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Integrating Sustainability in Risk Management and Internal Control Systems: An Empirical Assessment of ESG Reporting of German DAX40 Firms

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Abstract

Integrating sustainability into enterprise risk management (ERM) and internal control system (ICS) and the corresponding reporting is gaining importance for organizations due to increasing pressure from regulators and stakeholders. The objective of this paper is to analyze corporate disclosures on the integration of sustainability into the ERM and the ICS. Based on stakeholder agency theory, this study applies a self-developed disclosure index on the ESG reports of 29 German DAX40 companies for 2022 and 2023. The index evaluates from an organizational, regulatory, and, with a focus on environmental issues, business practice perspective. Overall, companies report with restrained quality. The study found varying results across the index sections and a minor positive trend from 2022 to 2023. A sub analysis to identify potential differences in reporting behavior according to the affiliation to environmentally sensitive sectors revealed mixed findings. This paper holds different methodological limitations. However, it contributes to scarce qualitative research and provides deep insights into corporate sustainability reporting of German DAX40 companies. The results are of practical importance for businesses and regulatory bodies, as they reveal weaknesses in corporate reporting.

Keywords: disclosure index; ESG reporting; internal control system; risk management; sustainable corporate governance

1. Introduction

The 2008/09 financial crisis led to a significant loss of stakeholder trust in corporate governance mechanisms (Earle, 2009), and exposed massive failures in the area of enterprise risk management (ERM) and internal control systems (ICS). While these systems traditionally focused on financial aspects, the integration of sustainability is becoming increasingly important from multiple perspectives. Building on the following considerations, this study focuses on the reporting about the integration of sustainability into the ERM and ICS.

In terms of terminology, this paper defines the ERM as a system for the identification, assessment, reaction and prevention of negative effects (risks) that can significantly impact an organization (Bartuschka, 2022; Boiral et al., 2020; Brown et al., 2009; COSO, 2017; Gatzert & Martin, 2015). The ICS aims to ensure efficiency and effectiveness of operations, as well as compliance with regulations and guidelines (Bartuschka, 2022; COSO, 2013, 2023; Deumes & Knechel, 2008).

Overarching relevance for the research objective stems from the growing number of sustainability issues and associated risks that organizations face, which can cover a wide range of aspects (Boiral et al., 2020). These issues and risks are difficult to determine, quantify or mitigate, and can affect the profitability, success and ultimately even the survival of a company (COSO and wbcsd, 2018; Crawford & Nilsson, 2023). At the same time, stakeholders increasingly expect reliable and transparent sustainability reporting alongside sustainable corporate performance (Boiral et al., 2020; Fernandez-Feijoo et al., 2014; Rezaee, 2016).

Practical relevance was emphasized in previous academic literature (e.g. D. R. Anderson and Anderson, 2009; Shad et al., 2019). COSO and wbcsd (2018) highlight the integration of sustainability into the ERM and a corresponding reporting, as it helps to identify and respond to sustainability issues at an early stage and creates more transparency to stakehold-

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ers on how the organization deals with risks. Moreover, it can enable companies not only to react, but to proactively improve their sustainability performance (Rezaee, 2016). Although companies are already focusing on sustainability and risk management, there is often a lack of integration between these two paradigms (Soomro & Lai, 2017). On the other hand, an effective ICS can provide accountability in organizations (Jones, 2008), or help to assure the accuracy of environmental information collection and processing (Chan et al., 2021; J. Zhang et al., 2024). It therefore enhances the reliability and quality of sustainability disclosures, as credible reporting requires timely, complete and precise information (Healy & Palepu, 2001; Mercer, 2004) and is dependent on the internal collection of information (Traxler et al., 2020). A strong ICS can also enhance the effectiveness of the ERM (COSO and wbcsd, 2018). Integrating sustainability into the systems can therefore be an approach to adequately address sustainability risks and increase the reliability of sustainability reports (Chan et al., 2021; Harasheh & Provasi, 2023; J. Zhang et al., 2024).

Regulatory relevance can be derived from recent developments. Since the financial year 2017, European public-interest entities (PIEs) must publish a non-financial declaration under the 2014 European Union (EU) Non-Financial Reporting Directive (NFRD). Building on the NFRD, the 2022 EU Corporate Sustainability Reporting Directive (CSRD) and related Environmental Sustainability Reporting Standards (ESRS) refer for the first time to the RMS and ICS. PIEs must report on risk management and internal controls over the sustainability reporting process, as well as on selected risk management processes starting from financial year 2024. Future European directives (e.g. Corporate Sustainability Due Diligence Directive (CSDDD)) will add further obligations. In the context of German national legislation, the 2021 Supply Chain Due Diligence Act (SCDDA), effective from 2023, addresses the management of sustainability risks in the supply chain. The revised German Corporate Governance Code (GCGC) of 2022 introduced a soft law recommendation stating that the RMS and ICS should also include sustainability-related objectives.

There is growing research activity addressing ERM and ICS in the context of sustainability. For example, prior studies focused on the practical utilization of ERM from a management perspective (e.g. Valinejad and Rahmani, 2018), or on the implementation of environmental management systems as an approach for risk reduction (e.g. Boiral et al., 2018). Most empirical research uses quantitative methods and indicate positive effects of the ERM and ICS on corporate social responsibility (CSR) performance and disclosure (e.g. P. Huang et al., 2022; Musallam, 2018; Pérez-Cornejo and de Quevedo-Puente, 2023). There are also studies to the contrary (e.g. Sarkis, 2006). However, little qualitative research exists, especially with a focus on the German capital market. For example, a number of authors applied surveys to examine the integration of sustainability into ERM and ICS (DRSC, 2023; Scheffler & Flath, 2023). Other research already analyzed the reports of DAX companies at the intersection of sustainability and both systems (Stakeholder Reporting, 2022, 2023; Teucher & Ratzinger-Sakel, 2024). However, these studies only addressed sustainability as a subordinate focus or lacked methodological quality. Consequently, a research gap can be identified in the area of a qualitative analysis of corporate reports in the German capital market.

Given the illustrated relevance, this paper closes the identified research gap and contributes to existing literature with the following two research objectives. First, this study aims to provide empirical insights on the reporting quality about sustainability-related ERM and ICS. Second, it builds on previous findings on the reporting behavior of companies operating in (non-)environmental sensitive sectors and develops them in the context of sustainability-related ERM and ICS. Environmentally sensitive sectors (chemicals, construction, industrials, utilities) are defined following Garcia et al. (2017) and Richardson and Welker (2001).

This paper assesses the reporting on the sustainability-related ERM and ICS within the environmental, social and governance (ESG) disclosures of German DAX40 companies for the years 2022 and 2023 from the perspective of stakeholder agency theory. A self-developed disclosure index was applied, which allows an integrated analysis of the reporting on both systems. This method has been used in previous research (e.g. Hooghiemstra et al., 2015; Michelon et al., 2015), although the integrated analysis represents a new approach.

The sample is motivated as follows. DAX40 represent the largest listed firms in the German capital market. From a theoretical perspective, large companies often face significant agency problems (Jensen & Meckling, 1976; Sarens & Christopher, 2010). ERM or ICS can thereby serve as monitoring mechanisms (Hernández-Madrigal et al., 2020). As already mentioned, stakeholders increasingly put pressure on organizations to operate sustainably and demand transparent corporate disclosure. Integrating sustainability into the ERM and ICS, as well as reporting on it, may therefore reduce information asymmetries and agency conflicts. Moreover, the German capital market represents an interesting field of research, as it is the subject of globally unique European provisions (Velte, 2023).

After this introduction, Chapter 2 develops a basic understanding of the systems, and presents the theoretical framework and regulatory environment. Chapter 3 provides an overview of previous literature and develops the research questions. This is followed by a description of the research methodology in Chapter 4. Then, Chapter 5 elaborates on the empirical results and discusses them in light of the theoretical framework. Implications as well as limitations and recommendations for future research can be found in Chapter 6. Finally, Chapter 7 gives a summary.

