality with a sample of awarded reports in the initial seven years of the Association of Chartered Certified Accountants Environmental Reporting Awards. The aim of the analysis is to examine the extent to which assurance enhanced the transparency of the reports. They verify whether these reports addressed stakeholders, ensured assurance providers' independence, applied rigorous standards, addressed performance issues, evaluated environmental policy and performance, and confirmed the completeness of disclosure as true and fair. O'Dwyer and Owen (2005, p.210) further develop these evaluation criteria by marrying the above questions with the "recommended minimum contents of assurance statements" identified in guidance of assurance practice from AA1000 (1999), FEE (2002) and GRI (2002). This updated evaluation framework included 21 elements, among which some are in common with the three guidelines, and some are only suggested in one of them. Research studies using content analysis to measure assurance reporting quality afterwards mainly follow this framework, such as Perego and Kolk (2012), Bepari and Mollik (2016) DallaVia and Perego (2020). Another similar evaluation framework for assurance reporting quality employs the key elements advised in FEE (2002) and GRI (2002) to analyse the value-added part of assurance, and they treated more elements included in a report as higher quality (Deegan et al., 2006a, 2006b).

The elements of the evaluation framework in O'Dwyer and Owen (2005) evolve into a set of ranking criteria, and the scores resulting from it are adopted as the proxy of sustainability assurance quality in several quantitative research articles to examine its association with some inputs or process indicators (DallaVia & Perego, 2020; Gürtürk & Hahn, 2016; Martínez-Ferrero et al., 2018; Perego & Kolk, 2012; Rossi & Tarquinio, 2017; Sethi et al., 2017; Zorio et al., 2013). This ranking method is initiated by Perego and Kolk (2012) with 16 elements from O'Dwyer and Owen (2005), in which they measure the extent of the content disclosed in the assurance reporting according to the key elements suggested in the evaluation framework to measure the quality of the sustainability assurance reporting. Subsequent research studies have either added to or reduced the elements in their evaluation framework to calculate the quality scores, but the main items and calculations have remained consistent with these two previous studies. The challenges of the measurements remain in balancing comprehensiveness with practicality and in standardising evaluations across different reporting standards. A detailed comparison of the measurements of assurance report quality are presented in Appendix II Table 4.

4.3.2 Assured Sustainability Reports and Integrated Reports

The assured sustainability reporting quality (SRQ) is a function of sustainability assurance quality (SAQ), the quality of the sustainability information reporting system (SIRS) and its innate characteristics (IC), as discussed in Section 3. Thus, we may use sustainability reporting quality to proxy sustainability assurance quality. Two measurements are identified in this section.

The first one is to directly evaluate sustainability reporting quality. Researchers have attempted to measure the level of alignment for sustainability reporting with the GRI reporting guidelines (Clarkson et al., 2008; Moroney et al., 2012), or the level of alignment of integrated reporting with the IR framework (Zhou et al., 2017) as the quality of these reports.

Some studies attempted to use third-party reporting scores as the ranking of reporting quality (Wang et al., 2020).

The other method is to measure the adverse outputs of sustainability reporting. Occurring restatements can be used as a proxy for adverse auditing quality in financial statements auditing (DeFond & Zhang, 2014) and found to have a negative association with auditor industry specialisation, tenure and experience (Knechel et al., 2013). However, the occurrence of restatements in sustainability reporting has not yet been determined whether it is with negative quality. Some researchers suggest that assurance enhanced the quality of CSR reporting by detecting errors and improving methodologies in reporting (Ballou et al., 2018; Venter & Van, 2021). The empirical results from Michelon et al. (2019) and Pinnuck et al. (2021) both support that sustainability reporting restatements are positively associated with sustainability reporting assurance. However, whether it is a signal for negative assurance quality in the occurrence year is not yet clear. With global survey data, Ballou et al. (2018) do not find evidence that pure-error misstatements are associated with assurance services. However, with S&P 500 companies' sustainability reporting data, Michelon et al. (2019) find that assurance is more likely to be associated with pure-error misstatements than with methodology update restatements. They categorise restatements into pure error, methodology updates and other unspecified errors.

4.3.3 Annual Reports with Sustainability Information

Regarding more countries adopting International Financial Reporting Standards (IFRS) S1 and S2, we anticipate that sustainability information will increasingly be included in annual reports. A previous study measures CSR disclosure quality in annual reports by calculating the ratio of CSR items reported to the number of critical items expected to be reported (Appuhami & Tashakor, 2017). Other research study attempts to measure the quality of annual reports with sustainability information based on the alignment of financial and non-

financial information within the reports, and they find that Big 4 auditors help to improve the alignment of the information (Simnett et al., 2024). The level of reporting alignment is measured by whether it refers to the TCFD reporting framework, reporting with the TCFD four-pillar structure, and reporting Scope 1, 2, and 3 data in the annual reports (Simnett et al., 2024). This is a novel attempt to measure the quality of financial reports with sustainability information.

4.3.4 Summary

The outputs category includes sustainability assurance reports, assured sustainability reports and integrated reports, and annual reports with sustainability information. Measuring the quality of these reports provides a direct approach to quantifying sustainability assurance quality. The articles discuss measurements of outputs are listed in Appendix II Tables 4 and 5.

4.4 Context

The indicators in the context category have influences on the inputs and process categories simultaneously. Not much literature discusses how assurance quality is affected by context issues. We identified some potentially important indicators in this category. They are audit fees or non-audit fees, the size and reputation of assurance firms, the tenure of assurance providers, regulation and the ecosystem of sustainability reporting.

4.4.1 Audit Fees, Non-Audit Fees and Assurance Fees

Audit fees have been used in auditing literature as a proxy for audit quality, with higher fees representing higher auditing quality. In sustainability assurance literature, one study finds that firms investing in higher audit fees are more willing to release sustainability reports disclose more information in the reports, and have these reports assured (Chen et al., 2016). In addition, this association is enhanced when sustainability reporting is assured. Chen et al. (2016) argue that managers willing to invest in audit quality should have the same

willingness to invest in assurance quality. Because they should have the same level of eagerness to reduce the information asymmetry in both financial and non-financial reports. The authors also assert the internal information systems for reporting financial and non-financial information are the same. Thus, the information quality should be at the same level. More information disclosed in the sustainability reports can be used as a proxy for higher reporting quality.

