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Environmental Reporting Practices in German EMAS-registered Organisations

In-depth Content Analysis

by

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Environmental standards are an important part of corporate sustainability efforts. According to signalling theory, they provide relevant information about a company's efforts, while institutional theory assumes that firms use them to mitigate societal pressures by selectively disclosing information. The European Eco-Management and Audit Scheme (EMAS) is a widely applied example of a voluntary environmental standard. This paper aims to uncover insights into the application of the standard in the highly relevant case of Germany. A new framework was constructed to conduct a content analysis of environmental reports combining requirements from literature and the standard itself. The framework was applied to a sample of 81 reports from German firms that recently registered with the standard. The manual in-depth analysis of the reports was followed by statistical testing to uncover patterns in the data collected. The results suggest that firms use reporting in a more encompassing way than previous studies suggested. Especially the inclusion of core indicators was satisfying and a learning experience could be detected from the inclusion of other items. The only significant difference between types of firms found suggests higher core indicator coverage in the manufacturing sector. The outlook on firm performance was not able to find an association between report quality and firm performance. Overall, the study supports the assumptions of signalling theory over institutional theory and includes important trajectories for research and policymakers on how to improve the standard.

Keywords: EMAS, Environmental Reporting, German firms, Content Analysis, Indicators

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Table of Contents

List of Tables

List of Figures

List of acronyms

EMAS .....Eco-Management and Audit Scheme

IPCC……. Intergovernmental Panel on Climate Change

EMS .....Environmental Management System

EU .....European Union

GRI .....Global Reporting Initiative

NACE .....Nomenclature of Economic Activities

OLS .....Ordinary least squares model

ROA .....Return on Assets

ANOVA .....Analysis of Variance

KW-Test…….Kruskal-Wallis Test

1 Introduction

The most recent report by the Intergovernmental Panel on Climate Change once again emphasises the urgency of addressing climate change to avoid manifold risks for humanity and ecosystems as well as criticises the extent to which actors have taken up action so far (IPCC, 2022). This calls for increased efforts towards a more sustainable future. At the scale of transforming entire industries and encouraging firms to behave more sustainably, the role of the government in supporting the firm's journey toward a greener economy has been identified as crucial (Delmas, Lyon & Maxwell, 2019). Despite being far behind the demands of scientists, the European Union (EU) has ambitions to be the first climate-neutral continent and strives to have zero greenhouse gas emissions by 2050 through the implementation of the European Green Deal (European Commission, 2022a). The Eco-Management and Audit Scheme (EMAS) was already established in 1993 and is an important governmental instrument for supporting firms in their efforts toward more sustainable business and has notable advantages in credibility as it includes third-party verification (European Commission, 2022b). It has long been established that the general public is highly critical of the environmental practices of firms and increasingly demands transparency that goes beyond the economic activities of a firm (Daub, 2007). This increasing pressure to demonstrate their efforts has led to rising numbers of firms publishing information in the form of environmental reports outside of mandatory schemes (Roca & Searcy, 2012). Published by EMAS-certified firms, these environmental reports provide a unique opportunity to investigate the implementation of voluntary standards as a governmental instrument to improve firm sustainability. The method used in this study to assess the quality of the environmental reports is a content analysis approach. Content analysis of sustainability reports has so far relied mostly on counting the number of relevant words, remaining at a rather superficial level (Papoutsi & Sodhi, 2020). This calls for a more in-depth analysis of sustainability reports published as a part of the EMAS certification. The central role of Germany in the EU economy (Bulmer & Paterson, 2013) prompted this study to focus on German organisations. The insights on the thoroughness of the implementation of the standard will be combined with an outlook on the impact of report quality on firm performance. Investigating if closely following the guidelines can help firms reap economic benefits.

1.1 Research Problem

While the flexibility of voluntary standard's requirements has led to widespread application of the EMAS standard and allows organisations to adapt it to their specific needs and come up with individual solutions (Testa, Rizzi, Daddi, Gusmerotti, Frey & Iraldo, 2014), this flexibility also comes with its downsides. Methodologically, it has proven difficult to assess results for EMAS since the reports have weaknesses connected to the comparability of data, operationalisation of indicators, and lack of harmonisation of measurements and indicators

(Testa et al. 2014). Therefore, through a content analysis of published EMAS reports, this study aims to answer the following research questions:

1. How well do German organisations report on the required elements of EMAS in their environmental reports?
2. Does the quality of reports differ between different groups o firms according to the sector, size, and year of certification?
3. Is there an association between report quality and economic performance?

Although there is a lot of research in the field analysing environmental management systems (EMS), very few studies address the EMAS standard specifically (Testa et al. 2014). This might be because ISO 14001 as an alternative standard is more frequently implemented, especially on a global level (Neugebauer, 2012). Erauskin-Tolosa, Zubeltzu-Jaka, Heras-Saizarbitoria and Boiral (2019) identified a knowledge gap for practitioners as well as public decision-makers since no clear picture of the impact of voluntary standards has emerged yet. Sustainability reporting can only be considered transparent and reliable if the data disclosed is of sufficient quality and made available to stakeholders (Arthur, Wu, Yago & Zhang, 2017). Along those lines, a common criticism of the existing literature is that mostly self-reported impacts of EMS are used to analyse outcomes. Those can be influenced by common biases, like social desirability. This study aims to overcome those weaknesses by using EMAS statements that are deemed to be less biased due to their external verification (Marrucci & Daddi, 2021), and have been neglected in the literature as a credible source of data (Heras-Saizarbitoria, Boiral, García & Allur, 2020).

Previous studies have pointed out that a significant amount of the EMAS statements analysed did not include enough concise information on their environmental impacts and management system, and call for more precise guidelines and a more rigorous procedure of verification of the published information (Skouloudis, Jones, Sfakianaki, Lazoudi & Evangelinos, 2013). This is a motivation for this study as well as a snapshot of the status quo of the environmental statements in the past. The standard has been revised and improved since previous investigations, calling for more research on the reports published after the 2010 revision to investigate if this has led to improvements in the environmental reporting of EMAS certified firms (Skouloudis et al. 2013).

It has long been recognised that comparability is crucial for the effectiveness of external reporting (Bonilla-Priego & Avilés-Palacios, 2008). The lack of standardisation and comparability has led to the tendency to view a certification with a voluntary standard as a form of greenwashing (Papoutsi & Sodhi, 2020). This is further motivation to investigate those reports more closely.

This study makes the following contributions. First, new data is collected from the environmental reports and analysed using a novel content analysis approach and specifically constructed index. This data is investigated closely to identify patterns and differences between types of organisations. Lastly, the study takes one additional step in trying to investigate the

association of the collected report quality data with the certified firm's financial performance. This has been deemed interesting since Frondel, Krätschell and Zwick (2018) state that, while the link of EMS to environmental performance is extensively researched and mostly considered positive, there is a lack of understanding concerning the economic performance outcomes of those systems. The effects of environmental reporting can vary substantially according to whether the public perceives them as credible and encompassing (Hahn & Kühnen, 2013). The main focus of the study will be on analysing the reports thoroughly with the newly constructed framework, investigating the status-quo of EMAS reports in Germany.

1.2 Aim and Scope

This study aims to analyse how well different German firms incorporate the compulsory core performance indicators and other requirements proposed by EMAS in their public environmental statements. The focus on German firms when analysing environmental standards such as EMAS has been called for in the literature since previous studies tended to focus on southern European countries which can also be seen in the literature review (Heras-Saizarbitoria et al. 2020). This gap becomes especially relevant since Germany is the country with the most EMAS certified organisations and is still experiencing growth in registrations (European Commission, 2022b). This can be due to the institutional context in Germany, making efforts to aid firms with the administration of EMAS by providing regulatory relief (Testa, Heras-Saizarbitoria, Daddi, Boiral & Iraldo, 2016). Apart from that Germany has historically taken on a central role in the EU, especially in its economy (Bulmer & Paterson, 2013). This makes it not only an interesting environment to analyse EMAS reporting but also provides a sample size of registered firms big enough to draw interesting conclusions and base statistical inference on.

The continuous growth of registrations in recent years becomes especially important since the sample will be restricted to firms that have been certified recently. Since January 2010 EMAS III, the second modification of the standard is in effect. This revision includes the environmental core indicators for reporting purposes. Together with the more recent improvements of the standards, which have to be implemented since 2017 (European Commission, 2022b), this will allow addressing the recent developments in the standard and investigate if they have brought about improvements in the reporting. In addition, this study will give an outlook on performance outcomes associated with the thoroughness or quality of the reports. This led to the restriction of the study sample to firms that must publish their financial statements according to German law. The firms have to publish their financial statements 12 months after the end of the fiscal year (Bundesamt für Justiz, 2022). At the time of the study financial reports from 2020 were not fully available. To arrive at a more comprehensive sample financial performance was taken from the 2019 financial reports. This is assumed to be unproblematic as report quality remains constant. The benefits of EMAS implementation for firms can typically be detected after one to two years (European Commission, 2022b), along those lines the sample must be restricted if effects on financial performance are to be measured to allow the changes to come into effect.

This study provides insights into the validity of standards with relatively open implementation guidelines. It contributes newly collected data in an up to date and a highly relevant country case for Germany. Additionally, it provides a new framework for the content analysis of EMAS reports specifically by including the standard's newest requirements. Additionally, it can point out weaknesses in the design of the EMAS requirements that should be improved upon by policymakers to ensure positive environmental and economic outcomes.

1.3 Outline of the Thesis

The remainder of the thesis will be structured as follows. First, important background information on the EMAS standard is provided. This study's research questions and aims will be supplemented by a presentation of relevant previous works and an overview of the related theoretical concepts in the third chapter. This will be followed by a description of the data used for the analysis in chapter four and the introduction of the methods and model used in chapter five. Chapter six contains the empirical analysis and explains the findings of the study in detail discusses them and puts them into the context of the research. Finally, chapter seven will conclude the study by reflecting on the main outcomes.

2 Background

To understand the research motivation, it is important to provide some background on the EMAS standard. The Eco-Management and Audit Scheme (EMAS) was introduced in 1993 by the European Commission (2022b) and is open for voluntary participation by organisations. Since 2001 the certification is available for all sectors, not only industrial activities, and includes the international standard ISO 14001. The EMAS standard has become one of the most frequently implemented and most credible of the voluntary environmental standards (Iraldo, Testa & Frey, 2009). The 2010 revision of the standard includes improvements for application in smaller firms, the inclusion of quantitative core indicators including; energy, material, water and land-use, waste, and emissions; as well as opening the standard to organisations worldwide (European Commission, 2022b). It can be considered a step toward further standardisation and credibility of the reports (Skouloudis et al. 2013) The newest revision of the EMAS regulation took place after the publication of the new ISO 14001 guidelines in 2015. Since the EMAS certification already went beyond many aspects of the ISO 14001 standard, only a few changes had to be made regarding the content of the environmental reports (European Union, 2017).