2. Theoretical framework

2.1. Enterprise risk management and internal control system

There are various definitions of ERM and ICS. This paper adopts the understanding of the widely used ERM frame-

work by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). COSO defines ERM as follows: "The culture, capabilities, and practices, integrated with strategy-setting and performance, that organizations rely on to manage risk in creating, preserving, and realizing value." (COSO, 2017, p. 10). In this sense and in line with the regulatory environment of this paper, the aim of the ERM is the identification, assessment, reaction and prevention of negative effects (risks) that can significantly impact an organization (Bartuschka, 2022; Boiral et al., 2020; Brown et al., 2009; COSO, 2017; Gatzert & Martin, 2015). Given the aforementioned scope and complexity of sustainability issues, this paper adapts the concept of an enterprise-wide risk management system (RMS), which differs from traditional silo-based RMS through its integration into the entire company (Hernández-Madrigal et al., 2020; Lu et al., 2022; Naseem et al., 2020). For the ICS, the paper also refers to the corresponding COSO framework, which defines the system as follows: "Internal control is a process, effected by an entity's [...] management, [...], designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance." (COSO, 2013, p. 3). Consequently, it aims ensure the efficiency and effectiveness of operations as well as compliance with regulations and guidelines (Bartuschka, 2022; COSO, 2013, 2023; Deumes & Knechel, 2008). This paper adopts the view that the ICS is an essential part of a broader ERM (COSO, 2023; Velte, 2022). This perspective is supported by previous studies and legislation that often refer to internal control and risk management systems and thereby imply closely interconnection (Henk, 2020; Sarens et al., 2009). The systems are nevertheless regarded as separate.

Against the background of the geographically applicable regulations in this paper, an effective risk management and ICS requires internal auditing and includes a compliance management system (CMS) (Government Commission on the German Corporate Governance Code, 2022). The internal audit system (IAS) provides auditing and consulting services on behalf of the management, with the aim of evaluating and improving the effectiveness of the ERM and ICS (Berwanger & Kullmann, 2012), while the CMS aims to ensure compliance with regulatory and legal obligations (IDW, 2022). The Institute of German Certified Public Accountants (IDW) has established auditing standards for all four systems (RMS, ICS, CMS, IAS) (see IDW, 2017a, 2017b, 2017c, 2022). It can therefore be assumed that the systems are closely linked but can be observed separately. Given the focus of this paper, the CMS and IAS are not considered in detail in the remainder of this paper.

2.2. Stakeholder agency theory

This paper will examine ESG reports on the sustainability-related ERM and ICS from the perspective of stakeholder agency theory (Hill & Jones, 1992). This theory represents a trade-off between stakeholder theory (Freeman, 1984; see also Freeman, 2010) and agency theory (Hill & Jones, 1992; Jensen & Meckling, 1976). According to agency theory, information asymmetries arise between management and shareholders due to the separation of ownership and control (Jensen & Meckling, 1976). This can lead to self-serving behavior and moral hazard by the management (Brennan, 2005). Accordingly, suitable control mechanisms for monitoring the management must be established as part of corporate governance (Short et al., 1999). Hill and Jones (1992) extended this problem of agency conflicts between the management and shareholders to other stakeholders (Hernández-Madrigal et al., 2020). Based on this view, the company is a nexus of contracts with explicit and implicit contractual relationships involving various stakeholders, while simultaneously recognizing different levels of power (Collier, 2008). Therefore, managers can be considered as stakeholder agents (Naciti et al., 2021). Stakeholders include for example investors, customers, employees, the environment, or the society (Hill & Jones, 1992; Rezaee, 2016).

The objective of this research is to analyze the reporting practices on the integration of sustainability into the ERM and ICS of German DAX 40 companies that were initiated by the management. Unlike the Anglo-Saxon one-tier system, the German listed companies are organized under the so-called two-tier system (management and supervisory board) (Stiglbauer & Velte, 2014). While this organizational separation can also lead to information asymmetries within an organization, the theoretical framework of this paper focuses on the relationship between management and external stakeholders.

Stakeholder agency theory may provide various contributions to the different facets of this research. Stakeholders are expecting disclosure about the organization's activities and how it addresses risks in order to ensure the company's survival (Shad et al., 2019). As a result of the growing focus on sustainability issues, companies publish ESG reports with the aim of increasing transparency and reducing information asymmetries (Buallay, 2022; Gray et al., 1995; Hahn & Kühnen, 2013; Michelon & Parbonetti, 2012). Management may see an increased need for the publication of sustainability information if the company is undervalued on the capital market, for example (Dienes & Velte, 2016). Additional incentives for publishing sustainability reports come from standard setters such as the Global Reporting Initiative (GRI) (Dienes & Velte, 2016). This framework is used as the dominant reporting basis for the sustainability reports of German DAX40 companies (Stakeholder Reporting, 2023), thereby supporting the theoretical focus of this paper.

DAX40 companies represent the largest listed companies within the German capital market. Following Dumay and Hossain (2019), larger companies are likely to publish more information to lower information asymmetry and reduce agency costs, as they are often facing significant agency problems (Jensen & Meckling, 1976; Sarens & Christopher, 2010).

The substantive focus of this paper lies on the reporting on the sustainability-related ERM and ICS. In general, both

systems are not directly visible to stakeholders outside the organization, which makes them dependent on reporting in light of information asymmetries (Deumes & Knechel, 2008). However, reporting on the sustainability-related risk management and control systems, as well as the integration of sustainability itself, is not directly prescribed in Germany yet. But, voluntary disclosure may serve as an external monitoring mechanism to reduce agency costs (Louie et al., 2019). Stakeholder agency theory could therefore explain why companies voluntarily report on their sustainability-related ERM and ICS. Besides, this paper deals with the integration of sustainability into ERM and ICS. As described in the introduction, ERM and ICS can provide several benefits, such as enhancing environmental information or help to adequately address sustainability risks. Therefore, a corresponding risk management and internal control system (including internal auditing) can help to reduce the efficiency loss in agency conflicts by serving as a monitoring and control mechanism according to stakeholders' demands (D. Anderson et al., 1993; Deumes & Knechel, 2008; Hernández-Madrigal et al., 2020; Jensen & Meckling, 1976; Sarens & Christopher, 2010).

A recent literature review on sustainability reporting and management control showed that stakeholder theory and agency theory are the most commonly used theories in this area (Traxler et al., 2020). When analyzing the ICS, agency theory is also the most popular theory, as shown by the literature review of Henk (2020). The same applies to ERM (Crawford & Jabbour, 2024; Jankensgård, 2019). Stakeholder agency theory is used less frequently, but has also been applied by previous studies, for example in the analysis between ERM and CSR (e.g. Pérez-Cornejo and de Quevedo-Puente, 2023) or ERM implementation (e.g. Hernández-Madrigal et al., 2020).

2.3. Regulatory background

Given the overall research objective, there are several regulatory dimensions of relevance. German DAX40 companies have been subject to national legislation with direct reference to the RMS and ICS for a long time. The obligation to implement a RMS was introduced for the first time in 1999 with the German law on control and transparency in business (KonTraG), thereby laying the foundation for further legal obligations. In the following decades, often in response to economic scandals, a series of laws followed, which placed more specific requirements on the RMS and ICS and its reporting (e.g. the German Accounting Law Modernization Act (BilMoG), or the German Financial Market Integrity Strengthening Act (FISG)). Sustainability was first considered with the recommendations of the revised version of the GCGC effective from fiscal year 2022.

Next to national legislation, German DAX40 companies are also subject to European regulatory requirements, which play a unique role in global comparison (Velte, 2023). General relevance for the integration of sustainability into the RMS and ICS can be derived from the requirements of the European Green Deal. According to its provisions, European companies must be climate-neutral by 2050 (European Commission, 2021). In the context of this paper, this target is relevant for companies as the RMS and ICS can also focus on the reduction of emissions (COSO and wbcsd, 2018), for example by the integration of carbon risks in the RMS (Subramaniam et al., 2015), or by enhancing quality of greenhouse gas data through an effective ICS (COSO, 2023). More specific requirements for the integration of sustainability into the RMS and ICS and the corresponding reporting are set out in the CSRD and the associated ESRS, which are to be applied from the 2024 reporting year.

The described regulatory developments at national and European level underline the complexity of the regulatory environment for the German capital market and DAX40 companies. Due to the large number of individual regulations both at national and European level, Table B1 in the Appendix provides a comprehensive overview of the relevant standards regarding the RMS and ICS and sustainability reporting.