Non-audit fees, which include assurance fees, might also be related to sustainability assurance quality. Lu et al. (2023) find that companies with a higher non-audit fee to audit fee ratio are less likely to have their financial statement auditors as their assurance providers. Some research suggests that non-audit fees capture efforts on sustainability assurance from assurance providers (Lu et al., 2023; Sharma et al., 2018). However, non-audit fees might not be proper to be directly used as a proxy for sustainability assurance quality, because other consulting fees are included in them.

4.4.2 Assurance Firms' Size and Reputation

Literature suggests that assurance firms' size and reputation may influence assurance quality. Some interview results indicate that both accounting and non-accounting assurance providers thought that "boutiques", which refer to small non-accounting firms offering sustainability assurance services, are less credible and showed a desire to distance themselves from these boutiques (Boiral et al., 2020, p.319; Channuntapipat et al., 2020, p.9). In addition, they perceive assurance providers from engineering consultancies or certification bodies are more credible than those from boutiques. In the meantime, assurance providers in Big 4 firms assert that the quality of their assurance processes is better than that of the boutiques (Channuntapipat et al., 2020). Another study examines the effects of switching assurance providers and finds that clients achieve significantly positive abnormal returns when the new assurance provider is a larger firm (Ferguson & Pündrich, 2015). Regarding reputation, some

research find that Big 4 firms and assurance providers with industry expertise are more likely to report negative opinions in sustainability assurance reports (Martínez-Ferrero & García-Sánchez, 2018). The authors argue that assurance providers' brand names have an influence on the level of assurance. However, there is no further direct evidence from empirical research with regard to the association between firm size or brand value and assurance quality.

4.4.3 Assurance Providers' Tenure

Literature has some limited evidence on the association between assurance providers' tenure and sustainability assurance quality. Martínez-Ferrero et al. (2018) find that the length of the audit-client relationship in years is positively associated with assurance report quality, and this association is more salient when the providers are accounting firms. However, the authors acknowledge that their research model does not consider institutional and ownership factors. They also note that assurance provider tenure could be measured using alternative methods, such as the number of years auditor partners have worked with clients. In addition, some researchers point out that the ideal tenure range for ensuring high assurance quality is unclear (Boiral et al., 2019b). In practice, it is noticed that the majority of the reporting companies are using the same assurance companies for several years, but the influence on the assurance quality regarding the long-term relationship is not explicitly clarified in the assurance statements (Boiral & Heras-Saizarbitoria, 2020).

4.4.4 Regulation

Mandatory and voluntary assurance co-existence in sustainability assurance practice. Since regulation influences auditing quality (DeFond & Zhang, 2014), it is reasonable to presume that either a mandatory or a voluntary assurance scenario may influence assurance providers' and clients' inputs and the assurance process, which in turn influences the overall assurance

quality. Generally, from survey data, there seems to be no significant difference between mandatory and voluntary assurance in terms of the market participation of assurance providers (IFAC, 2023). Accounting and non-accounting providers all participate in the global market in both scenarios (IFAC, 2023). One exception is in Australia, where the auditor responsible for an entity's financial statements also conducts assurance on the mandatory climate-related disclosures included in the annual report (AUASB, 2025). No research has been conducted on whether the level of input from assurance providers will be different in the two contexts, while in terms of client inputs, Simnett et al. (2025) find that companies tend to adopt ESG-related compensation policies after the countries move into mandatory assurance. It is also noted that the limited assurance level is dominant in mandatory assurance in each of the South Africa, Italy and Spain contexts (Ackers & Eccles, 2015; Simnett et al., 2025), and a similar situation in the voluntary assurance context in Australia and the United States (Bepari & Mollik, 2016; Gipper et al., 2024). After the implementation of mandatory assurance, companies are more likely to opt for limited rather than reasonable assurance (Simnett et al., 2025). Further analysis shows that previously reasonable assurance companies do not revert to limited assurance, suggesting that mandatory assurance regulation primarily drives new entrants into limited assurance, increasing its overall prevalence (Simnett et al., 2025).

4.4.5 Ecosystem of Sustainability Reporting

Knechel et al. (2020) suggest that auditing quality is influenced by the ecosystem of financial reporting. We agree that the assurance quality is also influenced by the overall ecosystem of sustainability reporting. However, the participants and processes differ from those in financial reporting. From the generation of sustainability information, the systems used for reporting, internal control, and management oversight, to board-level governance, each step involves distinct participants. These processes then interact with external assurance providers while

also being shaped by the influence of investors, activists, standard setters and regulators. As a result, the indicators of sustainability assurance quality differ from those used to assess audit quality.

4.4.6 Summary

The indicators in the context category include audit fees, non-audit fees and assurance fees, assurance firms' size and reputation, assurance providers' tenure, regulation and the ecosystem of sustainability assurance. The indicators in the context phase have an influence on the inputs and process categories simultaneously. The articles discuss process are summarised in Appendix II Table 6.

4.5 Consequences

The Consequences block includes outcomes related to companies' sustainability performance (Du & Wu, 2019; Hummel et al., 2019; Pinnuck et al., 2021), financial performance (Elbardan et al., 2023; Fuhrmann et al., 2017; Pflugrath et al., 2011), and other consequences on company management (Al-Shaer & Zaman, 2019). Assurance improves sustainability performance mainly through two channels. First, companies willing to pay for assurance mean they are more committed to sustainability (Du & Wu, 2019). Second, assurance may help to figure out the weaknesses in sustainability issues and help to improve future performance (O'Dwyer, 2011). In terms of financial performance, assurance enhances credibility in sustainability reporting and reduces companies' capital costs and information asymmetry. As to the influence on company management, assurance processes and reports can provide a lot of information regarding internal control weaknesses and other things to improve, which can be incorporated into managers' decisions.

The association between assurance quality and sustainability or financial performance might be two-way (Du & Wu, 2019; Hummel et al., 2019). Some previous studies test an

association without specifying a direction or argue that higher-quality reports lead to higher assurance quality. Previous research called for papers investigating the association between CSR performance and assurance (assurance quality) (De Villiers et al., 2022).