To register an organisation with the EMAS standard of the European Commission (2022b), the organisation must fulfil certain requirements including demonstrating that they comply with the relevant legislation, pledge to continue to work on minimizing their environmental impacts and demonstrate the involvement of stakeholders, especially their employees. This makes the standard a management tool for firms who want to work on their environmental performance by encouraging them to evaluate, report, and finally improve their performance. Iraldo, Testa and Frey (2009) categorise policy instruments for environmental issues into two groups. One is related to control and less flexibility, while the other provides firms with incentives to achieve targets more efficiently. According to the design of the standard as a management tool, EMAS belongs to the latter.

Additionally, the organisations' EMS including the environmental reports must be verified by an external party. Independent environmental accreditors are licensed by a licensing body of an EU member state, to ensure conformity to the EMAS regulations as well as compliance with environmental regulations (European Commission, 2022b). The environmental statements also allow organisations to inform interested parties about their sustainability efforts and update them on their performance as well as on the implemented measures. Once an organisation is verified and registered with a local competent body, they are entitled to use the EMAS logo (European Union Law, 2017). This third-party validation of the information on environmental performance counteracts common biases in self-reporting (Marrucci & Daddi, 2021), which can significantly contribute to the transparency and validity of the published information. EMAS provides a signal of environmental excellence and commitment to improving environmental performance, which is reviewed by a third party, unlike other reports providing firms with an advantaged position (Iraldo, Testa & Frey, 2009).

However, the impact of EMAS certification on environmental performance is a highly researched area, and while some authors have found evidence that the adoption of EMS improves environmental performance (Iraldo, Testa & Frey, 2009) voluntary standards such as EMAS are not to be viewed as an automatism for better environmental performance (Heras-Saizarbitoria et al. 2020).

According to the European Commission (2022b), as of October 2021, there were 3,887 registered organisations and Germany, Italy and Spain are among those with the most registrations an overview of the registrations in the EU can be found in Appendix A Table A-1. While there has been a slight increase from June to October 2021 of 1.26% there are still some countries that experienced a decrease in registrations in this period an overview is presented in Figure 2-1. Possible reasons for the decline in the EMAS registrations were found in the lack of resources, financial as well as personnel, a lack of public knowledge about the standard, no clear picture for firms on the benefits and a lack of support from the institutional context (Daddi, Giacomo, Frey & Iraldo, 2018).

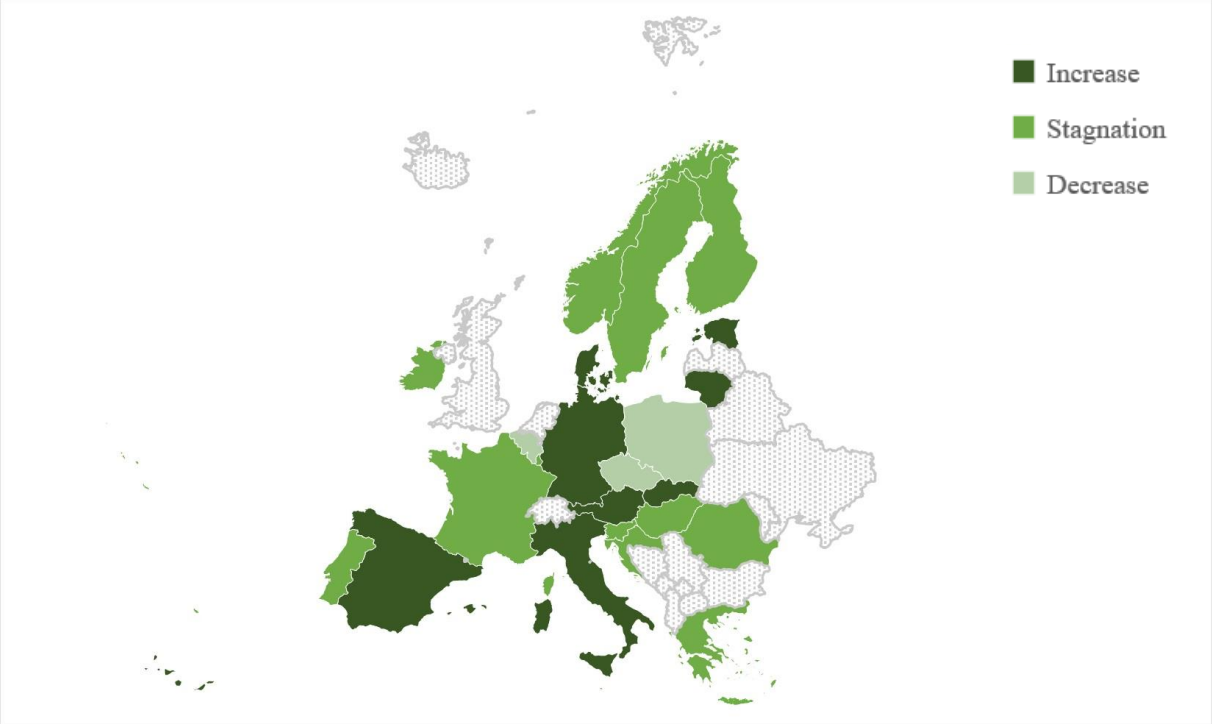

Figure 2-1 EMAS registrations in the EU (author's illustration adopted from (European Commission, 2022b))

Notes: Cyprus has experienced an increase in registered organisations during that period but was left out for visual reasons.

The European Commission (2022b) issued a study on the perceived costs and benefits of participation in the standard. The most common benefit identified by the participants is savings in resources, especially energy, followed by the minimisation of negative incidents as well as better relationships with the organisation's stakeholders. Organisations registered under the EMAS scheme can also receive benefits in the form of regulatory relief as some EU member states offer the certified firms advantages such as reduced fees, longer renewal periods for

permits, and simplified reporting. However, the implementation of the standard also comes with costs of consultancy, time, and human resources to gather the necessary information, implement, and follow up on different measures to improve the performance as well as costs for inspections and registration fees. Firms of different sizes, in different countries, or in different industries find that the costs and benefits differ a lot between them (European Union Law, 2017). For example, smaller firms face proportionally large up-front costs while bigger firms can benefit from economies of scale.

The literature has been investigating the role of the institutional environment of the member states in the adoption of EMAS. There are several ways in which public administration can influence the adoption of a voluntary standard such as EMAS, ranging from providing knowledge, and subsidies, to improving the benefits that firms can derive as well as regulatory reliefs (Testa et al. 2016). According to Kollman and Prakash (2002) initially, opposition in Germany towards the EMAS standard was strong. They state, that since German environmental law is very thorough compared to other member states, and to comply with EMAS, firms need to comply with their home countries' regulations first, it was feared that this would lead to a disadvantage for German firms. A heavy debate on details of the implementation at the national level followed. That made the business associations in Germany, which characterise the centrally organised German private sector, very involved with the implementation of the standard. This facilitates the dissemination of the standard immensely since their network supported coordination as well as the exchange of information. This led to Germany being among only four nations that adopted all of the promotional tools identified by Whitford and Provost (2019) who found a significant effect of government promotion for the adoption of EMAS as a voluntary standard. On a similar note, Glachant, Schucht, Bültmann and Wätzold (2002) found Germany to be a pioneer in subsidising the EMAS standard as well as offering regulatory relief to registered firms. German policy aids the widespread adoption in Germany through this strong selective promotion of the standard.

3 Theory

This chapter will introduce the theory commonly used to investigate sustainability reporting and environmental standards and provide an overview of the work of previous researchers.

3.1 Theoretical Approach

It is important to put this study in the context of available theory to explain sustainability reporting since this has been identified as a shortcoming in previous literature (Hahn & Kühnen, 2013). Signalling theory and institutional theory are the two main theories guiding this study and they propose contrary expectations for the quality of reporting that can be expected.

Signalling theory is especially important for this study since it focuses on the publicly available environmental reports that can serve as a signal to interested parties. It is viewed as one of the main factors for firms to get their EMS certified since it can be used to inform regulatory institutions as well as potential buyers and investors about high-quality environmental management (Johnstone & Labonne, 2009). According to Connelly, Ketchen and Slater (2011), the underlying assumption of signalling theory is that firms pay to use signals that help them to inform their stakeholders about firm characteristics which increase its attractiveness. This is especially relevant for sustainability-related issues as the efforts a firm takes to tackle those are difficult to recognise from outside of the organisation, for example for consumers or investors that want to discern sustainable from unsustainable organisations. To reduce this information asymmetry, firms adopt environmental standards such as EMAS even though they are connected to up-front costs for the firms, as they help showcase their commitment to sustainability and to distinguish themselves from competitors in the market. For interested parties, it is not feasible to conduct the collection of information on environmental performance themselves, so they rely on credible and thorough information provided by the firm (Johnstone & Labonne, 2009). EMAS is especially adept in achieving this due to the obligation to publish annual reports as well as the third-party validation of the published information (European Commission, 2022c). The effects that reporting has on information asymmetry differ greatly on how reliable and thorough the disclosed information is perceived (Hahn & Kühnen, 2013).

Institutional theory is concerned with the formal structures of a firm's organisational environment, which are determined by social norms and processes proposing that firms have to do business within the context of governance structures surrounding them, incorporating the social expectations imposed on them into their business practice (Dillard, Rigsby & Goodman, 2004). A firm must mitigate the pressure imposed by institutions in the firm environment that provides the regulatory frame for doing business, and the environmental practices of the standard-setting firms in an industry can work as a benchmark for other firms that aim to

improve their standing (Connelly, Ketchen & Slater, 2011). This occurs over time since the dynamics of the organisational context lead to the homogenisation of the firms due to outside pressure and imitation in the face of uncertainty (DiMaggio & Powell, 1983). Concerning sustainability reporting practices, institutional theory suggests that firms resort to disclosure to address pressures imposed by powerful interest groups, to imitate other organisations perceived as more successful, or to adhere to social norms (Amran & Haniffa, 2011).

These theories led to the development of important hypotheses for this paper:

1.A The environmental reports are of low quality, disclose information selectively or are unavailable. Institutional theory suggests that firms adopt sustainability reporting or standards to distract from their insufficient environmental performance (Papoutsi & Sodhi, 2020).

1.B Environmental statements are encompassing and of high quality. Signalling theory suggests that sustainability reporting informs about actual sustainability performance as a signal of excellence (Papoutsi & Sodhi, 2020).

These first hypotheses are alternatives, and the paper will investigate which theory seems to better explain the sample.

2. Larger firms publish reports of higher quality. The institutional theory proposes this because they are subjected to more scrutiny from the public(Amran & Haniffa, 2011). Signalling theory proposes similar effects as larger firms are more present in the public eye and receive more media coverage so their signals can be more powerful (Hahn & Kühnen, 2013).

3. Some sectors publish reports of higher quality. Hahn and Kühnen (2013) assume this since some sectors might be more present in the public eye and more inclined to publish information on their sustainability performance.

4. Organisations that participate in EMAS for longer exhibit higher quality reporting. Institutional theory also suggests that the quality of reports should assimilate over time complying with the standard more and more (Hahn & Kühnen, 2013).