3. Literature review and research questions

There is already considerable research addressing the integration of sustainability into ERM and ICS from a conceptual, management perspective. For example, studies look at ERM in relation to different areas of application, such as the supply chain (e.g. Foerstl et al., 2010; Giannakis and Papadopoulos, 2016; Valinejad and Rahmani, 2018; T. Wu and Blackhurst, 2009) or sustainable risk identification in the product development (e.g. Palousis et al., 2010). Lenssen et al. (2014), for example, emphasizes the relevance of an integrative approach for sustainability, risk management and governance. Other studies highlight the advantages of an ICS in relation to sustainability issues in organizations, for example with regard to corporate sustainability performance (e.g. Harasheh and Provasi, 2023), or data collection (e.g. Chan et al., 2021; J. Zhang et al., 2024).

Empirically, the link between ERM and ICS and sustainability has also already been investigated. With regard to ERM, there is a large number of studies that examine the influence of environmental management systems (EMS). Mohammed (2000) found that one of the main reasons for implementing an EMS can be the reduction of risks. Therefore it can be argued that EMS is a crucial element of a complete ERM system (S. J. Wu et al., 2008). The results of a literature review and a meta-analysis point in the same direction. Boiral et al. (2018) found mainly positive effects on the reduction of environmental risks in the application of the EMS Standard ISO 14001. The results of Nawrocka and Parker (2009) show similar results, but with less available evidence. As an EMS can also include other factors in addition to the management of risks, it will not be discussed in detail in the remainder of this paper.

Most of prior research showed a positive effect of RMS on CSR applying quantitative methods. Pérez-Cornejo and de Quevedo-Puente (2023) found that ERM system quality can improve CSR performance and corporate reputation, while

Musallam (2018) showed that the existence of a RMS enhances CSR disclosure. Moreover, firms with an effective RMS can reduce the effects of individual and overarching risks on CSR objectives, and are more willing to engage in CSR activities (Kuo et al., 2021). In line with that, Shah et al. (2024) demonstrated that the integration of an ERM reduces ESG risks and increases "green growth". On the other hand, there are limited studies that indicate a negative effects. Sarkis (2006) showed a significant negative effect of adaption of environmental risk management practices on environmental performance, with a potential explanation that the focus on risk minimization does not necessarily entail environmental improvements. In line with that, Dobler et al. (2014) found a negative but insignificant relationship between active management of environmental risks and environmental performance. Here the authors argued that this finding does not necessarily indicate an ineffective RMS, but that the system simply did not affect the examined environmental performance variables.

In other studies, ERM, CSR or ESG was applied as a moderator or mediator. ERM mediates the positive correlation between board gender diversity and sustainability performance (Fakir & Jusoh, 2020), or partially mediates the positive relationship between CSR and firm performance (Naseem et al., 2020). Chairani and Siregar (2021) found that ESG moderates the positive relationship between ERM and firm value, while Pérez-Cornejo and de Quevedo-Puente (2023) showed that CSR mediates the positive correlation between ERM and corporate reputation. Further studies indicated additional effects of integrating sustainability into ERM, such as the reduction of costs of equity capital (Sharfman & Fernando, 2008), or the financial risk forecasting effectiveness (Capelli et al., 2021). Another widely cited work is that of Shad et al. (2019), who establishes a conceptual framework for the integration of sustainability reporting into ERM and the relationship to business performance.

For the ICS, recent studies empirically indicate a positive influence of the ICS on CSR disclosure or performance. In general, ethical and social responsible firms are more likely to have an effective ICS (Kim et al., 2017). P. Huang et al. (2022) found in a Chinese setting a positive correlation between internal control quality and the information content of CSR reports by reducing companies' agency costs. In line with that, Wang and Hu (2023) showed internal control effectiveness favorable for environmental information disclosure. Other authors came to similar conclusions (R. Huang & Huang, 2020; J. Zhang et al., 2024). With regard to environmental performance, ICS can have a positive effect on environmental performance through its positive effect on environmental investments (Liu et al., 2024). In line with these findings, the probability of ICS weaknesses is negatively related to ESG performance (Moffitt et al., 2023). Moreover, a company's ESG rating is positive related to the growth (change of costs) of the ICS (Harasheh & Provasi, 2023), which emphasizes the relevance of the ICS for CSR performance. In contrast, there are hardly any studies that show negative effects of ICS. Only one study indicated no effect between ICS and CSR activities (Qin, 2019, cited by Li, 2020).

As for the ERM, a mediating or moderating effect was investigated in some studies. The ICS partially mediates the positive correlation between CSR and financial performance (L. Zhang & Su, 2023), or moderates the positive relationship of corporate environmental responsibility and financial performance (Liu et al., 2024). Other authors showed that the positive relationship between ESG ratings and financial performance was negatively moderated by ICS weaknesses (Boulhaga, Bouri, et al., 2023). Further studies showed additional effects of the ICS in relation to sustainability, such as that in environmental uncertainty the ICS effectiveness is higher (Jokipii, 2010). In light of the theoretical background of this paper, Boulhaga, Elbardan, and Elmassri (2023) found that a higher quality ICS (through the integration of CSR) can reduce conditional accounting conservatism, which helps to reduce agency conflicts (Shen et al., 2020). CSR and ICS can also have a positive impact on stakeholders view of the firm (Akisik & Gal, 2017).

With regard to German companies and the capital market, there is less research in the analysis at the intersection of ERM, ICS and sustainability. Based on a survey of 100 German industrial companies (including 65% listed companies), Scheffler and Flath (2023) found a full integration of sustainability risks into the ERM by 39%. Another study examined the statements on the appropriateness and effectiveness of the RMS and ICS for 2022, and observed only single statements on the still expandable integration of sustainability into the systems (Teucher & Ratzinger-Sakel, 2024). The Accounting Standards Committee of Germany (ASCG) examined the implementation of the ESRS with the help of a survey among the DAX40 in 2023. They found that 30% linked sustainability issues to risk management and 12.5% to the internal control system (DRSC, 2023). The results differ from two studies carried out by the consulting firm Stakeholder Reporting. These studies examined DAX40 sustainability reports for 2021 and 2022, with a partial aspect of the analysis focusing on the risk management system. The authors found that 85% in 2021 and 87.5% in 2022 of companies reported integrating sustainability risks into their risk management system (Stakeholder Reporting, 2022, 2023), although the description of the method and a theoretical embedding was barely provided.

The existing studies in relation to the German capital therefore fail to examine the company reports in relation to the ICS and RMS in more detail, or have methodological or scientific limitations. Against this background, this paper aims to answer the following main research question:

> *RQ1: What is the status of reporting on the sustainability-related ERM and ICS in German DAX companies?*

Previous research emphasize that companies operating in environmental sensitive sectors are expected to disclose more environmental information (Chelli et al., 2018). As mentioned before, the second objective of this work is to examine

how these findings can be further developed in the area of reporting on sustainability-related ERM and ICS. This paper adopts the definitions for sensitive industries from previous studies (Garcia et al., 2017; Richardson & Welker, 2001). From the perspective of stakeholder agency theory, stakeholders may hold higher expectations of these organizations, for example, in the area of sustainable corporate governance or reporting. To meet the increased demand for information and to counteract the subsequent information imbalances, more detailed reporting may be necessary. Based on this, the second research question is as follows:

> *RQ2: How does the reporting differ between companies from environmental sensitive, and less sensitive industry sectors?*

4. Research methodology

4.1. Sample selection and data sources

This study examines 29 German companies listed on the DAX40 for the period from 2022 and 2023. The corresponding DAX40 composition is based on the official report of the financial services provider Qontigo as of 31 December 2023.

The German capital market was chosen due to recent European (e.g. CSRD) and national regulatory (e.g. GCGC) developments. In addition to the substantive regulatory requirements, corporates operating in the German capital market are subject to two different forms of legal binding (hard law vs. soft law), making them a unique research object. DAX40 companies were selected as they represent the largest companies within the German capital market. In light of the theoretical framework, these organizations are expected to need and have a more developed RMS and ICS (Gatzert & Martin, 2015; Lundqvist, 2015), as they are facing a broader range of stakeholders (Hernández-Madrigal et al., 2020) which are increasing demanding sustainability disclosure (Boiral et al., 2020), and are more likely to face significant agency problems (Jensen & Meckling, 1976; Sarens & Christopher, 2010). In addition, they are subject to the most comprehensive regulatory provisions due to their size.