4.5.1 Sustainability Performance Consequences

Previous research finds some association between sustainability assurance and companies' sustainability performance, and the association might be two-way. Gipper et al. (2024) find a positive association between sustainability assurance and CSR performance for U.S. companies, while another study focuses on the hospitality industry shows that companies with better CSR performance are more likely to have their reports assured (Koseoglu et al., 2021).

Some researchers explore the association between sustainability assurance quality and corporate sustainability performance. A study on European companies reveals a negative association between sustainability performance and assurance quality (Hummel et al. (2019). They separate the quality of the assurance report into two aspects: assurance process depth, which reflects the ability to discover issues in the auditing process, and statement breadth, which relates to the likelihood of disclosing them. The negative relationship is significant in the assurance process depth scores. The authors conclude that the results implied that companies involved with inferior sustainability performance might demand sustainability assurance services of higher quality to improve internal assurance processes and systems. In this circumstance, assurance services are used as an impression management tool for companies with poor CSR performance. Another research study finds that companies with restatements are associated with higher levels of social performance (Pinnuck et al., 2021).

An adverse consequence of sustainability performance is CSR misconduct, which refers to material legal proceedings that listed companies must disclose under regulations, specifically

those related to environmental and social issues. Research conducted in the U.S. context find that current CSR reporting prevents next-period CSR misconduct, but assurance on the reports does not have incremental effects on this association (Christensen, 2016). Another study in the Taiwan context finds that the association between CSR reporting and misconduct issues in CSR is not held, but assured reports are negatively associated with misconduct (Du & Wu, 2019). The authors explain the difference between these two results as the different legal environments and investor protection in these two countries and assert that the reporting and assurance influence on companies' CSR performance is context-specific. Future research can further extend the above studies into whether different levels of assurance quality may have effects on CSR misconduct, and as suggested by Du and Wu (2019), take corporate governance, country differences and mandatory or voluntary reporting (assurance) into consideration.

ESG rating dispersion is another outcome under the category of sustainability performance. It measures the difference between ESG scores measured by different rating agencies, and sometimes researchers use it as a proxy for the difference between ESG disclosure and ESG performance (Aboud et al., 2023). Some research has investigated the association between ESG rating dispersion and sustainability assurance. In a multi-country context, it has been found that after mandatory reporting of sustainability information, i.e. implementing the European Union’s Directive 2014/95, the gap in the ratings is decreased, and further testing reveals that assurance plays a moderate role in the above association (Aboud et al., 2023). This means assurance of the reporting and mandatory reporting are substitutive to each other, and assurance may also help to reduce the rating gap. In another voluntary reporting context, researchers also find that ESG rating differences are lower for companies issuing ESG reports, and this association is more salient for those companies having their reports assured (Kimbrough et al., 2024). In addition, among those assured companies, the association is

strengthened when the assurance providers are accounting professionals. However, the role of assurance quality is not further tested in the above studies. Future research can further investigate the different levels of assurance quality's influence on the dispersion of ESG ratings in either a mandatory or voluntary reporting (assurance) context.

4.5.2 Financial Consequences

Some literature has examined whether sustainability assurance impacts capital costs, improving investors' decision-making, analysts' predictions or firm value, but limited research has been conducted on the association between sustainability assurance quality and various financial consequences.

Financing Costs

Previous literature states that assurance helped companies reduce financing costs. Evidence is found that companies with sustainability reports, assured or reports assured by accounting providers, are associated with lower costs of capital in the U.S.A. (Casey & Grenier, 2015). Consistent with this, another global study reports a negative relationship between assurance and both capital constraint and the cost of debt (Carey et al., 2021). In addition, the above association is more salient when the assurance providers were accounting professionals and in low investor protection countries. A recent study finds that assurance is associated with a lower cost of capital and interest expense in France, Spain and Italy, where assurance is mandated (Simnett et al., 2025). Additionally, another study documents that companies with higher-quality GHG emissions disclosure are associated with lower costs of debt (Mahmoudian et al., 2023). Drawing on the previous literature, it is suggested the association between sustainability assurance quality and financing costs tends to be negative.

Firm Value

Some research studies find that having sustainability reporting assured is positively associated with firm value, but whether the quality of assurance influences firm value is not clear. With a global sample, Clarkson et al. (2019) find companies with assured CSR reports have higher market value and those assured by Big 4 accounting firms are also more valued by the market. However, this association is not held with higher levels of assurance scope. Some recent studies also find that sustainability reporting and assurance of the reports are positively associated with firm value (Elbardan et al., 2023; Kuzey et al., 2023). In addition, they also find that the audit committee (independence and expertise of audit committee members) and executive CSR compensation play a moderating role in the above relationship. These conditions may influence the assurance quality and should be taken into account when doing research in this topic. Khaireddine et al. (2023) examine the 40 largest companies listed in Euronext Paris in the 2010s and find that companies with higher assurance reporting quality are associated with higher firm value.

Investor Decision-Making

Some research studies have found assurance influences both professional and non-professional investors' decision-making. An experimental study conduct on both professional and non-professional investors find that they assign higher value to a company's stock price when its CSR reports are assured, particularly when CSR-related targets are included in the CEO's remuneration plan, and the company has a high level of CSR investment (Brown-Liburd & Zamora, 2015). In addition, another experiment reveals that external assurance amplifies non-professional investors' inclination to invest more significantly when the disclosed ESG indicators are of high strategic relevance, compared to when such indicators are of lower strategic importance (Cheng et al., 2015). Shen et al. (2017) echo this association

between assurance and investment and further find that it is particularly pronounced when sustainability reports contain only positive information.