In the following, two other important theories that can help to explain why firms engage in environmental reporting and standards will be explained. First, *legitimacy theory* assumes that organisations only exist with the approval of society, embedded in a social system that can penalise undesired behaviour of the firm (Ratanajongkol, Davey & Low, 2006). Therefore, firms need to comply with the expectations of the society around them in order not to lose their legitimacy. Firms can resort to environmental reporting to grant their legitimacy (Hahn & Kühnen, 2013). This theory is closely related to the institutional theory introduced earlier. However, legitimacy theory is focused on the congruency between the organisation's and society's value system while institutional theory is more concrete about measures to improve firm stability such as incorporating institutionalised norms and assimilation with similar firms (Chen & Roberts, 2010). *Stakeholder theory* is often used as the theoretical foundation of investigations on corporate sustainability reporting (Arthur et al. 2017). Its main proposition is that a firm is embedded in a network of actors that have different interests and sustainability reporting should address all of those stakeholders' interests by including indicators of interest, especially to those interest groups who lack the power to demand this type of disclosure

(Clarkson, 2016). Therefore, sustainability reports go beyond addressing just shareholders as done in traditional reporting on financial issues and address a wider array of interest groups to inform them about how the organisation incorporates their interests concerning more sustainable business practices (Hahn & Kühnen, 2013). This view can be seen as similar to legitimacy theory with a special focus on interest groups and their differing demands (Ratanajongkol, Davey & Low, 2006). Aggarwal and Singh (2019) state that while legitimacy theory assumes that firms publish information especially relevant to society or their communities to meet social norms, the stakeholder view states that if firms voluntarily disclose thorough and quantitative information they aim to improve their relationship with their stakeholders to improve their reputation and secure competitive advantages.

Theories explaining the link between voluntary environmental standards and firm performance include *transaction cost theory* proposing that firms will participate in costly sustainable practices only if they can see the economic benefits of doing so (Connelly, Ketchen & Slater, 2011). The *resource-based theory* analyses firms according to the resources they have at their hands (Wernerfelt, 1984). Those resources are limited, and a firm needs to weigh the costs and benefits of any sustainability effort (Connelly, Ketchen & Slater, 2011). Based on this theory, if a firm sustainably handles its resources, its environmental strategies might be connected to performance outcomes (Hart, 1995). These theories build the groundwork for investigating the associations between report quality and firm performance in this study.

3.2 Previous Research

This study is deeply rooted in the literature on voluntary environmental standards. In the field of this study, the two most important streams of literature are studies investigating environmental reporting practices connected to voluntary standards, and studies investigating the performance outcomes of voluntary standards as presented in Figure 3-1. Following this scheme literature on content analysis but also environmental and financial performance outcomes of standards will be introduced. Table D-1 in Appendix D gives an overview of the literature in these fields. It shows that content analysis is most frequently used for analysing

environmental reports based on EMAS and Global Reporting Initiative (GRI) guidelines[1]. A lot of the studies have a focus on one country only and due to the focus on EMAS, it is mostly European countries with a tendency towards investigating southern Europe. Another insight emerging from this overview is that a substantial number of investigations concern reporting standards from 2000to -2010. This again confirms the necessity of more up to date studies.

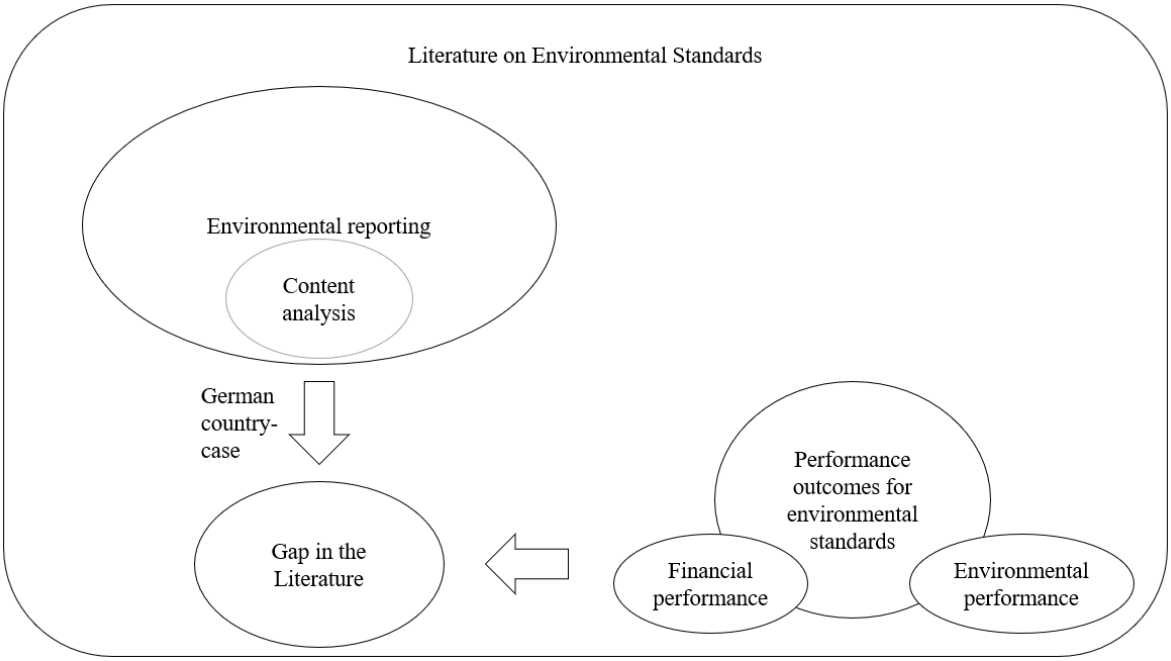

Figure 3-1 Overview of relevant literature (author's illustration)

3.2.1 Content analysis

The most important stream of literature for the main part of this study concerns the application of the content analysis method to environmental reports. Firstly, literature on environmental reporting, in general, will be introduced. Followed by literature that is mainly concerned with

[1] GRI is an independent organisation that provides guidelines on how to report an organisation's impacts in sustainability reports in a standardised way. It is the most widely used framework for constructing a sustainability report globally. Global Reporting Initiative (2022)

the inclusion of performance indicators, literature on firms using the GRI guidelines and finally, previous content analysis studies on EMAS registered firms.

Aggarwal and Singh (2019) analyse sustainability reporting in Indian firms in 2014 since developing countries are underrepresented in the literature and India has made reporting on CSR activities mandatory. They argue that previous studies mostly analysed reporting by the means of the presence and absence of indicators while neglecting the quality of the reports. Their framework is twofold 0/1 for inclusion to measure the quantity and 0-5 to measure quality distinguishing for example between qualitative and quantitative information. They investigate the differences in quality and quantity across different dimensions, industry types, ownership structure, company size and company performance, and find that reports differ significantly. This is followed by a criticism of the difficulty of comparing reports between companies as well as an overall lack of quality of the reports. While large firms appear to be publishing higher-quality reports, findings for profitability were unexpected as firms with low profitability had higher scores on reporting quality and quantity. Concerning differences among sectors, the energy sector emerged as performing best while the telecom sector performed worst. Boiral, Heras-Saizarbitoria and Brotherton (2019) take a slightly different approach than the majority of the literature by analysing the assurance statements by a third party included in mining and energy companies' sustainability reports from 2006-to 2013 to give an overview of the quality of those reports as perceived by the assuring party. They use a qualitative content analysis without a regional focus, assisted by a measuring software. The cautious and optimistic tone that they find in those assurance statements raises some doubts about the independence of the assessment, supporting the rather critical theories of firms using their statements to ensure legitimacy rather than giving full disclosure on their environmental impacts. Overall, they issue serious critiques of the third-party validation of reports and view their credibility as doubtful.

Performance Indicators

A substantial part of the literature is concerned with the inclusion of performance indicators in environmental reports. Papoutsi and Sodhi (2020) collect sustainability indicators from practice, literature, and guidelines, and conduct a content analysis without computer-aided text analysis to provide in-depth insights. They score 51 indicators from 0-3 for non-inclusion, qualitative inclusion, and numerical inclusion to extensive quantitative information with goal definition. Reports included are from European and American firms from 2014. In an analysis of the environmental reports of Spanish hotels from 2005, Bonilla-Priego and Avilés-Palacios (2008) put focus on comparability and differences between types of hotels and the standard of their reporting practice. For their analysis, they group indicators collected from several guidelines and the literature into operational performance and management performance indicators. They investigate how the disclosed data varies between the size of the hotels, the type of tourism they offer if they are part of a hotel chain or not and the number of years that they have been holding the certificate. The authors find that the indicators used most are related to energy, water, and waste as well as big discrepancies overall concerning the comparability of indicators and units used, missing information, and a lack of disclosure on how the data is measured. They are not able to find statistically significant differences between the different types of hotels. Most notably, no experience effect could be found as well as no influence on the size of the hotel. Finally, the availability and usefulness of the reports are criticised, and they suggest moving towards more standardisation in environmental reporting. Roca and

Searcy (2012) investigate the disclosure of quantitative indicators in the 2008 sustainability reports of Canadian firms by counting the number of reports each indicator was mentioned in. They find satisfying coverage on several indicators especially economic indicators, environmental indicators on energy and water use as well as information on emissions, donating and safety. However, the type and number of indicators vary widely among reports.

GRI reporting

A framework that is used most frequently by firms developing their reporting agenda is the GRI which has developed guidelines to ensure standardised reporting that can be voluntarily adopted by firms and adapted to their needs (Daub, 2007). Due to their popularity, GRI reporting standards are frequently investigated in the literature. Boiral and Henri (2017) investigate sustainability reporting in the mining sector with a special focus on measurability and the ability to compare such reports between firms that are part of the same sector and use the GRI guidelines. They investigate the comparability of the individual indicators they identified as well as between firms. Without focusing on a specific region, they find it impossible to compare the firms or to rank them by environmental performance in a credible way based on the analysed reports from 2007. The main issues hindering comparability are vague and unclear statements which overemphasise the positive impacts, loose evaluation, incomplete answers, domination of qualitative non-comparable data, heterogeneous measurement units and the complexity of reports. Another study investigating sustainability reports by Arthur et al. (2017) focuses on the extent of GRI performance indicators disclosed by mining companies in Ghana, adding to the literature on developing countries. They use content analysis to identify the inclusion of economic, environmental, and social indicators rating them solely on inclusion or omission. Economic indicators are most disclosed in the sample followed by ecological indicators, while social indicators are least disclosed. Direct impacts are disclosed more than indirect impacts and in the ecological category materials and energy consumption are more often disclosed than energy efficiency or environmental protection. Overall, a significant improvement in indicator disclosure could be detected from 2008 to 2012, indicating increasing awareness about sustainability issues among Ghanaian mining companies although there is still much room for improvement. They also address that firms might be selective in the indicators disclosed focusing on those not perceived as harmful to the firms' image. Daub (2007) developed a framework based on the GRI guidelines to analyse the contents of sustainability reports published by large Swiss firms in 2001. Their framework includes weighted scores for coverage, policy, performance dimensions, and general aspects of the report. They found a considerable lack of inclusion of performance indicators and criticised that firms struggled to provide hard data on their impacts.