The observation period starts with the financial year 2022, as the revised version of GCGC had to be applied here for the first time. Moreover, the financial year 2023 is the last year before the application of the CSRD. Beyond that, the years 2022 and 2023 are the most recent years for which the data sources were available. The two-year period allows the observation of a possible trend, albeit only to a limited extent.

Data was sourced from annual reports, sustainability reports, if available integrated reports, which were manually downloaded from the respective companies' websites. These data sources were chosen because all DAX 40 companies publish such reports, and all data was expected here for the further course of the data analysis. Other published disclosure vehicles such as "ESG presentations" and the like were not included. For reasons of comparability, only reports in English language were analyzed.

The initial sample consists of all 40 companies listed in the DAX40. This paper applies three exclusion criteria. First, eight financial and insurance companies are excluded due to their special regulations (Velte, 2017), following the approach of previous research (e.g. Deumes and Knechel, 2008; Gad, 2020). Second, for reasons of comparability and due to the research focus, this paper excludes two additional companies that do not report in accordance with German law. This approach is also in line with prior studies (Teucher & Ratzinger-Sakel, 2024). Third, one company was excluded due to its practical reporting practice. The non-financial statement according to GCC represents a relevant report element in the context of the data analysis (see Chapter 4.4). Therefore, one company, whose non-financial statement was integrated into another company's group statement, was excluded. The final sample therefore consists of 29 companies.

In light of the second research questions of this paper, the final sample is further categorized into companies operating in (non-) environmental sensitive industries.

Table 1 provides an overview of the selection process, distribution by industry as well as the proportion of companies operating in (non-) environmental sensitive sectors. Table B2 in the Appendix provides a comprehensive overview of all the companies examined, their associated industry and the company reports that were used for the data analysis.

4.2. Development of the disclosure index

A cornerstone of this research was the development of a suitable method for analyzing ESG reports in terms of the integration of sustainability into the ERM and ICS. This paper applies a self-developed disclosure index, which can be seen as a sub-type of a content analysis (Hassan & Marston, 2019; Krippendorff, 2019). In previous research, disclosure indices were often deployed to analyze disclosures on the ICS (e.g. Deumes and Knechel, 2008; Gad, 2020; Van De Poel and Vanstraelen, 2011). However, there is less use of indices with regard to the RMS. To the best of the author's knowledge, there has been no previous study that has examined the ERM and ICS in an integrated index. The attempt of this paper to develop an index for the integrated analysis of both systems therefore represents a novel approach.

The selection of the items is one of the key issues in the development of an index (Marston & Shrives, 1991). Against this background, the content of the index in this paper was developed on the basis of two popular conceptual frameworks by COSO. Specifically, it builds on the Enterprise Risk Management – Integrating with Strategy and Performance framework (see COSO, 2017), and the Internal Control – Integrated Framework (see COSO, 2013). These frameworks are the dominant models for both the RMS and ICS (Chen et al., 2017; Hayne & Free, 2014; Hernández-Madrigal et al., 2020). Previous research also used COSO frameworks for the development of disclosure indices (e.g. Hooghiemstra

Table 1: Sample selection and description.

Panel A: Sample size	
Companies in the DAX40	40
less	
Finance and insurance companies[a]	8
Not reporting to German law	2
Practical reporting practice	1
Final sample	29
Panel B: Distribution by industry sector	
Industry sector[b]	**Number of companies**
Automobile	5
Chemicals	5
Consumer	3
Industrial	5
Pharma & Healthcare	3
Utilities	2
Others	6
Panel C: Categorization by (non-) environmental sensitive sector[c]	
Companies in environmental sensitive sectors	13
Companies in non-environmental sensitive sectors	16

[a] This includes two companies that were classified as financial holdings by the Frankfurt Stock Exchange and were therefore excluded.
[b] The sectors were determined on the basis of the Frankfurt Stock Market classification. Sectors that only include one company (Construction, Retail, Software, Technology, Telecommunications, Transportation & Logistics) haven been grouped as "Others".
[c] Environmentally conscious sectors include the following industry sectors: Chemicals, Industrial, Utilities, Construction.

et al., 2015; Michelon et al., 2015), thereby supporting the approach of this paper.

The development of the index was based on the different conceptual elements of the frameworks. COSO defines so-called *components*, *principles*, and for the ICS framework *points of focus*. Principles represent the fundamental concepts within each component of the respective systems. Points of focus provide further explanations. Thus, the assessment criteria of the index are mainly derived from the principles, as they are well suited as evaluation items due to their substantial and practical focus. In some cases, the assessment criteria refer to the points of focus. Recently, COSO has further developed the internal control framework for sustainability reporting (see COSO, 2023). Similarly, the COSO risk management framework was adopted for the application to ESG-related risk (see COSO and wbcsd, 2018). In doing so, COSO does not define any new components or principles, but interprets and explains them in the context of sustainability. With regard to the focus of this paper, the new interpretations are also considered when developing the assessment criteria. In addition to the COSO frameworks, the substantive structure of the index is also derived from the regulatory environment. This approach makes it possible to combine the more practical, process-related character of the COSO frameworks with some of the content-related focal points on sustainability issues found in recent legislation.

Notably, some of the components and associated principles in the frameworks are very similar (Lundqvist, 2015), for example in terms of their substantive focus and possible practical application. Therefore, certain principles are merged within the index to reflect these overlaps and to avoid double data collection. As mentioned before, this integrated approach for analyzing the reporting on the ERM and ICS represents a new method. Previous studies often examined either and exclusively the ERM or the ICS based on its components defined by COSO (e.g. Chen et al., 2017; Crawford and Nilsson, 2023; Michelon et al., 2015). Nonetheless, the merging of these frameworks is supported by recent literature, which emphasizes the substantive overlap and a sometimes unclear distinction between the individual principles (Prewett & Terry, 2018). The consolidation of the principles is supported not only by factual similarities but also by the integrated understanding of the ERM and ICS of this paper. In this way, the integrated index developed for this study will analyze the reporting of both systems in a connected and integrated way.

4.3. Integrated ERM and ICS disclosure index

The developed index is conceptually structured as follows. *Assessment criteria* form the specific items for the evaluation of each ESG report. These criteria are grouped into different *categories* based on their substantive focus. *Sections* then divide these categories from an organizational perspective.

The index is divided into three sections: (1) *General characteristics*, (2) *Performance on environmental issues*, and (3) *Monitoring*. The first section outlines general features of the systems from an organizational perspective. It includes the categories *System environment* (category 1), *Statement on system setup* (category 2) and *Specific system setup* (category 3). The second section provides an in-depth analysis of the practical application of the systems within the five topic-related ESRS for environmental aspects (ESRS E1 to E5). In this way it combines the process-related character of the COSO frameworks with content requirements of the regulatory environment. Consequently, the focus is less on the specific systems but more on the practical management of sustainability risks. Based on the five ESRS topics, this section consists of five categories *Performance I - V* (category 4 to 8). The third section deals with the monitoring of the systems and includes the categories *Internal oversight* (category 9) and *External oversight* (category 10).

Due to the different number of assessment criteria and index categories, the index is not weighted equally. Since in the later analysis each index section is considered separately and the different sections are not set in relation, a balancing weighting was not considered necessary.

All criteria are rated on a binary scale from 0 to 1. *Zero points* correspond to no statement on the respective criterion. *One point* correspond to the existence of the respective criterion. Here, for example, a detailed description of a process is necessary. Simply referring to the existence of a corresponding process is not considered sufficient. This leads to a total achievable score of 45 points (100%).

Table B3 in the Appendix provides a general overview of the index, including the allocation of the COSO framework principles and the embedded regulatory framework. Table B4 describes the derivation principles and a detailed description of the assessment criteria.

4.4. Data analysis

The data analysis comprises of the following four steps: selection of relevant disclosure vehicles, definition of report elements to be analyzed, performance of the assessment, and analysis of the data.