Information Asymmetry

Some studies attempt to test the relationship between assurance quality and information asymmetry. Fuhrmann et al. (2017) analyse the content of assurance statements of companies listed in the STOXX Europe 600 index and find different aspects of sustainability assurance reporting quality have shown mixed associations with information transparency. They reveal that a higher assurance level of the assurance report is associated with lower information asymmetry, leading to better decisions in trading. They also document that the tests of details of numerical data improved information transparency, suggesting that the assurance process designed to reduce assurance risk would increase the credibility of information in the sustainability reports. However, the tests of aggregated indicators and underlying processes are only found to be associated with reduced information asymmetry for companies in purely voluntary disclosure countries. Other research results in different contexts support the association between sustainability assurance quality and information transparency. For example, one global study finds that longer tenure of assurance providers can reduce information asymmetry (Ruiz-Barbadillo & Martinez-Ferrero, 2023), while research in South Africa suggests that combined assurance enhances information transparency (Zhou et al., 2019). Accordingly, in future research, more proxies for assurance quality can be tested, and such investigations should consider the importance of regulatory differences across countries.

Analysts Prediction Accuracy

Previous literature has explored the impact of sustainability assurance and the profession of assurance providers on analysts' perceived credibility of sustainability information or their forecast accuracy. Some evidence shows that assured CSR information is perceived by analysts as more credible compared with non-assured information (Pflugrath et al., 2011).

The study also finds that reports assured by professional accountants are perceived as more credible than those assured by sustainability consultants. This association is stronger in the mining industry and in Australia and the U.K. than in the U.S., which means industry and country context have an influence on the associations. Another research found that first-time assurance or assurance provided by accounting professionals helps to reduce analysts' forecast errors and dispersion (Casey & Grenier, 2015). In addition, evidence finds that the level of integrated reporting aligned with the IR guidelines and combined assurance helps to reduce analysts' forecast error and dispersion (Zhou et al., 2017, 2019). These studies' results reveal that higher credibility of sustainability reporting improves analysts' forecast accuracy.

4.5.3 Other Consequences

It is also noted assurance quality may have other influences. One study finds that companies with sustainability reports assured are more likely to have sustainability-related incentive terms in their CEO contracts (Al-Shaer & Zaman, 2019). In this case, the corporate governance approach results from CSR report assurance. In addition, current research suggests that managers who commit to investing in audit quality are also likely to enhance the transparency of sustainability reporting (Chen et al., 2016), and companies use the same auditing firm for sustainability assurance tend to achieve higher assurance quality (Ruiz-Barbadillo & Martínez-Ferrero, 2020). We presume higher assurance quality may help to improve audit quality as a knowledge spillover effect. Another study reveals an association between assurance quality and company reputation (García-Sánchez et al., 2022). Overall, assurance quality may have various value-added effects on companies that worth further investigation.

4.5.4 Summary

The association between assurance quality and various consequences provide fruitful research topics, and the potential two-way association should be taken into account when conducting research. In the meantime, the three types of consequences: sustainability performance, financial performance and other consequences might have interaction effects between each other, which has some evidence in the literature (Jo & Harjoto, 2011), but it is out of the range of this paper. The articles discuss consequences are summarised in Appendix II Table 7.

5. Discussion and Avenues for Future Research

This section explores potential avenues for future research. They are also organised into five categories as in the framework, which are inputs, process, outputs, context and consequences.

5.1 Inputs

We suggest more research on the competence and skills of assurance providers and their association with the assurance process, outputs and consequences. Although existing research has attempted to build associations between assurance providers' profession and assurance quality, we suggest more emphasis should be put on their subject matter expertise, audit expertise, industry specialisation, ethics, independence and professional scepticism.

Subject matter expertise should be further examined for two key reasons. First, there are various participants in the sustainability assurance market. In auditing, there are educational background requirements, qualifications or certifications for practitioners to achieve to be qualified auditors (Knechel et al., 2007). In addition, only public accounting firms are permitted to provide auditing services in the market for audits of financial statements. However, in sustainability assurance, there are no registration requirements for these firms to enter the market. Gipper et al. (2024) revealed that the U.S. assurance market is dominated by non-accounting firms, holding 80% of the market share, whereas in Australia, accounting firms lead

the market (IFAC, 2023). Globally, the participants of assurance providers are composed of accounting firms, specialist consultants, certification bodies, broader consultants, individuals, government bodies and agencies, and non-government organisations (NGOs), etc. (CorporateRegister, 2008). The subject matter expertise possessed by these practitioners varies. Second, existing literature examining the association between assurance providers with different professions and assurance quality showed mixed results. Accordingly, we suggest the measurements of subject matter expertise can be refined. In sustainability assurance, we should investigate beyond the assurance providers' profession and further examine their sustainability subject matter expertise in terms of educational background, certifications received, and related working experience.

Industry specialisation should be measured with more sophisticated methods. In existing literature, industry specialisation is measured by the number of clients or clients' sales amount (Martínez-Ferrero et al., 2018; Martínez-Ferrero & García-Sánchez, 2018). While these methods are reasonable proxies, we suggest more innovative measurements considering the sustainability context. For example, for the overall sustainability reporting, we suggest industry expertise might be more closely related to clients' size at the assets level because large companies are more exposed to the public in terms of all kinds of sustainability issues. For the assurance of climate-related information, such as greenhouse gas emissions, the industry expertise can be measured as the clients' emission volume, because auditing clients with more emissions involved develops their expertise. For those issuing equal pay or gender pay equity report assurance, the industry expertise might be measured by the number of employees of the clients.

Other important but lacking research indicators are professional scepticism and principles of ethics. Assurance guidelines and standard setters require assurance providers to obey the ethical standards of professional accounting when they use the ISAE standards. It is still controversial

whether other professionals will follow the accounting ethical standards, whether other professions' understanding of ethics for accountants is the same as accountants' understanding. Because accountants are trained with professional standards and rigorously follow principles of ethics, when compared with assurance providers in different professions, they might not be at the same level of independence (O'Dwyer, 2011).

Moving on to the clients' inputs, whether characteristics of companies are associated with assurance quality has not been extensively examined yet. These characteristics include profitability, leverage ratio, cost of capital, or existence of CSO, high CSR commitment, CSR strengths and concerns. In addition, some industry-level indicators, such as environmental- or social-sensitive industries and legal orientation among countries, may also have direct or interaction effects on clients' seeking higher assurance quality. In addition, the association between corporate governance characteristics and assurance quality is mixed, especially the various expertise of board members, audit committee members, sustainability committee members and internal control function staffs, which lacks research. Similarly, the association between assurance quality and the incentives of the executives or board members requires further investigation. Previous studies reveal overlaps between these committees, such as shared membership between the Audit and Environmental Committees, may influence both the level of involvement in sustainability assurance and the choice of assurance providers (Peters & Romi, 2015; Trotman & Trotman, 2015). Future research could explore how the structure and composition of board committees, such as Audit, Sustainability, and Risk Committees, impact sustainability assurance quality, particularly given the contextual variability in their roles and responsibilities.