EMAS reports

Some studies focus on EMAS reporting specifically. Erkko, Melanen and Mickwitz (2005) investigate the inclusion of eco-efficiency in EMAS reports of Finnish organisations from 1999 to 2001. They use a scale from A-D differentiating between not referring to eco-efficiency mentioning it in text, with targets, and showing real development similar to the index of Papoutsi and Sodhi (2020). After reviewing the contents of the reports and classifying them according to the inclusion of measures for eco-efficiency, they find that this phenomenon was rarely reported on. Bonilla-Priego and Avilés-Palacios's (2008) analysis mentioned earlier

focuses on the EMAS reports of Spanish hotels investigating differences in the data collected and reported between different groups of hotels. Instead of rating them on a scale, they report details on how information was displayed. Mazzi, Mason, Mason and Scipioni (2012) conduct a quantitative study to investigate the inclusion of indicators in the EMAS reports of Italian public administrations registered until 2008. They identify over 2000 indicators for different environmental areas and report on how many of the sample firms include each indicator. Despite this extensive number of different indicators, there is a significant inconsistency in the use of indicators and there are very few that are used by at least 30% of the municipalities. Moreover, the relevance of the indicators remained doubtful, they are not always robust due to differing indices. Consequently, they are not useful to support benchmarking. Another study on benchmarking in environmental reports by Heras-Saizarbitoria et al. (2020) investigates the inclusion of performance benchmarks and industry best practices in the EMAS reports of Spanish, Portuguese, and Italian hotels. They collect the published data on core indicators and compare the values to industry benchmarks. Using two time periods (2003-2008 & 2013-2017), they find that the inclusion of benchmarks is rarely used by the certified firms and interpret this as a failure of the standard to indicate that the certified firms are forerunners or above and beyond the industry standard. The authors regard this as the main weakness in previous studies that rely on managers' self-assessment to measure outcomes and benefits and stress the need for less biased methods of evaluation. Skouloudis et al. (2013) use content analysis and a detailed scoring system to assess the quality of EMAS statements of Greek firms in 2011. Their scoring system includes weighted scores for individual report elements like material flows, problem areas, and target groups and overall quality like clarity, relevance, text, and visual design similar to the one used by Daub (2007). They find noticeable differences in the information the firms disclose in their reports, concerning comprehensiveness but also a lack of inclusion of core indicators. Firms are found to be very selective on what to disclose. Often, a focus is put on plant and policy description while indicators and critical areas are omitted. They find companies conforming to three types, the biggest group being in the medium performance range disclosing only a satisfactory amount of information, a significantly smaller number of firms are considered committed to the process and go beyond just disclosing the expected amount, and the smallest group are firms who report just enough as to not be rejected by the verifier. The larger the firm the more thorough the reports usually are, although even the big firms do not disclose as exhaustive statements as could be expected. The authors were unable to confirm the expectation of a learning curve. Criticizing the diversity of the statements analysed they state that the current practice does not aid comparability over time or between organisations and fails the concept and purpose of environmental accountability. They assume that these weaknesses hinder firms from identifying opportunities for investments into more sustainable but also more profitable technologies and management strategies. Although some rich insights into EMAS reporting have been gained already, the literature is not exhaustive on this specific standard and more research has been called for (Skouloudis et al. 2013).

3.2.2 Outlook on environmental performance

An important question that comes to mind when investigating voluntary environmental standards and their reporting practices is if those certifications indicate superior environmental performance when compared to uncertified organisations. This section gives an overview of the

literature in this field. The link between disclosure in sustainability reports and sustainability performance at large is investigated by Papoutsi and Sodhi (2020). In addition to the construction of a measure of reporting quality, they use inclusion in sustainability indices as a measure of sustainability performance. The study was able to establish that firms with a better sustainability performance publish more information on their sustainability practices, supporting the expectations of the signalling theory.

Marrucci and Daddi (2021) analyse the impact of EMAS on Italian manufacturing firms' environmental performance from 2016 to 2018. They collect data on the performance concerning the core indicators from the firms' published reports, finding stability with a tendency towards declining environmental performance over time. Iraldo, Testa and Frey (2009) investigate if enterprises that are EMAS certified in 2005 have a better environmental performance. The channels through which they see EMAS affect environmental performance are effective planning and ensuring compliance throughout their supply chain. They test this by relying on data that has been collected during a study on behalf of the European Commission to improve the scheme. Their analysis suggests that environmental performance is only improved through more effective planning ensured by the EMAS management system in their sample.

Since the literature on standards and the ensuing environmental outcomes produced inconclusive and sometimes contradictory results, Erauskin-Tolosa et al. (2019) conduct a meta-analysis on the literature existing in 2019 looking at the environmental performance outcomes connected to certification with the voluntary ISO 14001 and EMAS standards to come to a more conclusive perspective on how the adoption of standards influences environmental performance. The authors find that ISO and EMAS certification seem to have a positive influence on environmental performance, as measured both by firm disclosure and external rating in the literature, to a similar degree. They ascribe the similarity of outcomes despite the strictness of EMAS to the external forces driving firms towards a superficial adoption of EMAS. From this short review of the existing literature, one can cautiously assume that the EMAS standard can help organisations to improve their environmental performance.

3.2.3 Studies on financial performance

Next to the literature on environmental performance outcomes, there is a stream of literature investigating economic performance outcomes. Some studies at the intersection of those two streams combine the two performance measures. The impact of ISO 14001 on a firm's environmental and economic performance from 2009 until 2018 is researched by Arocena, Orcos and Zouaghi (2021). They define environmental performance as tons of CO2 per unit of output and financial performance is represented by the return on assets (ROA). The authors consider the size of a firm and the grade of environmental awareness in the country the firm operates as moderating factors for the influence on performance outcomes. Results show that both indicators are significantly and positively impacted by the adoption of the standard. As expected, firm size aids in reaping economic benefits but it does not help with reducing carbon emissions. The relative economic benefits are greater in countries with more awareness while the environmental benefits are more visible in countries with less environmental awareness. Another study addressing both outcomes is the one by Iraldo, Testa and Frey (2009), who apart

from investigating the impacts of EMAS certification on environmental performance, hypothesise that through improved environmental performance firms also perform better economically. They find that adopting EMAS is not sufficient for performance improvement and are not able to make out a competitive advantage for certified firms in their study. Other studies that solely look at economic performance outcomes like Frondel, Krätschell and Zwick (2018) distinguish between the mere adoption of an EMS and the certification thereof from 2000 until 2003. This includes both the theory of cost-saving and competitive advantage, as well as the effects of signalling environmental performance to the public. They use a combination of matching and regression methods on survey data and find that the implementation of such a system only leaves performance unaffected. However, a certification like EMAS leads to significantly better performance outcomes providing evidence for the signalling theory but not for cost-saving effects. On another note, Guidry and Patten (2010) investigate market reactions to the first-time release of an environmental report for US American firms from 2001 to 2008. Their findings suggest no significant positive market reaction to firms publishing their first report. However, the more in-depth analysis of the impact of the report quality measured by the breadth of indicators reported shows that the market seems to react positively to a high-quality environmental report. They indicate that the quality of the information disclosed matters. These studies suggest that under certain circumstances the adoption of a standard like EMAS can lead to economic benefits especially combined with high-quality reporting. This leads this study to combine content analysis of reports and financial performance outcomes. The number of studies that combine the content analysis approach with a study of the organisation's financial outcomes is very limited. One study by Montabon, Sroufe and Narasimhan (2007) analyses the impact of EMS on firm performance by employing a content analysis strategy on corporate environmental reports to gather data on firms' environmental performance. They uncovered evidence that certain environmental measures positively affect firm performance while no relationship is found for others. This confirms the win-win hypothesis of firms engaging in environmental issues. However, no study addresses the association of report quality and firm performance directly, which this study tries to incorporate. Overall, a thorough review of the literature made it clear that there is a need for more up to date investigation. This study contributes by constructing a new indicator inspired by previous work and applying it to a relevant country case that is missing from the literature.

4 Data

The European Commission (2022c) provides a public EMAS register, where certified organisations can be found. Information is provided on the date of registration, organisation details such as the number of employees and location of the site and the NACE industry codes[2]. The firm's reports can be retrieved from their websites. Those reports often include a mix of qualitative and quantitative information. Even though publishing a report is mandatory not all reports could be accessed. Previous authors have found only 30% of Italian manufacturing firm's reports were publicly available in the EMAS register or on the company's website (Marrucci & Daddi, 2021) while others considered 76% of Greek firm's statements readily available through the website or the request of a copy (Skouloudis et al. 2013). The availability of reports is an indication that the standard's rules and regulations are not always followed. It was considered to contact firms that do not publish their reports on the website. However, this would be a highly time-consuming and possibly not rewarding process as some firms still refused to disclose their statements in earlier studies. Having to contact the firm does not comply with the requirement of making the reports easily accessible to the public. Including reports that had to be requested in the analysis would therefore have distorted the sample and it would no longer be possible to draw conclusions. Apart from the firm's EMAS reports as a source of data, financial data is collected from the firm's financial statements.

4.1 Reports sample

Firms were extracted from the EMAS registration database with the restriction to German firms registered between 01.10.2010 – 31.12.2017. The date range chosen for the analysis reflects the date of implementation of the 2010 revision of the standard to be able to investigate the effect on firms that registered after this as has been called for (Skouloudis et al. 2013). Other studies as well as the European Commission consider timespans from 1-2 years enough for the financial

[2] Nomenclature statistique des activités économiques dans la Communauté européenne (NACE) codes can be acessed via https://nacev2.com/en

effects of EMAS implementation to become visible (European Union Law, 2017; Iraldo, Testa & Frey, 2009) Therefore, a registration up until 2017 was considered likely to impact the financial data for 2019. The sampling process is visualised in Figure 4-1.

In this first step 464 organisations that fit the criteria were identified. The next sample restriction applied was if they are required to publish their financial data in Germany. This was achieved by looking up the financial statements in the German company register. In Germany, the publication of financial statements is very encompassing to ensure transparency, so even small organisations are required to publish financial information (Bundesamt für Justiz, 2022). According to the design of the EMAS standards any type of organisation public or private institutions can participate (European Union Law, 2017). Therefore, a lot of the organisations excluded in this step were public non-profit organisations. Organisations that did not publish a financial statement were excluded from the sample to ensure testability of report quality impact on financial performance. This step eliminated 222 organisations with no publicly available financial data from the sample. 35 additional organisations were eliminated from the sample since their financial statements did not include the relevant data to calculate the financial performance indicator.