The *first step* was to select relevant disclosure instruments for the subsequent analysis. Drawing on the theoretical and regulatory framework, annual reports, sustainability reports, and integrated reports (where available) were considered relevant and defined as data sources. In a *second step*, the relevant report elements were determined. In light of the theoretical background, only those elements that are initiated by management were considered. Based on the regulatory framework, the entire management report and the sustainability report were considered relevant, thus serving as the fundamental database for the assessment. However, certain index categories deviate from this general logic. For index categories 2 and 9, only the corporate governance statement and the risk and opportunity report within the management report are considered. Both index categories were derived from the recommendations of the GCGC. The mentioned reporting elements represent the expected locations for corresponding reporting. For index category 10, the auditor's report is the relevant part of the report due to the focus of the assessment criteria. All other report components (e.g. the annual financial statement, or the remuneration report) were excluded from the analysis due to their irrelevance to the focus of this study. The general focus on the narrative elements of reports is also in line with the approach of previous studies (Hooghiemstra et al., 2015), as information about for example on the ICS (Deumes & Knechel, 2008; Van De Poel & Vanstraelen, 2011) and sustainability (Beattie, 2014) mainly occurs in these parts. The allocation of the analyzed report components to the assessment criteria can also be found in Table B3 in the Appendix. The *third step* was the assessment based on the criteria of the disclosure index. The final results were documented in a separate Excel spreadsheet. This spreadsheet forms the dependable data basis for the analysis. Simultaneously, the documents were coarsely systematically coded according to the assessment criteria. MAXQDA2024 (Version 24.4.0) was utilized for the coding. The reason for the coding methodology was to achieve better transparency, traceability and thus finally the best possible consistency. In summary, a total of 2610 individual data points needed to be recorded for the entire sample and both years. The coding resulted in 2985 labeled passages. *Step four* was to analyze the collected data. In order to provide an overall statement about the reporting quality, this paper follows the four levels defined by Wulf et al. (2020). A score of 25% or less is considered *rudimentary*. Reporting is rated as *restrained* if the score is between 25% and 50%, and *satisfactory* if it is between 50% and 75%. Reports scoring over 75% are considered *comprehensive*. Percentages were calculated by dividing the individual points by the maximal achievable score. The presentation of the findings was partly inspired by the research of Braasch and Velte (2023) and Deumes and Knechel (2008), who also applied assessment models, although in a different research areas.

5. Results

5.1. Overall results

Table 2 shows the numerical scoring distribution with absolute and relative data for all 29 sample companies and both years analyzed.

In the following, the overall results are described. They are displayed in the *Total Score* column in Table 2. The percentages presented are calculated based on the maximum achievable score for the entire index. The analyzed companies achieved an average score (*Mean*) of 42% in 2022 and 45% in 2023. Both mean values are therefore in the range of restrained report quality. Although a positive trend can be identified, the *Mean Growth Rate* of +3.80% is only in the low single-digit percentage range. The maximum number of points ($Points_{Max}$) in both years is 67%, corresponding to a satisfactory level. On the other hand, the minimum number of points ($Points_{Min}$) is 22% in 2022 (20 % in 2023), and thereby in the area of rudimentary reporting quality. From the perspective of stakeholder agency theory, the results demonstrate that companies have significant potential for improvement in order to reduce information asymmetries and agency costs. The overall results are also presented in Figure 1.

5.2. Results by index section

This chapter describes the consolidated results per index section. The results for the three index sections are provided as *Sub-scores I-III* within Table 2. Base values for calculating the percentages are the respective maximum scores of the index sections. The results for the first index section (*General characteristics*) are above the mean of the total score in both years. The average sub-score increases from 69% in 2022 to 70% in 2023, equal to a mean growth rate of +1.24%. Both values are therefore in the satisfactory area of reporting quality. From a theoretical perspective, it can be implied

Table 2: Consolidated numerical scoring across sections and categories.

	(1) General characteristics				(2) Performance on environmental issues						(3) Monitoring			
Year	**Cat. 1**	**Cat. 2**	**Cat. 3**	***Sub-score I***	**Cat. 4**	**Cat. 5**	**Cat. 6**	**Cat. 7**	**Cat.8**	***Sub-score II***	**Cat. 9**	**Cat. 10**	***Sub-score III***	***Total score***
2023														
$Score_A$	4	4	4	*12*	6	6	6	6	6	*30*	5	3	*8*	*50*
Mean	3.79 (94)	2.90 (72)	1.66 (41)	*8.34 (70)*	3.34 (67)	1.24 (25)	2.66 (53)	1.83 (37)	1.97 (40)	*11.03 (37)*	0.79 (16)	0 (0)	*0.79 (10)*	*20.17 (45)*
Median	4 (100)	3 (75)	2 (50)	*8 (67)*	3 (60)	1 (20)	3 (60)	2 (40)	2 (40)	*11 (37)*	0 (0)	0 (0)	*0 (0)*	*20 (44)*
Std. Dev.	–	–	–	*1.06*	–	–	–	–	–	*4.33*	–	–	*1.13*	*4.85*
2022														
$Score_A$	4	4	4	*12*	6	6	6	6	6	*30*	5	3	*8*	*50*
Mean (%)	3.97 (99)	2.69 (67)	1.59 (40)	*8.24 (69)*	3.14 (63)	1.24 (25)	2.38 (48)	1.55 (31)	1.62 (32)	*9.93 (33)*	0.55 (11)	0 (0)	*0.55 (7)*	*18.72 (42)*
Median (abs)	4 (100)	3 (75)	2 (50)	*8 (67)*	3 (60)	1 (20)	2 (40)	1 (20)	1 (20)	*9 (30)*	0 (0)	0 (0)	*0 (0)*	*18 (40)*
Std. Dev.	–	–	–	*1.22*	–	–	–	–	–	*4.16*	–	–	*0.89*	*4.66*
Mean Growth Rate	–	–	–	*+1.24%*	–	–	–	–	–	*+5.51%*	–	–	*9.95%*	*+3.80%*
Sensitive sector	–	–	–	–	–	–	–	–	–	–	–	–	–	*+3.11%*
Non-sensitive sector	–	–	–	–	–	–	–	–	–	–	–	–	–	*+4.39%*

Note. This table shows the total scoring, broken down by index section and the associated ten index categories. Moreover, it presents the results based on the sector categorization. Percentages have been rounded to one decimal place.
Abbreviations: $Score_A$ = Score achievable. Std. Dev. = Standard Deviation.

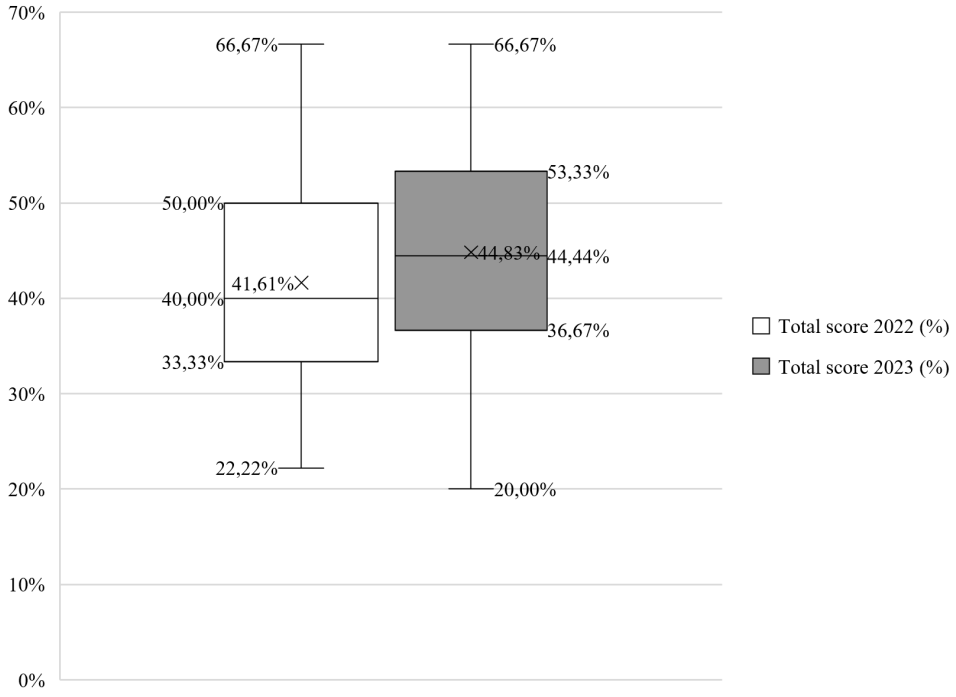

Figure 1: Overall scoring for 2022 and 2023.