As discussed in Section 4.1.2, the role and competence of internal control function staff may also contribute to assurance quality, which needs more research. Though a study finds no significant association between the IAF and assurance quality, it might potentially be due to

overlooked factors such as auditor tenure, function design, and task scope (Rossi & Tarquinio, 2017). Trotman and Trotman (2015) highlight that factors like business risk exposure, organisational emphasis on sustainability, mandatory reporting requirements, and strategic objectives (e.g., emissions targets) may shape the IAF's role in sustainability reporting and assurance. They also find the IAF's involvement in sustainability assurance remains limited and evolving, with minimal participation in GHG and energy reporting. It is also revealed that senior management support increases IAF involvement, while audit committee oversight does not (Soh & Martinov-Bennie, 2018). These findings suggest that the complexity of corporate governance structures affects the IAF's role, making its impact on assurance quality difficult to generalise but rich with research potential.

5.2 Process

Future research could explore the influence of stakeholder engagement on sustainability assurance quality, as its impact remains unclear. First, studies could investigate how various levels of stakeholder engagement across companies affect assurance quality, with a focus on identifying the optimal level of stakeholder engagement. Second, research could examine the different roles stakeholders play in the assurance process, which might range from assurance providers to audit committee members, and investigate whether these roles act as substitutes or complements. Understanding these issues could provide valuable insights into how stakeholder engagement shapes the sustainability assurance quality in the assurance process.

Another area of interest is the composition and operation of multidisciplinary teams. Though it is widely recognised that sustainability assurance often requires expertise from various domains, little is known about an optimal team composition, how multidisciplinary teams influence the assurance process, including decision-making and the formulation of assurance opinions.

Another important area for exploration is the assessment of materiality. There remains limited understanding of how materiality is actually assessed in practice and how it affects the quality of sustainability assurance. Future studies could investigate whether novel or innovative methods are being applied in materiality assessments within the context of sustainability assurance, and whether these approaches improve the relevance and reliability of assurance. In addition, the introduction of CSRD and its emphasis on double materiality further opens new avenues for research. Future studies could explore how assurance providers are adapting their materiality assessment processes to meet these new requirements, and what benefits and challenges they encounter in applying the double materiality perspective.

The relationship between clients and assurance providers presents a promising field for investigation. Interactions such as negotiations over assurance fees, decisions regarding the level of assurance, and the extent of evidence shared by clients can all influence assurance quality. Moreover, the level of independence maintained by assurance providers is also influenced by these interactions. Future research could investigate the interactions between assurance providers and clients to better understand how such negotiations shape the assurance quality. Furthermore, future research could examine how other critical indicators in the audit process, such as quality control, professional judgment, risk assessment, analytical procedures, and the processes of obtaining and evaluating evidence, are adapted in the context of sustainability assurance, how they differ from financial reporting audit, and how they influence sustainability assurance quality.

5.3 Outputs

Regarding the measurement of sustainability assurance report quality by grading the reporting content, we suggest improvements should be made. Because using elements from the three major guidelines (AA1000AS, ISAE 3000 and GRI) to assess assurance reports may

introduce bias, as reports may not fully align with all guidelines, particularly those not following AA1000AS, which contributes the most elements, could be unfairly disadvantaged (Hummel et al., 2019). In addition, some reports may not follow any of these guidelines. Future research could focus on refining the criteria used to assess assurance report quality to ensure they are applicable across different sustainability assurance standards. It may also develop more nuanced scoring systems beyond binary measures to better capture variations in the assurance reports. These improvements would contribute to more accurate and consistent evaluation frameworks for sustainability assurance reporting quality.

Future research could explore new content in sustainability assurance reports to better assess assurance quality. With the move toward mandatory assurance, it is likely that assurance reports will begin to provide more detailed and substantive information. If, potentially, some contents similar to Key Audit Matters are released in assurance reports, this might offer a valuable opportunity for researchers to study how enhanced disclosure affects assurance quality.

The measurement of the quality of assured sustainability reports is also an area for further refining. Currently, quality is commonly measured by the extent to which the reports are aligned with reporting guidelines. As companies transition to mandatory reporting or gain more experience in sustainability reporting, it may become increasingly difficult to distinguish variations in reporting quality using the current measurement approach. In addition, this method has limitations when comparing reports prepared under different sustainability reporting guidelines. We suggest that future research refine this measurement to ensure its adaptability to both standardised reporting frameworks and those based on various reporting guidelines.

Future research could further explore whether restatements in sustainability reports signal improvements or weaknesses in assurance quality. As suggested by prior literature, restatements, particularly during the early stages of sustainability reporting, may indicate efforts to improve reporting accuracy through assurance. In this case, it would be valuable to further examine the types of errors addressed and the inputs from assurance providers (such as industry specialisation, tenure, or experience) or clients (such as audit committee characteristics, internal control weaknesses, or misconduct) that contribute to reducing those errors. Another potential avenue is to investigate whether restatements are linked to penalties for assurance providers or to client issues such as management misconduct, which would support the view that restatements reflect poor assurance quality. These investigations would help clarify whether restatements can serve as a proxy for high or low sustainability assurance quality.

The measurements of output indicators for sustainability assurance quality discussed in this review can all be traced to some types of reporting. However, output quality may also be a perceived quality from the reporting users' view. How they understand sustainability and assurance reports may lead to their perspectives on assurance quality. The association between inputs assurance quality and perceived output quality is worth further investigation.

5.4 Context

The role of audit fees might need further investigation. Because companies are not currently required to release their assurance fees currently, audit fees may provide a pathway to examine the association between assurance fees and sustainability assurance quality. We may further examine whether audit fees influence sustainability assurance quality or whether they can be a proxy for assurance quality.