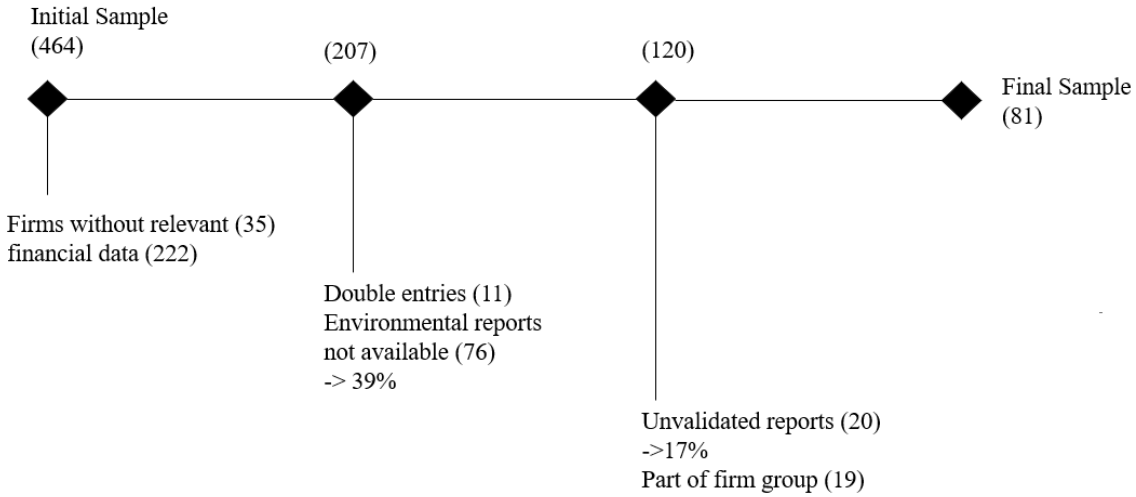

Figure 4-1 Sampling process (author's illustration)

For the remaining sample of 207 organisations, the environmental statements were searched for in the EMAS register and the respective websites. During the search process, 11 of the organisations listed were excluded since they were mentioned twice. So, in total, the reports were searched for 196 organisations. For 76 organisations no environmental statement could be found that was publicly available. This corresponds to a non-disclosure rate of the environmental statements of 39%. Upon closer inspection of the reports, 20 were not validated by an official EMAS verifier and therefore not deemed useful for the analysis. Reports were

classified as unvalidated if they were missing the verification statement signed by an officially accredited verifier at the end of the report. This ensures that the reports analysed are a part of the firm's EMAS certification since especially bigger firms published a variety of information on sustainability that was unrelated to the standard. For some reports, only certain pages of the report referred to the EMAS requirements and were verified thus only those pages were considered relevant. 19 further organisations were excluded from the sample since they belong to a group so the financial data and the environmental reports could not coherently be linked for the analysis. The final sample that was analysed using a context analysis method contained 81 firms. The sample size was considered satisfactory for the method used as previous studies using similar methods worked with sample sizes ranging from 12 (Boiral & Henri, 2017), 40 (Erkko, Melanen & Mickwitz, 2005), 60 (Aggarwal & Singh, 2019), 87 (Kozlowski, Searcy & Bardecki, 2015), 94 (Roca & Searcy, 2012) to 140 (Almeida-Machado, Pinto-Dias & Fonseca, 2021) sample reports.

The main contribution of the study is the data collected from the primary sources of the most recent available EMAS report for each firm. This was achieved by performing a content analysis on the sample of reports rating the inclusion of important information required or recommended by the standard. The items included will be explained more in detail in the methodology. The reports that were manually reviewed ranged between 11 and 106 pages, the structure varies but most included a general description of the organisation, followed by environmental impacts, often backed up with quantitative information, and finally gave an outlook into future efforts by mentioning targets. On average the reports had 39 pages for an overview refer to Table A-6 and Figure A-1 in Appendix A.

4.2 Data on financial performance

To enrich and expand the study, the data that was gathered in the content analysis as explanatory variables will be compared to the sample firms' economic performance as an explained variable. Therefore, it was necessary to calculate an overall indicator of report quality from the data collected. To obtain these percentages for the inclusion of the items were calculated similarly to Aggarwal and Singh (2019). This led to a performance indicator of overall inclusion of the items in the sustainability reports, as well as one for the inclusion of the core indicators and one for the inclusion of the other relevant items in percent. Data for economic outcomes was collected from firms' annual reports. They are made public in the German firm register which was accessed online and provided the documents for all firms required to publish their financial statement in Germany (Bundesanzeiger Verlag, 2022). While some studies use a broad variety of economic performance indicators like market shares and sales or turnover (Iraldo, Testa & Frey, 2009), sales and costs (He, Liu, Lu & Cao, 2015), return on investment or operating earnings (Montabon, Sroufe & Narasimhan, 2007). The most commonly used indicator in the literature is the return on investment (ROA) (Aggarwal & Singh, 2019; Cavero-Rubio & Amorós-Martínez, 2017; He et al. 2015; Jong, Paulraj & Blome, 2014; Montabon, Sroufe & Narasimhan, 2007). ROA is a way of calculating how well a firm uses its assets,

independently from how they are financed to generate income. Uncoupling the earnings from the forms of capital used comes with benefits for comparability as it allows for the comparison of firms with different capital structures (Al Nimer, Warrad & Al Omari, 2015). Another issue with comparability that cannot be solved by ROA is differences in capital intensities of industries making ROA most effective in comparing firms within similar sectors (Selling & Stickney, 1989). Despite this limitation, ROA still is the most suitable and widespread indicator of firm performance. ROA for the sample firms was calculated using the data provided in the firms' financial statements. The formula for ROA[3] (Al Nimer, Warrad & Al Omari, 2015) used was

$$ROA = \frac{annual\ net\ income + interest\ on\ borrowed\ capital}{total\ assets}$$

to improve comparability, data from the financial statements of 2019 was used for all companies. This ensured that values were not distorted for firms who are behind with publishing their financial statements as well as excluding potential impacts of the pandemic of 2020. The data for control variables was collected from the EMAS register (European Commission, 2022c)

[3] If the annual net income was not indicated since the profit was transferred due to a profit and loss transfer agreement the transferred amount was used in place of the annual net income.

5 Methods

The paper uses a mixed-methods approach combining qualitative content analysis with quantitative techniques such as descriptive statistics, ANOVA (Analysis of Variance), Kruskal-Wallis Test (KW-Test), and Ordinary Least Squares (OLS) regression on firm performance. While content analysis will provide richer and more in-depth insights into the sustainability reporting practices of EMAS-certified firms, the addition of quantitative testing will allow the quantification of the results, a comparison of differences as well as an indication of how report quality could potentially benefit firm performance.

5.1 Content Analysis

A content analysis approach was used to analyse the reports published by the companies included in the sample. Content analysis has previously been used to assess the quality of sustainability reporting (Aggarwal & Singh, 2019; Papoutsi & Sodhi, 2020; Roca & Searcy, 2012; Skouloudis et al. 2013). Testing the impacts of environmental certification on performance outcomes is also often researched (Arocena, Orcos & Zouaghi, 2021; Frondel, Krätschell & Zwick, 2018; Iraldo, Testa & Frey, 2009). Content analysis is suitable to gather information from environmental reports and convert it into data that can be used for later testing, together with the lack of standardisation of information in reports this is the appropriate method to analyse them (Montabon, Sroufe & Narasimhan, 2007). Aggarwal and Singh (2019) define content analysis as being a qualitative method that allows researchers to examine sources with mixed information like sustainability reports in a systematic way. It consists of identifying relevant measures and evaluating the material on their basis making the information quantifiable. It is considered a technique to gather and analyse information of qualitative and quantitative nature including text but also tables, images, symbols, and more in a replicable and valid way (Krippendorff, 2004).

This study analysed the reports manually, using a mix of reading strategies, advancing from previous studies that often perform content analysis by software that counts the frequency of keywords (Landrum & Ohsowski, 2018). The strategy allowed finding information that is specific to the indicators and avoided missing information presented in graphs or images. The in-depth approach also ensured that no information was missed due to inconsistently named indicators and keywords (Papoutsi & Sodhi, 2020). Other advantages emerged during the data collection process. Sometimes, the concepts whose inclusion was evaluated were just mentioned in the reports as a buzzword but without further elaboration. In a text software

approach, this would be counted as an inclusion of the concept in the report while in this manual analysis mentioning the concept without backing it up was counted as missing information.

The variables measured in the content analysis were based on the requirements for EMAS reports. An overview of the scale and the items used can be found in Table 5-1. The scale used is similar to the one developed by Papoutsi and Sodhi (2020), ranking the core indicators on a discrete scale of 0-3 according to how well the indicator is addressed in the reports. The core indicators for *Energy* and *Waste* were rated on a scale from 0 to 4, an additional point was given for distinguishing between the consumption of self-produced renewable energy and the production of hazardous waste respectively. The identification of *goals* was rated 0 if goals were only qualitative and 1 if they were quantified. The rest of the items were rated as either 0 for not being included or 1 for being included in the report.

Table 5-1 Scale for core indicators and other items designed for content analysis (author's elaboration)

Scale	Indicator	Meaning
0-3	Core Indicators Water, Emissions, Materials and Land	0=not included, 1=qualitative, 2=absolute numbers, 3=ratio
0-4	Core Indicators Waste & Energy	0=not included, 1=qualitative, 2=absolute numbers, 3=ratio, 4=distinction (hazardous waste / self-produced renewable energy)
Items added to enrich the scale		
0/1	Goals	0=qualitative, 1=quantitative
0/1	Indirect Impacts Significance	0= item not referred to in the report, 1= item addressed in the report
Items required since 2017		
0/1	Context analysis Interested Parties Life Cycle Risks and Opportunities Social sustainability	0= item not referred to in the report, 1= item addressed in the report

First, the inclusion of the core indicators was analysed. Indicators have been recognised in the literature as one of the most important features of environmental reporting (Mazzi et al. 2012). While they are crucial for evaluating and communicating environmental impacts, if used comprehensively they can also serve as a tool for environmental management (Johnston & Smith, 2001). The EMAS regulations are very clear on the importance of relating the environmental data to firm-specific outputs (European Union, 2018). The advantage of ratios is that they represent eco-efficiency and absolute numbers do not provide a useful ground for comparisons between firms (Skouloudis et al. 2013) this was considered in the construction of the scale. The firms used a variety of different reference activities to calculate the indicators such as output in numbers or tonnes, yearly monetary turnover, and the number of employees.

Table A-2 in Appendix A provides an overview of the core indicators as defined by European Union (2018) as well as the measurement units recommended. The first indicator that is required is the total *Energy-use* of a firm. The *Materials* indicator can include any type of material except energy carriers and water that the firm uses to provide its products or services and the measurement is highly dependent on the type of material used by the firm. *Water-use* refers to the total water used in a firm's process. The indicator for *Waste* should be broken down into different waste types by weight or volume. *Land-use* is taken as an indicator of the firm's influence on biodiversity and can be measured by sealed areas or nature-oriented areas. To simplify the rating scale the *Emissions* were not rated individually, rather the inclusion of any type of emission was considered as complying with the requirements. The indicator used most is emissions of CO^2 in tonnes.