that companies report in a comprehensive manner to meet stakeholder demands and reduce information asymmetries. The mean value for the second index section (*Performance on environmental issues*) is slightly below the respective value of the overall scoring. In 2022, the mean sub-score is 33% (37% in 2023). This places both years in the area of restrained reporting quality on performance on environmental issues. However, the mean growth rate (+5.51%) is slightly above the corresponding value of the overall scoring. The third index section (*Monitoring*) reveals the lowest sub-scoring. In 2022, the average is 7% and reaches 10% in 2023. This corresponds to a relatively high Mean Growth Rate of +9.95%. However, the values are clearly in the rudimentary range in terms of reporting quality. For the last two categories, there is the risk of insufficient reporting quality to adequately address information asymmetries between the management and external stakeholders.

5.3. Results by index category and criterion

The following chapter describes the results from the scoring categories and selected assessment criteria based on the mean values. For the index categories, Table 2 displays the consolidated results. Detailed results for all assessment criteria can be found in Table B5 in the Appendix.

Categories of the first index section. The first category (*General system environment*) addresses the system environment of the ERM and ICS, comprising relatively general items. This index category contains the highest mean value within the first index section for both years (2022: 99%; 2023: 95%). All four assessment criteria are close to the optimal mean of 1.0, indicating comprehensive report quality and a solid approach to addressing information asymmetries. One possible explanation for these results may lie in the broad and generic focus of the specific COSO principles on which the assessment criteria in this category are defined. Category 2 (*Statement on system setup*) was developed on the basis of recommendation A.3 of the GCGC to integrate sustainability into the RMS and ICS and consequently into the CMS. For both years, the average mean values indicate satisfactory reporting quality and show a positive development (2023 = 72%; 2022 = 67%). When examining the declaration of compliance with recommendation A.3 of the GCGC (assessment criterion 2.1), a positive development can be observed, with all analyzed companies providing a corresponding statement in 2023. Thus, the maximum mean value of 1.0 was achieved in 2023 (2022: 0.90). One potential explanation for the lower score in 2022 might be that the GCGC revision was introduced during the financial year 2022. Therefore, not all companies may have published a corresponding declaration on the revised code in time. With regard to individual statements about the systems, three assessment criteria cover the RMS (assessment criterion 2.2), ICS (assessment criterion 2.3) and CMS (assessment criterion 2.4). The analyzed companies report most frequently on the integration of sustainability into the RMS (2023 = 0.90; 2022 = 0.86), followed by the ICS (2023 = 0.72; 2022 = 0.62), and lastly the CMS (2023 = 0.28; 2022 = 0.31). Except for the CMS, a positive development from 2022 to 2023 is noticeable. However, the values are distributed in the spectrum of restrained, satisfactory and comprehensive reporting quality, demonstrating uneven reporting quality on the systems. Particularly noteworthy is the significantly

lower level of reporting on the integration of sustainability into the CMS. The substantially lower score for the CMS may be explained by the fact that the GCGC only refers to the RMS and ICS in its recommendation A.3. However, the CMS is described as a part of the RMS and ICS in Principle 5 of the GCGC and should therefore also be included in the reporting. The results for the RMS are similar to those of Stakeholder Reporting (2023), who found that 87.5% of the analyzed DAX40 companies had integrated sustainability into their risk management system by 2022. Finally, category 3 (*Specific system setup*) deals with statements about selected system specifications. The analysis reveals restrained reporting quality for both years, with virtually no positive developments (2023 = 41%; 2022 = 40%). The analysis showed the highest mean values in the area of reporting on the application of environmental management systems (assessment criterion 3.4), which can be seen as part of a risk management systems (2023 = 0.93; 2022 = 0.93). Reporting on sustainability-related aspects of the respective industries (assessment criterion 3.1) received less attention and suggests restrained quality (2023 = 0.48; 2022 = 0.45). Companies barely report on their risk appetite (assessment criterion 3.2) or on the consideration of (un)intentional misuse (assessment criterion 3.3) in the area of sustainability issues. The mean values for both the reporting on the risk appetite (2023 = 0.10; 2022 = 0.07), as well as on the consideration of misuse (2023 = 0.14; 2022 = 0.14), clearly fall into the scope of rudimentary reporting.

Categories of the second index section. Categories 4 to 8 deal with practical statements on risk management performance for the five ESRS environmental issues and contain five assessment criteria each. Due to the large number of individual assessment criteria, the results are presented in condensed form in the following. A cross-category comparison of the mean values shows that the companies provide information particularly on the topics of climate change (2023 = 67%; 2022 = 63%), and water and marine resources (2023 = 53%; 2022 = 48%). Thus, reporting on both topics is of satisfactory reporting quality or has developed into this category during the observation period. The environmental topics of biodiversity and ecosystems (2023 = 37%; 2022 = 31%), and resource use and circular economy (2023 = 40%; 2022 = 32%) range in the middle of the five categories and demonstrate the biggest development. Nevertheless, companies only report on both topics with restrained quality on average. The topic of environmental pollution (2023 = 25%; 2022 = 25%) receives the least attention in the disclosure and is in the upper rudimentary range of reporting quality. Figure 2 shows the distribution of the scoring according to the five ESRS topics. As mentioned before, the same five assessment criteria are applied for each environmental ESRS topic (index category). Looking at the mean values for the five criteria across all ESRS topics, a clear focus emerges. Companies report most frequently on risk mitigation and response (2023 = 0.90; 2022 = 0.88), followed by risk identification, assessment and prioritization (2023 = 0.60; 2022 = 0.54). Reporting on the application of technology (2023 = 0.28; 2022 = 0.22), and the relevance and quality of data is almost identical (2023 = 0.24; 2022 = 0.22). It is particularly noteworthy that hardly any company makes a clear statement about integrating the ESRS topics into their risk management system (2023 = 0.18; 2022 = 0.12). This result is in line with the statements of Soomro and Lai (2017), who emphasize that the processes of sustainability and risk management are rarely integrated. However, the results for the integration of ESRS into the risk management system show a negative deviation from the results of a previous study. A survey found that 30% of DAX40 companies have integrated the ESRS into their RMS in 2023 (DRSC, 2023). This discrepancy highlights the necessity for companies to enhance their reporting quality in order to reduce potential information asymmetries. Figure 3 presents the average distribution of the assessment criteria across the five ESRS topics.

Categories of the third index section. Category 9 (*internal oversight*) focuses on internal oversight. Although this category achieves a better score than the second category in this section, it is still clearly in the area of rudimentary reporting quality (2023 = 16%; 2022 = 11%). The mean values of the assessment criteria are as follows. Companies most often report on the evaluation and improvement of systems in the context of sustainability (assessment criterion 9.3), albeit only in the area of rudimentary or restrained reporting quality (2023 = 0.38; 2022 = 0.28). The next most frequent item reported is the performance of an internal audit with a focus on ESG issues (assessment criterion 9.2). Although a relatively significant growth can be observed, both values indicate only rudimentary disclosure (2023 = 0.21; 2022 = 0.10). The remaining three items play a subordinate role in the reporting and score all in the area of restrained reporting quality. In light of existing research, the results of assessment criterion 9 are noteworthy. This item deals with the statement on the appropriateness and effectiveness of the ERM and ICS with regard to sustainability in accordance with recommendation A.5 of the GCGC. Teucher and Ratzinger-Sakel (2024) also analyzed the reports of the DAX 40 companies in 2022 for this statement. In their analysis of the inclusion of sustainability in the statement, they remain quantitatively imprecise, merely referring to “individual cases” (Teucher & Ratzinger-Sakel, 2024, p. 366). The analysis of this paper obtained a mean score for both years of 0.1. In absolute figures, this corresponds to three companies that have reported accordingly. However, due to the lack of precise information, it is not possible to say whether this research is completely in line with the previous findings. The items in category 10 (*external oversight*) analyze whether an external audit of the three systems ERM, ICS and CMS has been carried out with regard to sustainability on the basis of the IDW standards. No company has reported on a corresponding audit.