Empirical quantitative studies could explore the relationship between the size of assurance firms and the quality of sustainability assurance. It might be because large companies have more resources to recruit proper experts to conduct sustainability assurance. In addition, auditing firms' size is used as a proxy for auditing quality, because it is believed that auditors from large auditing firms have the competence and independence to provide a high level of auditing quality and are less likely to compromise in the auditing process (DeAngelo, 1981). Thus, it is worth testing the association between an assurance company's size and assurance quality. However, a challenging part is how to compare the firm's size with accounting firms, consulting firms and other types of assurance service firms. Investigating the impact of partners' tenure or rotation on the quality of sustainability assurance would also be valuable.

Regulations such as mandatory assurance requirements may influence certain indicators in inputs and process, and influence the overall assurance quality. With limited research, we notice some benefits and changes for these companies moving to mandatory assurance. We suggest future research can compare assurance quality before and after mandatory assurance and separate the companies into two groups. One group includes those already engaged in voluntary assurance, while the other comprises those who have not previously been involved in any assurance. Their previous inputs in the assurance from both clients and assurance providers are different. At the same time, the process of assurance will also be different for these two types of companies. It is also worth thinking about those not-ready companies and whether leaving them in voluntary assurance longer will be better than dragging them into reporting with poor quality or low assurance quality. Also, it might benefit assurance companies with lower engagement risks.

The ecosystem of assurance includes various participants, among them process owners, internal control, employees, customers, ESG activists, standard setters, regulators, community and

NGOs, lacking investigation in previous literature. We suggest future research could be conducted on their influences on assurance quality.

5.5 Consequences

The association between sustainability assurance quality and sustainability performance requires more research. It is still unclear whether good assurance quality helps companies improve their sustainability performance or vice versa. Another topic related to sustainability performance is CSR misconduct. As an extreme sample in sustainability performance, we suggest it might be used to verify the suitability of the proxy for assurance quality. For example, testing whether restatements are associated with CSR misconduct might be helpful to know whether restatements indicate strong or weak assurance quality. In addition, future research can further extend the research related to the association between assurance and CSR misconduct to explore whether different levels of assurance quality may have effects on CSR misconduct. When conducting the research, we should take corporate governance, country differences and mandatory or voluntary reporting (assurance) into consideration (Du & Wu, 2019).

Whether different levels of assurance quality are associated with ESG rating dispersion is also a promising topic. Limited research was conducted on the association between ESG rating dispersion and sustainability reporting or assurance (Aboud et al., 2023; Kimbrough et al., 2024). They found some evidence that assurance decreases ESG rating dispersion. We suggest higher levels of assurance quality may be associated with less ESG rating dispersion.

In terms of the market-related consequences, it is noted that assurance helps companies to reduce the cost of capital across different country contexts (Carey et al., 2021; Casey & Grenier, 2015; Simnett et al., 2025). Consistent with existing literature, higher assurance quality might

be associated with high-quality financial information, and this helps to reduce the cost of capital.

Evidence is found in auditing literature that higher audit quality is associated with more accuracy in analysts' forecasts (Behn et al., 2008; Davis et al., 2009). Thus, from the above findings, we argue higher levels of assurance quality may improve analysts' prediction accuracy. However, this association has not been examined yet.

Another stream of research is suggested to be conducted on the association between assurance quality and investors' decision-making or predictions. The investors here can be divided into two categories, which are professional investors and non-professional investors. Some existing literature has done some experimental research on the effect of assured sustainability reports on non-professional investors (Brown-Liburd & Zamora, 2015; Cheng et al., 2015; Shen et al., 2017). We suggest future research can be conducted on the influences of different levels of assurance quality and also examine such influences on professional investors. More specifically, some tests can be conducted on whether investors value companies with higher assurance quality or whether investors' predictions will be more accurate for companies with higher assurance quality.

Assurance quality may also have internal consequences for the companies. It lacks research on whether assurance quality influences management decision-making, remuneration plans, or companies' reputation. Some previous research suggests that for companies with higher assurance quality, managers may be more confident in putting such terms in incentive plans (Al-Shaer & Zaman, 2019). So, these companies' managers might be more confident in adopting sustainability information in decision-making.

Overall, in each category of assurance quality, we find some research opportunities. Some can be tested between two categories, and some might involve indicators across several categories.

When future research is conducted, we suggest referring to our framework for building a solid association for examination.

5.6 Measurements of Inputs and Outputs Sustainability Assurance Quality

Following DeFond and Zhang (2014) audit quality proxy comparative dimensions, we summarise the characteristics of the measurements of sustainability assurance quality in the literature in Table 3.

(Insert Table 3)

6. Conclusion

This research contributes to the literature on sustainability assurance quality. First, it builds a framework that includes the important indicators in four categories of assurance quality and the consequences associated with the levels of assurance quality. The indicators in each category of the current framework are collected from sustainability assurance literature. This framework synthesises existing literature on sustainability assurance quality, identifies the critical indicators influential to assurance quality and summarises measurements of assurance quality. The framework also separates the outcomes category from Knechel et al. (2013) into outputs and consequences. Accordingly, it synthesises the literature on the association between assurance quality and consequences.

Second, this research joins the discussion on the nature of assurance. In the inputs category, different from previous literature that only focuses on assurance providers' inputs, this framework includes both assurance providers' and clients' inputs, because we believe auditing is not only an economic product that results in an auditing report but also an economic service that the interaction between assurance providers and clients influences the assurance quality.

Third, the indicators of the assurance quality identified in the research might be incorporated into future assurance standards or guidelines. In addition, these findings may be useful for standard setters in setting rules for quality control or inspection of assurance quality.