To construct the framework for content analysis, first, a small random report sample was rated on the core indicators only as a basic assessment of compliance with the EMAS reporting requirements. Since the inclusion of core indicators was satisfying, other items were identified that can indicate the report's quality. In this step, the aim was to enrich the data gathered from the content analysis, which can lead to more conclusive results in the consecutive analysis. The first item added was the identification of environmental *Goals*. The EMAS standard requires the firms to identify objectives and targets for their environmental impacts. The literature supports this requirement and has found very strong evidence that setting targets and effective planning have the strongest impact on environmental performance which made it interesting to look at targets more in-depth (Iraldo, Testa & Frey, 2009). The regulations by European Union Law (2017) are very clear in their preference for measurable quantitative goals, and this was considered in constructing the scale of the variable. Another important requirement of the standard is the distinction between direct and *Indirect impacts*. All firms correctly identified the direct environmental impacts of their business while the reporting on the indirect impacts was less consistent. Direct impacts occur within the firms' activities, while indirect impacts, like capital investments and choice of services emerge in the interaction with third parties but can still be influenced by the organisation to a reasonable degree. Since the amendment of 2013, the environmental reports must include the criteria used to assess the *Significance* of the environmental impacts (European Union Law, 2017). The firms achieved this using different management tools.

With the latest revision of the standard by the European Union, 2017, new requirements for environmental reports were added. These requirements were included in the analysis as an indicator of how well the firms keep up with the requirements of EMAS and how committed

they are to the standard's values. Since then, firms need to identify their *organisational context*, which can impact the effectiveness of the firm's EMS. Therefore, firms must assess internal and external factors that influence their intended outcomes. Examples of this include scarcity of resources in the operating area as well as technological or competitive circumstances. The firms should pay attention to external *interested parties* who have an interest relevant to their environmental management. This can be done in the form of stakeholder-analysis and should include the parties' needs and expectations. In the revision of the EMAS Annexes of 2017, the standard also requires firms to use the *life-cycle perspective* when assessing the environmental impacts of the organisation and consider the process stages of their products or services. The inclusion of this new standard was assessed with the life-cycle variable. Another new section in the reports is the identification of *risks and opportunities* for the firm overall, that can potentially impact the outcome of the EMS.

Social sustainability is commonly viewed as an important pillar of sustainability and concerns the humanitarian context of the organisation (Haugh & Talwar, 2010). Investigating this is considered interesting as previous studies tended to neglect this dimension of sustainability (Papoutsi & Sodhi, 2020). Since many firms focus on the environmental aspects and the EMAS standard only requires those, *social sustainability* was considered an indicator of going above and beyond the requirements of the standard. The analysis of those aspects and the rating on the scale introduced in Table 5-1 were applied to the 81 reports in the sample and a dataset was constructed. This was quite an extensive process and provides the first contribution of this study.

5.2 Quantitative analysis of report quality

The EMAS register provides information on the firm size measured in terms of the number of employees, the number of sites registered with EMAS, the date of registration, and the industry a firm operates in (European Commission, 2022c). This was used to form groups and is followed by an empirical analysis, to uncover if there are statistical differences between the groups. Analysis of variance (ANOVA) has been used most commonly in previous studies with groups of polytomous[4] categories Bonilla-Priego and Avilés-Palacios (2008). The ANOVA

[4] A variable with two or more distinct categories.

method and its alternatives have been researched by van Hecke (2012), ANOVA is used to test the difference in the means of different groups and it hypothesises that there is no difference between group means. ANOVA assumes normally distributed data, and if this assumption is violated the results can be inaccurate. In the case of non-normality of data, the non-parametrical KW-Test can be used. While this test does not require normally distributed data it assumes the distribution of data in the groups is similar. Another difference is that it compares mean ranks instead of means, and it is considered to be more powerful for non-symmetric data (van Hecke, 2012). Issues with normality were investigated using the Shapiro-Wilk W-Test, a powerful tool to detect non-normality, accompanied by an ocular inspection of the distributions to avoid false rejection (Royston, 1992). The dependent variable quality of other items was found to be normally distributed and suitable for ANOVA, while the quality of core indicators was considered non-normally distributed therefore, a KW-Test is appropriate for this variable. Test results can be found in Table B-1 Appendix B. Since both ANOVA and KW-Test are omnibus tests and give no indication of which groups differ from each other, post-hoc testing was necessary. The appropriate post-hoc method for a KW-Test is the Dunn-Bonferroni method, which uses the outcomes of the KW-Test to estimate exact statistics for the groups with a Bonferroni adjustment to modify the rejection level accordingly (Dinno, 2015). Bonferroni adjustments will also be used as a posthoc test for ANOVA to correct for family-wise errors since it is one of the most common methods used to decrease the risk of committing type one errors for multiple statistical tests (Armstrong, 2014).

Apart from investigating differences between categorical groups an additional analysis for continuous variables is added. The simple OLS regression for continuous controls on the *quality of core indicators* and *quality of other items* of the firms as explained variables can be seen in equation (1)

$$(1)\ [Report\ Quality]_i = \alpha_0 + \alpha_1 employees_i + \alpha_2 years_i + \alpha_3 sites_i + \alpha_4 industry_i + \varepsilon_i$$

The constant is α_0 and $\alpha_{1\text{-}4}$ are the estimated coefficients for the number of employees, years since certification, number of sites registered and industry. The error term of the equation is expressed by ε_i.

As firms gather experience with EMAS a learning effect is expected, leading to the maximisation of outcomes as well as cost-effectiveness over time (Iraldo, Testa & Frey, 2009). Firms were found to publish better reports after having the certification for a longer time (Bonilla-Priego & Avilés-Palacios, 2008). To investigate the effects of the year of certification on the report quality the dates of registration were simplified to only display the year of certification, and then transformed to represent the number of years between the registration with EMAS and the year of the reports analysed. The distribution of firms that registered in the respective years can be viewed in Figure B-1 in Appendix B which shows an increase in registrations for the later years included in the analysis.

There are several reasons to investigate the quality of reports for firms of different sizes. While it is generally perceived to be easier for larger firms to improve environmental performance by applying the scheme, for smaller firms significant barriers like the lack of resources and know-how make those tools less useful (Iraldo, Testa & Frey, 2009). Additionally, it is commonly

assumed that firms of bigger size are more likely to publish more detailed information (Bonilla-Priego & Avilés-Palacios, 2008). There are several explanations for this perceived difference. Apart from those due to visibility mentioned in the theory, large firms have the advantage of having more resources at their disposal to implement the standards thoroughly, while smaller firms might lack the resources to integrate the standard into their business model, but they are also not as closely monitored and can get away more easily with disclosing information more scarcely (Arocena, Orcos & Zouaghi, 2021). Groups of firm sizes were formed similar to the approach used by Frondel, Krätschell and Zwick (2018) and the standard firm size groupings. Firms with less than 50 employees were considered small firms, firms with 50-249 employees are part of the medium-sized group, firms with 250 to 499 employees were considered large, while firms with over 500 employees were considered very large. As can be seen in Figure B-2 in Appendix B, most firms in the sample are part of the small and medium-sized group. This is another strength of this study as there has been a call for more research on smaller firms (Merli, Lucchetti, Preziosi & Arcese, 2018). Another variable that can account for the firm's size, as well as its experience with the standard, is the number of sites or locations where the firm operates registered with EMAS. This variable was used in its original form. Figure B-3 in Appendix B shows that most firms in the sample have only one or two sites registered.

Differences were also investigated for firms that are part of different industries to account for the differences in structure and environments these firms are embedded in. The EMAS register provides the NACE codes for all the registered firms, and grouping firms into industries using those codes has been established by other researchers Rubio (2017). Figure B-4 in Appendix B shows that most of the sample firms are part of the manufacturing sector. To simplify the analysis, the groups were summarised into three overarching fields, namely Electricity, Gas and Water supply; waste management and mining; manufacturing and services.

5.3 Financial Performance

To expand the study further, the collected data was combined with data on the economic performance of the sample firms to find associations between report quality and firm performance.

The analysis of the performance outcomes is not the main contribution of this paper and the data collected in the main part was simple in its cross-sectional structure, limiting the explanatory power of the analysis. The method used is a multiple linear regression using the OLS model explained in equation (2).

$$(2)\ ROA_i = \beta_0 + \beta_1 overall\ report\ quality_i + \beta_2 industry_i + \beta_3 year_i + \beta_4 employees_i + \beta_5 sites_i + \mu_i$$

The explained variable is the ROA of the firms, β_0 denotes the constant, $\beta_{1\text{-}5}$ are the constants of the control variables using overall report quality as main explanatory variable, while μ_i denotes the error term. For this analysis the year variable was transformed to display the years since registration until the year of the financial reports.

The model was inspired by previous authors investigating the impact of EMS comprehensiveness on firm performance with a two-stage least squares estimate on cross-sectional survey data, estimating EMS comprehensiveness in the first stage and its effect on performance in the second (Darnall, Henriques & Sadorsky, 2008). While the present study was unable to use two stages since the report comprehensiveness was measured directly, the model used here is similar to the second stage of the previous study and used the same controls. This comes with possible restrictions concerning endogeneity which will be addressed later. Iraldo, Testa and Frey (2009) analysed the effect of years using an EMS on various performance indicators in a multivariate regression model with cross-sectional survey data. Their analysis is analogous to an OLS model using the same assumptions only for multiple dependent variables. Since the current analysis had only one outcome variable the simple OLS was used. Previous studies served as an inspiration, but the analysis was adjusted due to the scope and cross-sectional structure of the data, using the same main assumptions. The control variables added, such as the number of employees, industry effects, and the year of registration was also taken from those models (Darnall, Henriques & Sadorsky, 2008; Iraldo, Testa & Frey, 2009)

Before conducting the analysis, model assumption tests were performed, checking for heteroscedasticity and normality of residuals. To test for heteroskedasticity a White's Test for heteroskedasticity was performed. The null hypothesis of homoskedasticity could not be rejected, indicating that the model does not suffer from heteroskedasticity. To investigate the normality of the residuals an ocular inspection of the distribution of residuals was undertaken and the residuals appear reasonably close to a normal distribution especially considering the small sample size. The results of these tests can be found in Appendix C. Multicollinearity was not problematic since the added variables were used as controls and not as explanatory variables. In sum, the model was deemed to be suitable for further analysis.

6 Empirical Analysis

After the careful design of the content analysis framework and collection of raw data from the reports which constitutes the largest part of research for this thesis the collected data was statistically analysed.

6.1 Results

In the following chapter, the findings of the study will be described and analysed to gain insights into the thoroughness of the reports.

6.1.1 Descriptive Analysis

The first findings of this thesis relate to the quality of the reports that were analysed. Detailed descriptive statistics on all items measured can be found in Appendix A Tables A-3, A-4, A-5, A-6. The percentage indicator for all items together indicates that on average firms included 72% of the required items, which can be considered satisfying. A more differentiated picture emerges when looking at the percentages of inclusion for the core indicators and the other items separately. While the performance of the reports considering the core indicators was quite high with an average score of 84% inclusion, the rest of the items were reported less thoroughly with an average of 61% inclusion.