5.4. Results by categorization based on environmentally sensitive sectors

With regard to the second research question of this paper, the analysis revealed mixed results. Prior research suggests that companies operating in environmentally sensitive

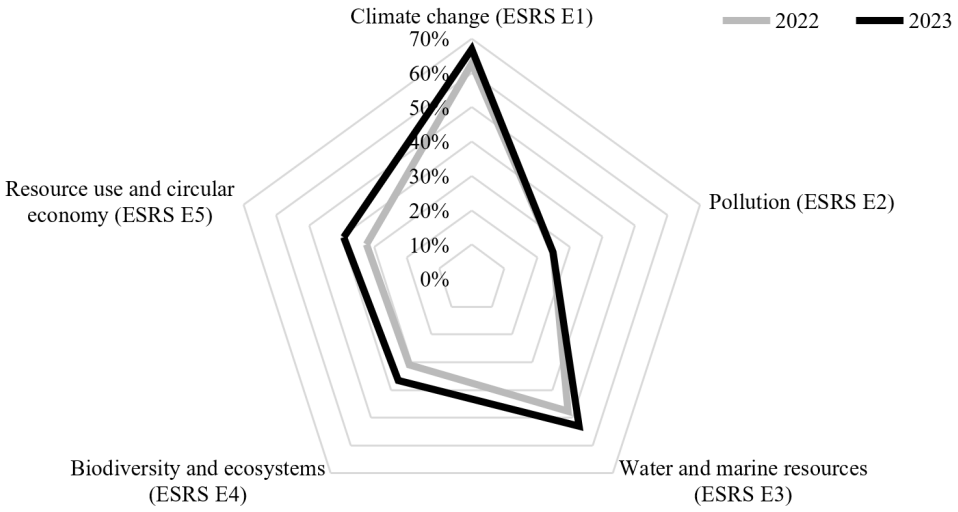

Figure 2: Scoring by index section two (ESRS topics).

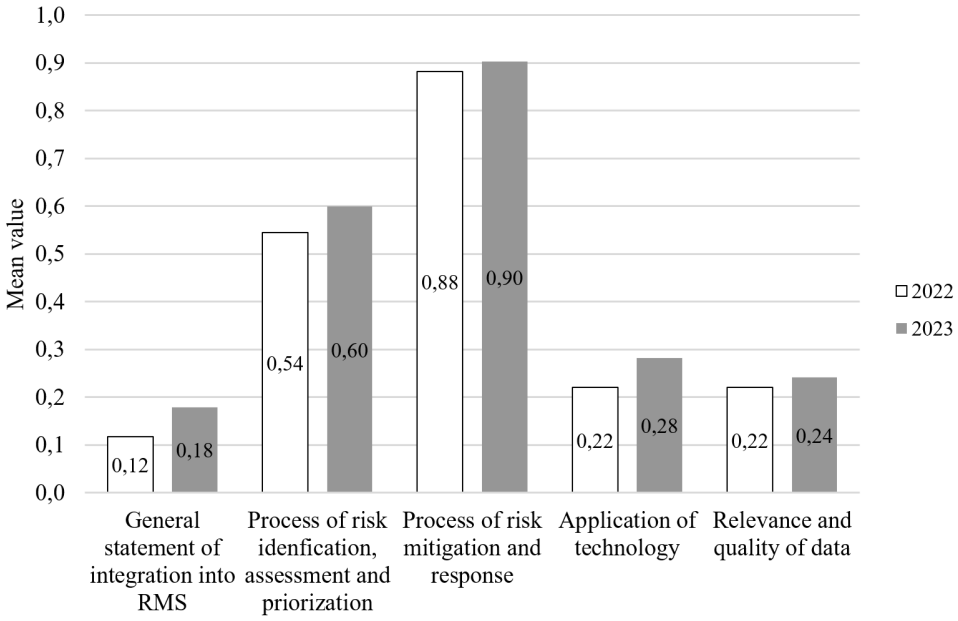

Figure 3: Scoring by assessment criterion in index section two.

sectors are expected to report more on sustainability (Chelli et al., 2018). From the perspective of stakeholder agency theory, external stakeholders may have higher expectations of these companies, for example with regard to sustainable corporate performance and reporting. Consequently, a more comprehensive reporting is required to address higher information asymmetries and reduce agency conflicts. For 2022, it can be observed that companies belonging to environmentally sensitive sectors produce better reporting quality. Nevertheless, the percentage difference is relatively marginal. Companies operating in the sensitive sector achieve a mean value of 44.72%, while the remaining companies achieve an average score of 40.28%. Both groups are still operating at the level of restrained reporting quality. The trend towards 2023 shows that the quality of reporting by companies from non-sensitive sectors has improved by a greater proportion. The mean growth rate here is +4.39%, while the sensitive sector only gained +3.11% on average. Consequently, the statement that companies in environmental sectors produce better reporting quality can no longer be fully supported for 2023. The results imply that the affiliation to environmental sectors does not necessarily influence the reporting quality in the context of risk management and internal control systems. Figure 4 presents the findings according to the categorization for both years.

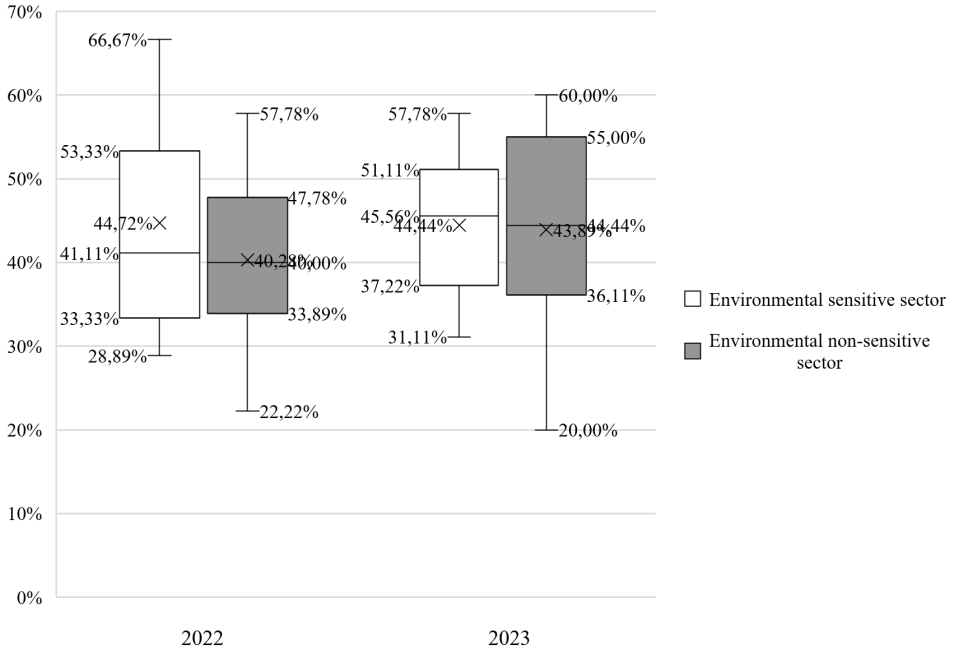

Figure 4: Scoring by (non-) environmental sensitive sector.