Appendix I

Figure 1: Assurance Dimensions

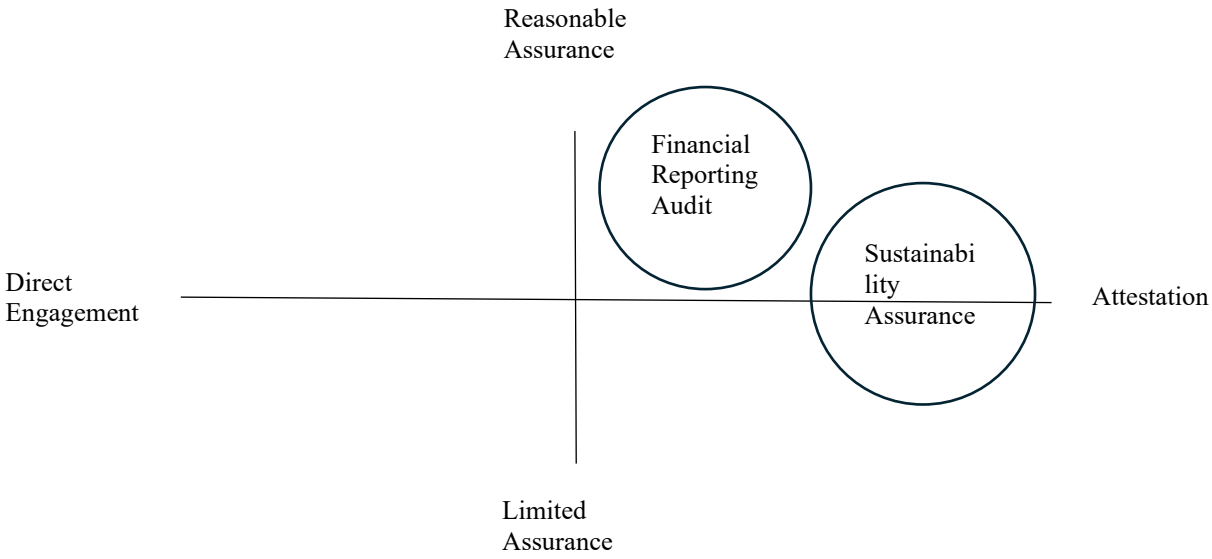


Figure 2: Flow Diagram of Identifying, Screening and Including Articles

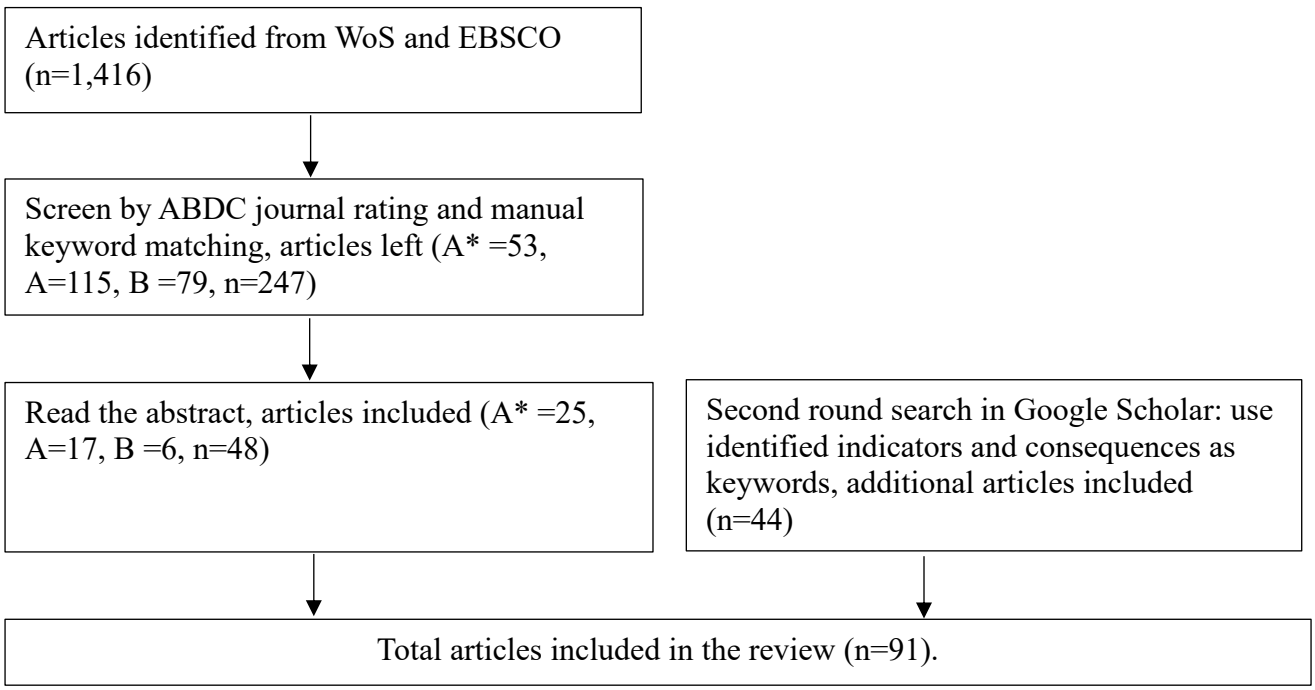
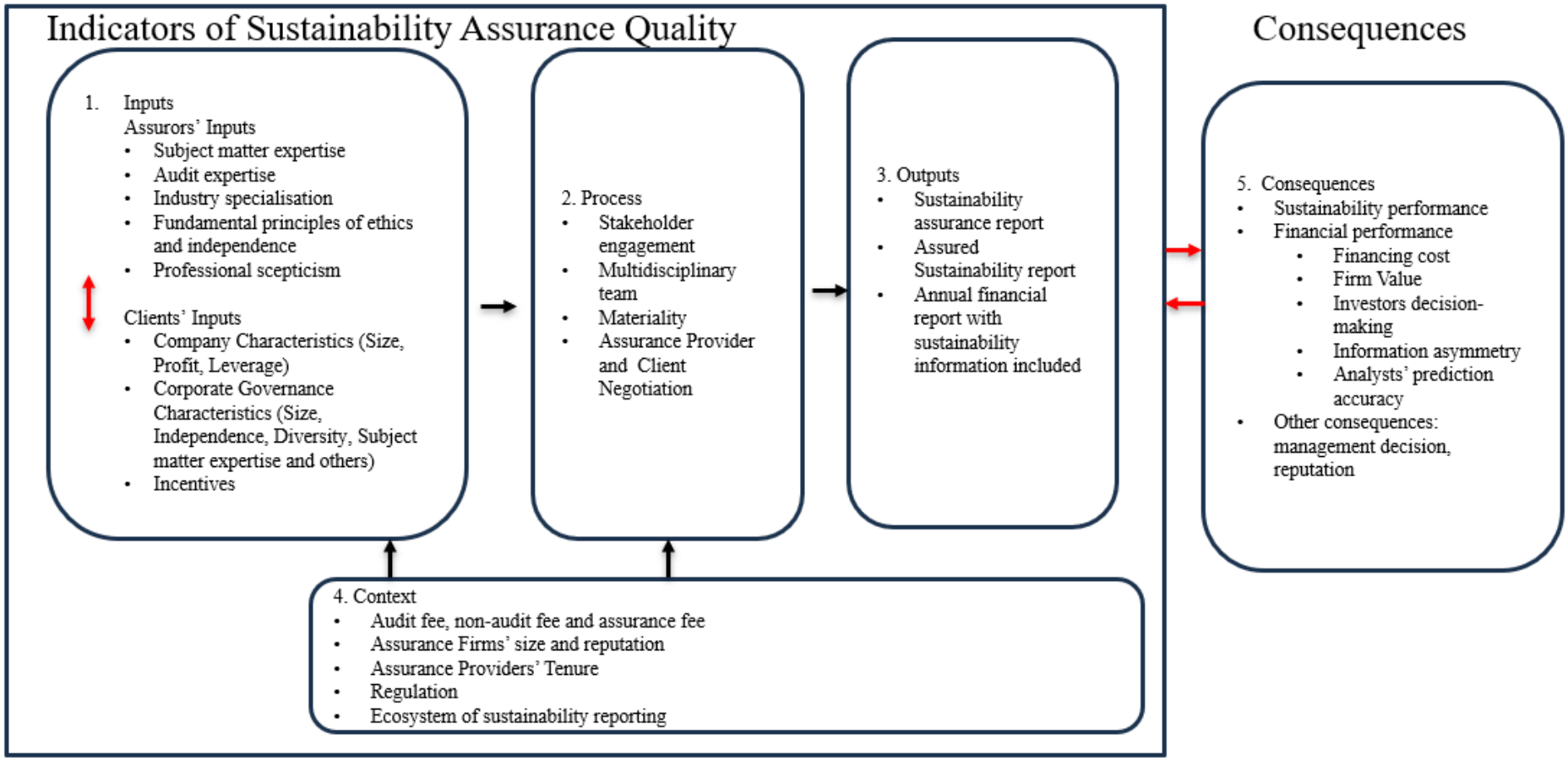