An overview of the percentage quality indicators can be found in Figure 6-1. This illustrates that overall reporting on the core indicators was better than on the other items. It also shows that the range of the indicator for the other items is larger than it is for the core indicators indicating more variability in the data. Another difference can be seen in the middle 50% of the data, which is more spread out for other items. The overall percentage indicator is a combination of the percentage on core indicators and the other items weighted equally.

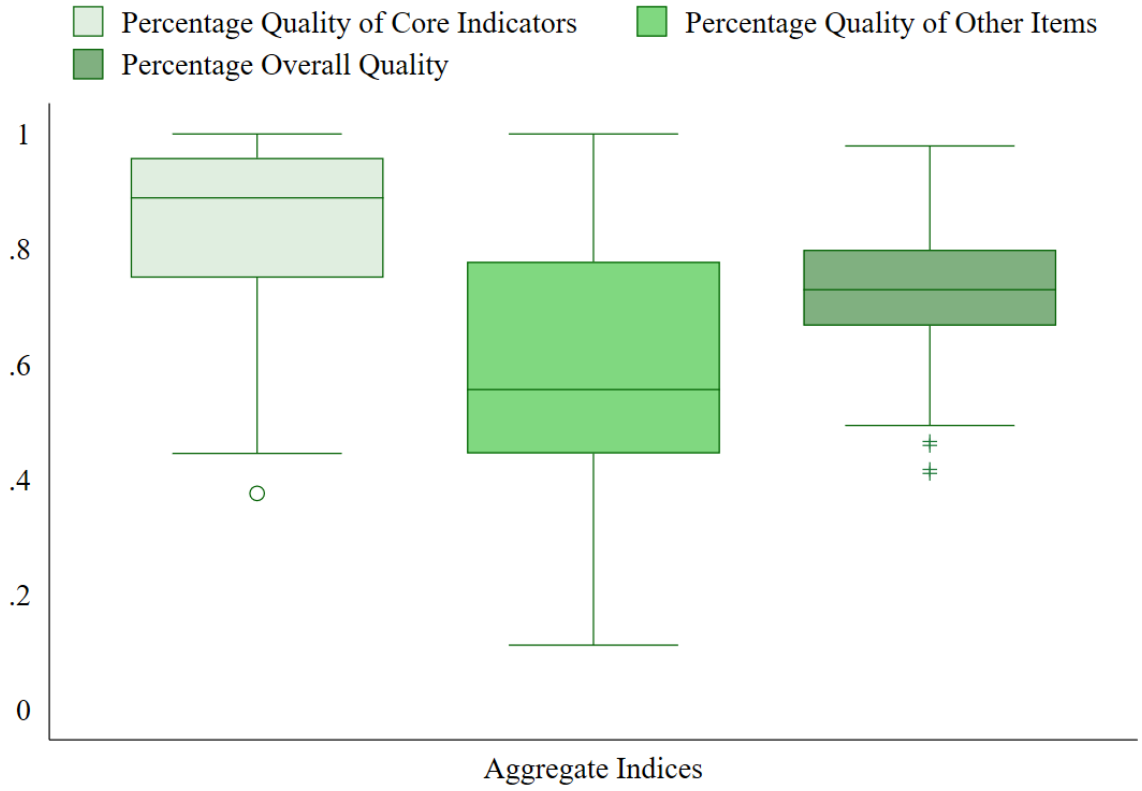

Figure 6-1 Report quality aggregate indices in percent (author's illustration)

To address this more in detail Figure 6-2 and 6-3 display the percentages of the quality ratings for the different items identified.

Overall, reporting of the core indicators was quite satisfying. The items that were left out the most were *Land-use* and *Materials*. For the indicators with a scale from 0-3, *Water-use* was reported in most detail followed by *Emissions* and *Materials*. The indicators with a scale up to 4 were reported on quite detailed while more reports included dangerous waste than self-produced renewable energy. However, *Waste* had more variation in the quality of reporting while *Energy* was included as a ratio in almost all reports. Overall, there were very few reports that include the information on the core indicators in a qualitative manner only. The indicator that was most referred to only qualitatively is *Waste*, while *Energy* was never reported on in a qualitative way only. *Energy* was also least addressed in absolute quantitative terms instead of ratios, followed by *Water*. *Waste Emissions* and *Materials* were seldomly reported in absolute terms. *Land-use* is the only indicator that was mostly reported in absolute terms.

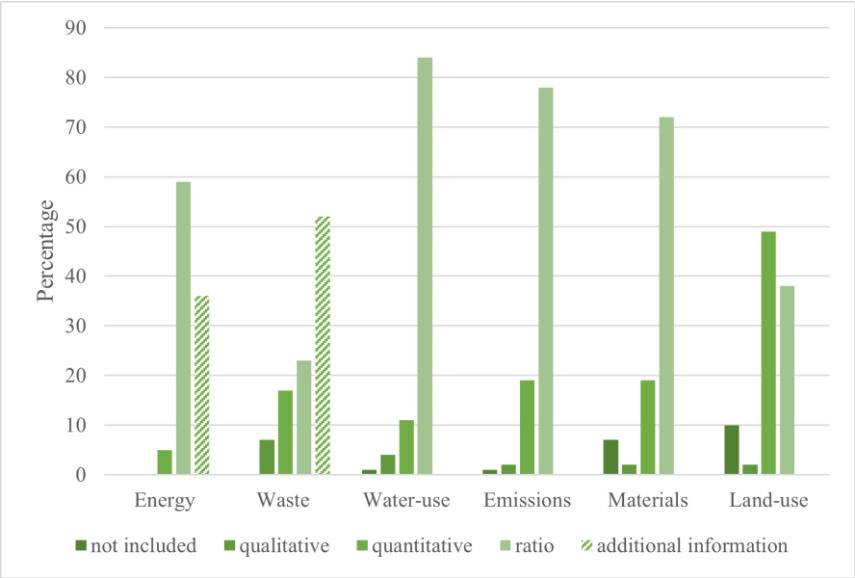

Figure 6-2 Quality ratings for the Core Indicators (author's illustration)

The quality of the firms' reports measured by *other items* shows a varied picture. Generally, the reporting on *social sustainability* was included the least. This was to be expected as it is not a requirement in the EMAS guidelines. However, some firms seem to want to exceed the standards proposed by EMAS. The reporting on *risks and opportunities* was also not included by the majority of firms followed by the use of the *life-cycle approach* to evaluate environmental impacts which was also not consistently used. The item that was included in all reports was the firms' environmental *goals*. Therefore, here a rating of zero means that the reports only mentioned their goals qualitatively. Still, a clear majority of the reports quantitatively addressed the goals as well as followed up on their accomplishment. One of the factors reported best in the sample was the differentiation between direct and *indirect* effects and the inclusion of an *assessment of significance* is also very common in the reports. The inclusion of the *organisational context* and the needs of *interested parties* was very mixed while the former was slightly less reported than the latter. The data shows a clear picture of requirements that have been included in the standard for a longer time being addressed more consistently than the requirements added in the latest revision suggesting a learning process.

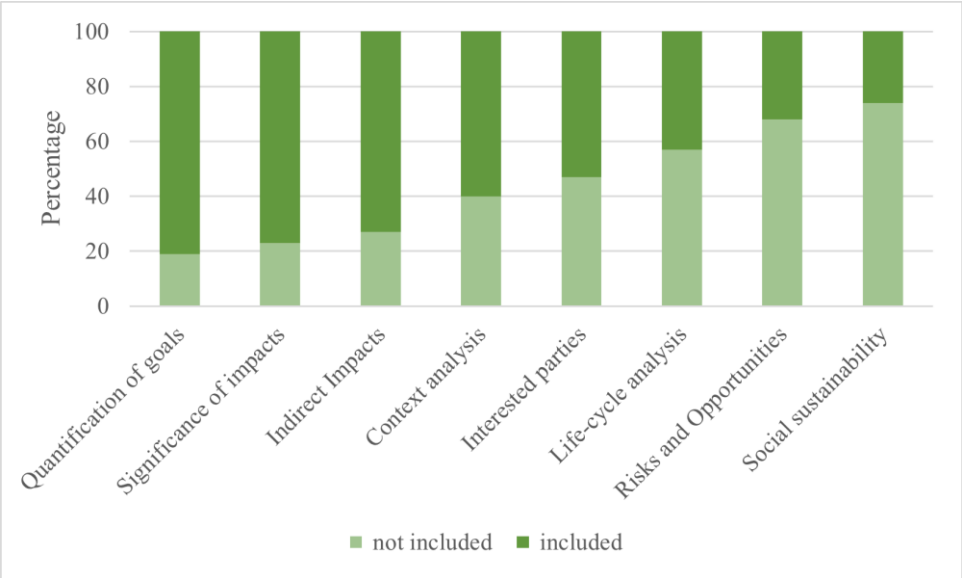

Figure 6-3 Percentage of Quality ratings for the other items (author's illustration)

Notes: The Goals variable has a 0 assigned to identifying goals only qualitatively and 1 to quantified goals since no report in the sample did not report on goals at all.

6.1.2 Differences by groups

To investigate the differences in report quality among different groups of firms the percentage quality indicators for core indicators and the other items were used separately due to the differences mentioned above. To test the differences between the groups, ANOVA tests were conducted to compare group means on a significance level of 0.05 on the dependent variable for the *quality of other items*. However, the differences were non-significant for all groups, indicating that there were no statistical differences between different firm sizes, industries, and the experience with EMAS regarding the inclusion of other items. Therefore, the results will not be discussed in detail and can be found in Table B-2 Appendix B. Since the *quality of core indicators* suffered from non-normality, the KW-Test was used to test differences between the groups. Table 6-1 shows the results of the KW-Test. Solely the differences between the groups for industries came back significant and the null hypothesis that there are no differences between the groups was rejected. This indicates that there was no significant difference in reporting the core indicators between different sizes of firms, or firms that participate in EMAS longer. To investigate the difference between industries further, the results of the Dunn-Bonferroni post-hoc test can be seen in Table 6-2. They show that the mean rank of the manufacturing sector differs significantly from both the electricity production as well as the service sector, indicating that the standard is implemented differently in different sectors. Since an ANOVA analysis can be quite robust to non-normality (van Hecke, 2012), the results of the ANOVA analysis on the *quality of core indicators* can be found in Appendix B Table B-2, B-3, B-4, and it mirrors the significant differences for industry groups. For the other groups, the hypotheses of no significant differences between the groups could also not be rejected.