6. Conclusions

6.1. Implications for academia, policy and business practice

This study contributes to sustainable corporate governance literature and closes a research gap for the German capital market. The paper developed a disclosure index that examines both the risk management and internal control system in the context of sustainability. To the best of the author's knowledge, this integrated approach has never been applied in research before and thus represents a novelty in academic literature. When looking at the findings, the overall analysis showed that companies report with restrained quality on the integration of sustainability into their ERM and ICS. From the perspective of stakeholder agency theory, companies publish sustainability reports to address information asymmetries between the management and external stakeholders, helping to reduce agency costs (Buallay, 2022; Gray et al., 1995; Hahn & Kühnen, 2013; Michelon & Parbonetti, 2012). High-quality reporting on the systems can therefore be seen as an important approach for improving transparency about the way sustainability risks are managed or how the internal control system may be used to improve the reliability of sustainable reports. The analysis also revealed that some aspects of the systems in connection with sustainability are not reported on, or insufficiently reported on. Therefore, there is a probability of information asymmetries, which may lead to agency conflicts or higher agency costs. Due to scarce prior research, a discussion based on previous findings presented a hurdle. As presented in Chapter 5, some of the outcomes are in line with previous research. However, existing studies often lack substantive depth or methodological quality, thereby hindering a valid comparison. With regard to the second research objective of this paper, the conclusions of earlier research cannot be clearly confirmed. Previous authors stated that companies operating in environmental sectors may publish more environmental information (e.g. Chelli et al., 2018). This does not necessarily appear to be the case when reporting on the interface between sustainability and ERM and ICS. While in 2022 a slightly better reporting quality from companies in environmentally sensitive sectors could still be observed, the results for 2023 showed an almost balanced reporting quality.

The results of this research also have implications for policy makers and regulatory bodies. The analysis showed a potential influence of specific legal provisions on reporting quality. For example, index category 3 was developed on the basis of the soft-law GCGC recommendation A.3. According to this, the ERM and ICS should also cover sustainability-related goals. Simultaneously, §161 GCC refers to the GCGC recommendations and requires a statement of compliance with the recommendations. If no compliance statement is provided, deviations must be explicitly explained. The results in category 3 reveal that for both years almost all companies (2023 = 100%, 2022 = 90%) did not declare any explicit deviation from recommendation A.3. The lower value for 2022 could possibly be explained by the implementation of the revised version within the observation period. However, further findings in category 3 reveal that fewer companies disclose a voluntary statement about the integration of sustainability into their systems. Under the stakeholder agency paradigm, simply stating compliance without providing specific substantial reference may not be as effective as making an explicit qualitative statement to reduce information asymmetries. This paper argues in favor of amendments to existing regulatory

obligations, also to counteract the risk of information asymmetries and agency conflicts. The goal should be a clear regulatory framework that enables companies to report in a reliable, comprehensive and consistent form on the integration of sustainability into the ERM and ICS. Consequently, distinct substantive requirements should be set. In the light of the findings of this paper, the following selected aspects should be included in future legal amendments. First, there should be a precise description of which sustainability aspects are included in the ERM and ICS. Second, the role of further corporate governance mechanisms (e.g. IAS) should be described in this context. Third, in view of the results of assessment criterion 9.5, a detailed qualitative statement on the effectiveness and appropriateness should be required. Fourth, reporting should also cover the performance and results of an external audit on the two sustainability-related systems. In addition to the substantive requirements, the legislation should also prescribe a clear location for such disclosures. From the author's point of view, the corporate governance statement may be suitable. A corresponding regulatory requirement may be integrated into Section 289 (4) GCC in conjunction with Section 289f HGB. According to the first paragraph, companies are already required to report on the key features of both systems, but in the context of the financial accounting process. The second paragraph requires the submission of the corporate governance statement.

Moreover, this paper reveals implications for business practice. The results indicate clear weaknesses (e.g. description monitoring aspects) when reporting on the integration of sustainability into the ERM and ICS. Consequently, companies may draw on these results, adapt their reporting and thus take a step towards reducing information asymmetries with external stakeholders.

6.2. Limitations and recommendations

This study holds some methodological limitations that also show the potential for future research. First, limitations exist with regard to the *sample selection*. This paper analyzed a narrow sample of 29 companies listed in the German DAX40. Thus, future research could also focus on the reporting practices of the financial and insurance companies that were excluded from this study. Furthermore, companies listed on other indices of the German capital market (e.g. MDAX, SDAX) could be examined. Since the obligations of the CSRD will also have to be applied by non-listed German companies in the future, an investigation may also be interesting here. Considering non-listed companies is also interesting since the recommendations of the GCGC to integrate sustainability into the RMS and ICS primarily target listed companies. Accordingly, these companies are required to submit a declaration of conformity. A comparison between listed and non-listed companies would also be interesting to examine the influence of recommendations and conformity declarations on disclosure practices. Moreover, the analysis could be carried out on the European capital market in order to examine possible differences between different national regulatory regimes on the reporting behavior and quality. Second, there are limitations in terms of the used *data sources*. The reports examined represent the dominant disclosure vehicles and are therefore suitable for the objective of this research using a disclosure index. However, it must be noted that not all written information necessarily reflects the actual integration of sustainability. Apart from text analysis, expert interviews or questionnaires for example could be additional qualitative methods to analyze the integration of sustainability into the RMS and ICS. Third, the application of a *disclosure index* as a type of content analysis holds some limitations. A disclosure index can only measure the content based on the pre-defined evaluation items. The development of the index used in this paper was given particular importance and has therefore also been developed based on the widely applied COSO frameworks for both systems. However, it cannot be ruled out that the index does not cover some aspects that were reported on and are also important for a further understanding of the integration of sustainability into the RMS and ICS. As mentioned by Marston and Shrives (1991), the problem may arise that certain items are not as relevant for some companies as they are for others. Since this paper examines companies from different industry sectors, this might also be a weakness of the method. Furthermore, the index does not reflect the extent of reporting on a specific criterion. The sole use of a binary disclosure index makes it impossible to analyze where a particular assessment criterion was reported in the reports. Fourth, there are also limitations in terms of the *scope of this research*. Also, against the background of practical realizability, this paper focused on performance in relation to the environmental issues defined by the ESRS. Future research could build on the conceptual framework of this paper and investigate the reporting on the integration of social topics into the RMS and ICS, for example using the social issues defined by the ESRS. Fifth, there are limitations with regard to the *practical execution* of this study. Through the clear definition of the assessment criteria and the use of a coding tool, an attempt was made to maximize reproducibility. However, as this study was conducted by a single person, biases or individual imprecision cannot be ruled out.

7. Summary

The aim of this paper was an empirical-qualitative assessment of the reporting on the integration of sustainability into the RMS and ICS. The overarching research objective of this study, stated by the first research question, was to gain empirical insights into the quality of reporting. A second research question focused on potential disparities in the reporting quality between companies operating in (non-) environmental sensitive sectors.

Building on stakeholder agency theory, the study focused on a sample of 29 German DAX40 companies. For the analysis, a self-developed disclosure index was applied to ESG reports for the financial years 2022 and 2023. The approach of integrating both systems into one index for an analysis of

ESG reporting represents a new method in academic sustainable corporate governance literature.

The topic, sample and observation period was motivated by societal, practical and regulatory relevance. Organizations are facing a growing number of complex sustainability issues and the associated risks, while stakeholders are increasingly demanding sustainable corporate performance and associated reporting. Integrating sustainability into the ERM and ICS and corresponding reporting can therefore be an approach to adequately address sustainability risks, improve sustainable corporate performance and increase the reliability of sustainability reports. Furthermore, companies are subject to an increasing number of current and future regulations at both the national and European level.

This research contributes to an identified research gap. There is very scare qualitative research at the intersection between sustainability and risk management and internal control systems. Existing research mainly uses quantitative methods. With regard to the German capital market, previous qualitative research pays little attention to sustainability or lacks methodical quality. To the best of the author's knowledge, there is no research examining the integration of sustainability into ERM and ICS with a combined disclosure index. Through the lens of stakeholder agency theory, reporting on these systems can help to reduce information asymmetries between the management and external stakeholders.

The empirical results indicate an overall restrained reporting quality. There are significant differences among the individual index sections, categories and assessment criteria. A minor trend was observed from 2022 to 2023. Therefore, with regard to the first research question, the results show a mixed picture. In light of the theoretical framework, there is a risk of information asymmetries between management and external stakeholders, which can lead to increased agency costs. As for the second research question, in 2022 it can be noted that companies in environmentally sensitive sectors are reporting at a higher rate. In 2023, this observation can no longer be supported.

The research has several methodological limitations, such as the size of the sample, possible methodological deficiencies in the development of the index, or personal bias when conducting the analysis. Based on a number of limitations, recommendations for future research can be derived.

The research is highly relevant for business practice, academia and regulatory bodies. The results show distinct shortcomings that can be drawn upon by policy makers and companies in the future.

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