Figure 3: Framework of Sustainability Assurance Quality: Influences and Consequences



(Adapted from Knechel et al. (2013))

Table 1: Eligibility Criteria for Review of Papers on the Research Topic

Category	Inclusion	Exclusion	Justification
Review question	1. Influences of sustainability assurance quality (SAQ) 2. Consequences of sustainability assurance quality 3. SAQ includes assured sustainability report quality, sustainability assurance report quality, financial reports with sustainability information quality, and stakeholders' perceived SAQ. 4. Sustainability reports include: ESG reports, CSR reports, Green House Gas Emission reports, Climate-related information disclosures, integrated reports.	Financial auditing quality, quality of sustainability reports without assurance	We focus on literature discussing sustainability assurance quality.
Study design	All kinds of primary studies: archival research, interviews, surveys, experiment Theoretical papers; Methodological papers	Literature review	We exclude literature reviews and restrict on empirical papers, theoretical and methodological papers
Publication status	Published and unpublished		We also included unpublished papers on SSRN because this area of research is evolving
Publication year	2004-2024	Before 2004	Few papers before 2004
Language	English	non-English	Journals on the ABDC list are published in English

Table 2: The Number of Studies by Year and Journal Ratings

Year	A*	A	B	SSSN	Total
2004			1		1
2005	1				1
2006		1	1		2
2008	1				1
2009	1				1
2010	1				1
2011	2		1		3
2012		2			2
2013		2			2
2014		2			2
2015	7				7
2016	4	4	1		9
2017		5	2		7
2018	1	7			8
2019	6	5			11
2020	5	2			7
2021	2	4			6
2022	2	2	2		6
2023	1	1	4	2	8
2024	3	2		1	6
Total	**37**	**39**	**12**	**3**	**91**

Table 3: Summary and Evaluation of Output and Input Measurements of Sustainability Assurance Quality

Proxy Category	Commonly used proxies	Directness	Egregiousness	Actual vs. Perceived	Measurement Issues			Unique Strengths and Weaknesses	
					Discrete vs Continuous	Consensus on measurement	Measurement error	Strengths	Weaknesses
Output Measures									
Sustainability Assurance Reporting Quality	Sustainability assurance reports Score	Relatively more direct	N/A	Actual	Continuous	Relatively High	Low	Capture the foundation requirements according to Assurance Standards	1. Assurance reports might be similar and hard to differentiate 2. Using content analysis to score the reporting is time consuming
Sustainability Reporting Quality	1. The extent that reporting follows the sustainability reporting guidelines	Relatively more direct	N/A	Actual	Primarily continuous;	Relatively High	Medium/Low	Tightly linked to the disclosure of sustainability information	Using content analysis to score the reporting is time consuming
	2. The extent that subject matter-related information is disclosed	Relatively more direct	N/A	Actual	Continuous/discrete	Relatively High	Medium/Low	Tightly link to the disclosure of sustainability information	Hard to compare between different reporting criteria and guidelines
	3. Restatement of Sustainability reporting	Direct	Relatively more egregious	Actual	Discrete	Relatively High	Low	Comparable between assurance provided under different assurance standards	The reasons for the restatements are various. Some companies may not report or restate, and this is a potential measurement error risk.
Input Measures									

Assurance Providers Inputs	1. Accounting companies, Professional companies (Accounting and Consulting companies), Big N 2. Industry specialisation, subject matter specialisation	Direct	N/A	Actual	Discrete	High	Low; High (industry/subject matter specialisation)	Easy to capture	Cannot differentiate quality in each company or lack of research on the calculation of industry/subject matter specialisation
Clients Inputs	Company Characteristics, Corporate Governance Characteristics and Incentives	Relatively more direct	N/A	Actual	Continuous/discrete	High	Low	Tightly link to reporting quality	Hard to measure

(Adapted from DeFond & Zhang (2014))

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