Table 6-1 Kruskal-Wallis for core indicators (author's elaboration)

Dependent variable: Quality of core indicators	X^2 (with ties[5])	p
Industry	8.00	0.02**
Number of Employees	3.990	0.26
Number of Sites	10.356	0.17
Year of certification	5.289	0.62

*** p<0.01, ** p<0.05, * p<0.1

Table 6-2 Dunn-Bonferroni post-hoc test for Industry (author's elaboration)

Row Mean – Col Mean	Electricity	Manufacturing
Manufacturing	-2.38	
	(0.03)**	
Services	-0.37	2.16
	(1.00)	(0.04)**

*** p<0.01, ** p<0.05, * p<0.1

The additional analysis for the association of continuous variables with report quality came back with no significant results for the *quality of other items* variable, those can be found in Appendix B-5. Appendix B also includes a stepwise modelling process for both models Table B-6 and B-7. For the *quality of core indicators* shown in Table 6-3, the number of sites was significant at p=0.05 and the number of employees only at p=0.1. However, the coefficients were rather small and had opposing effects which is surprising for two variables that are both supposed to measure firm size. The number of employees had a small but positive association while the number of sites had a small negative association with the *quality of core indicators*.

[5] Ties indicate that during the ranking process of means in the KW-Test two or more scores got assigned the same rank.

This might be an indication that the number of sites does not accurately proxy firm size. This can be due to it representing the number of sites registered with EMAS instead of the absolute number of sites a firm has. Firms that have more sites registered seemed to include the core indicators less thoroughly in their reports, while firms with more employees seemed to include them more thoroughly.

Table 6-3 Firm characteristics association with report quality (author's elaboration)

VARIABLES	Quality core indicators
Thousands of employees	0.0430*
	(0.0222)
Years since certification	-0.00546
	(0.00624)
Nr. sites	-0.0385***
	(0.0110)
Manufacturing	0.0498
	(0.0407)
Services	-0.0140
	(0.0464)
Constant	0.908***
	(0.0603)
Observations	81
R-squared	0.21
Adj R-squared	0.16

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.1.3 Financial performance

The association of report quality with financial performance as measured by the firms' ROA was estimated using a stepwise modelling process where every variable is added to the model individually. The main explanatory variable is overall report quality and the results can be seen in Table 6-4. Model (1) uses the overall report quality as the only explanatory variable which is an aggregate index of inclusion of core indicators and other items. Model (2) adds the years since certification with 2019 as a reference year as a control. Model (3) includes the number of employees in thousands as a control. Model (4) controls for the number of sites registered with EMAS. Model (5) adds the adjusted industry categories from previous analyses as a control and Model (6) is the final model, adding all those controls. The R-squared shows that the final model has the most explanatory power but it is almost zero and the adjusted R-squared is negative. This shows that the variables don't seem to be associated at all and the model does not explain the relationships. Overall, none of the used variables seem to be significantly

associated with the explained variable, as non of the outcomes were significant at p=0.05. The estimates of overall report quality are negative throughout the modeling process which also does not support a positive association between report quality and performance. The control for years since certification has a positive coefficient, the one for employees changes from negative in Model (3) to positive in Model (6), the control for the number of sites has a negative coefficient and manufacturing and services have a negative coefficient while the base-level is energy supply. However, non of these coefficients are significant at p=0.05. Together with the very low R-squared this model seems to be unfit for explaining the association of report quality with ROA. This can be related to the small sample size, the controls used and that there is little association between explained and explanatory variables.

Table 6-4 Regression results report quality association with ROA (author's elaboration)

Dependent Variable ROA	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Overall Quality	-3.526	-3.569	-3.384	-4.075	-2.884	-3.862
	(8.359)	(8.414)	(8.442)	(8.471)	(8.603)	(8.968)
Year since certification		0.0738				0.00440
		(0.421)				(0.443)
Thousands of employees			-0.219			0.470
			(1.141)			(1.606)
Number of sites				-0.280		-0.449
				(0.561)		(0.796)
Manufacturing					-1.127	-1.487
					(2.768)	(2.913)
Service					-1.430	-1.585
					(3.113)	(3.303)
Constant	7.219	6.885	7.216	8.199	7.738	9.383
	(6.124)	(6.450)	(6.161)	(6.460)	(6.287)	(7.554)
Observations	81	81	81	81	81	81
R-squared	0.002	0.003	0.003	0.005	0.005	0.010
Adj R-squared	-0.010	-0.023	-0.023	-0.020	-0.034	-0.070

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Industry groups are the same as for the differences between firm types testing and definitions can be seen in the methods chapter. The industry reference category is Electricity supply.

6.2 Discussion

At the first glance, the results of this study seem to be more optimistic than what was expected from the literature review. This first became apparent in the availability of the reports to the public with 61% of reports available on the firms' websites. Still, a significant number of reports were unavailable online contrary to the standard's requirements.

The quality of the reports was better than expected. The difference in inclusion between core indicators and other items can be explained by the core indicators being well and long-established in the EMAS guidelines. Furthermore, firms might find it easier to report on core indicators since they are more clearly defined than some of the conceptual items. The high quality of disclosure for the core indicators found is a stark contrast to the findings of (Marrucci & Daddi, 2021) who reported very little compliance with the disclosure of core indicators in Italian manufacturing firms.

There was some variance between the different core indicators concerning their inclusion in the reports. *Waste, Energy,* and *Water* were reported on best while *Land-use* and *Emissions* lacked thoroughness. This might be partially due to the perceived importance of specific environmental topics by the firm itself or by its stakeholders. Another reason for including one indicator over another is the availability of data. For some indicators like *Water*, *Waste* and *Energy,* most firms have contracts with service providers that list monthly or annual volumes consumed or collected. This facilitates the publication of such information and reduces the efforts necessary to provide transparency. Data on other indicators such as CO^2 *Emissions* might be less readily available.

Concerning other items, the organisation's environmental *goals* were among the items reported best. This is especially beneficial as setting clear and quantitative goals as well as tracking the way towards them has been identified as crucial in a successful EMS (Iraldo, Testa & Frey, 2009). Together with the thoroughness of the reporting on core indicators, the ability to quantify goals provides evidence that instead of using the indicators only to get certified (Marrucci & Daddi, 2021), the firms seem to use them as a target for improvement contrary to institutional theory assumptions.

The limitations of this approach are the reliability of the data which might be compromised due to biases in conducting the content analysis manually as well as the problem of human error, this is usually ensured by re-coding parts of the analysis by an independent researcher (Aggarwal & Singh, 2019; Arthur et al. 2017; Boiral, Heras-Saizarbitoria & Brotherton, 2019). This was not feasible in the scope of this thesis, and it was attempted to ensure reliability by keeping the rating scale simple and as unambiguous as possible. Another possible limitation is the exclusion of firms without financial data which might introduce selection bias.

Against the background of these findings, it is worthwhile looking at the theory again. The findings support the assumptions of signalling theory over institutional theory. This can be viewed in the high availability and quality of the reports which have been proven to significantly reduce information asymmetry, especially for externally verified reports (Cuadrado-Ballesteros, Martínez-Ferrero & García-Sánchez, 2017). This is further supported

by previous literature which found a positive link between voluntary disclosure and sustainability performance (Mahoney, Thorne, Cecil & LaGore, 2013; Papoutsi & Sodhi, 2020). However, the findings do not dismiss the assumptions of institutional theory completely. Despite the overall positive impression of the reports, some were still unavailable and not all items were reported thoroughly. This indicates that there are heterogeneous approaches among the sample firms and some might use the standard to display an image of environmental excellency that they do not deliver, to comply with social norms (Mahoney et al. 2013; Papoutsi & Sodhi, 2020).

Overall, items that have been required for a longer time were found to be reported on better. This might be an indication that firms need some time to catch up with new regulatory requirements or with setting up the structures to collect the necessary data consistent with the learning effects for firms over time found by Bonilla-Priego and Avilés-Palacios; Iraldo, Testa and Frey (2008; 2009). Institutional theory gives an explanation for the improvement of the reporting over time since firms' practices converge over time to mitigate uncertainties (Hahn & Kühnen, 2013). This could partially explain why this study found better incorporation of items than previous studies. However, there is still much room for improvement, and firms might be selective in the indicators disclosed, focusing on those not perceived as harmful to the firm's image.

There are several studies indicating that the comparability of the indicators used is low, even within an industry (Boiral & Henri, 2017; Kozlowski, Searcy & Bardecki, 2015). A finding that supports critical voices on the comparability of reports is the wide variation in report length. This can be seen as an indication of a lack of clarity on what needs to be included in a report (Roca & Searcy, 2012). A way to ensure comparability among reports is using ratios of environmental impact per unit of output. As can be seen from the findings Energy and Water-use were mostly reported in ratios while especially Land-use, but also Materials and Emissions were less frequently expressed as ratios. This demonstrates that the standard would benefit from using comparable measures across industries.

The European Commission (2015) has provided an overview of measures implemented by member states that might provide insights into how the institutional environment in Germany facilitates the high quality of EMAS reports. There are privileged regulations, like eliminating waiting periods, for certified firms concerning waste management, conditional to a thorough inclusion of waste-related indicators in the reports. An example of why German firms might include more information on the core indicators, especially the one for energy use, is that firms certified with the standard are exempt from the mandatory energy audits using the registration and environmental statements instead. Germany is also among the countries that have produced information pamphlets for organisations wanting to implement the standard, including detailed information about the performance indicators. This can help to clarify what to report. Together with differences in corporate culture among the member states, strict environmental laws in place in Germany and the German Chamber of Commerce offering checklists to conduct audits like EMAS (Kollman & Prakash, 2002), this might be an explanation for why the results of this study differ from previous studies conducted in other countries.

The non-significant results for testing the differences between types of firms using ANOVA and KW-Test could potentially be traced back to the lack of variance in the report quality.

Overall, the results were better than expected but this also means the sample was more homogeneous than expected. The lack of significant differences between the groups could partially originate from the lack of differences within the sample in general. Nonetheless, the testing could not confirm the theory of a learning effect from participating longer in the standard (Bonilla-Priego & Avilés-Palacios, 2008; Iraldo, Testa & Frey, 2009), nor the notion that larger firms outperform smaller firms measured by the quality of their reporting (Arocena, Orcos & Zouaghi, 2021; Bonilla-Priego & Avilés-Palacios, 2008; Iraldo, Testa & Frey, 2009). It is interesting to remark on the only difference that could be detected, between industries concerning the use of the core indicators. This is in line with previous research by Roca and Searcy (2012) who also found firms outside the manufacturing sector included fewer indicators in their reports and explained the variance in indicators using stakeholder and legitimacy theory. According to them, firms face different stakeholder interests and different expectations from society and therefore disclose different indicators. Although the EMAS standard seems to have improved reporting of core indicators as mentioned earlier, it has not ensured complete comparability among different types of firms.

Some studies were able to find a positive influence of ISO 14001 (Arocena, Orcos & Zouaghi, 2021) and EMAS certification (Frondel, Krätschell & Zwick, 2018) on performance outcomes, and there is support for report quality being beneficial for market reactions (Guidry & Patten, 2010). However, this study failed to detect a significant association of the report quality as measured by the overall quality index and the model constructed did not have predictive value. The study cannot support the assumption of the resource-based theory that sustainability efforts are connected to performance outcomes. Along the lines of transaction cost theory, it could be useful for policymakers to increase efforts in ensuring positive performance outcomes for certified firms.

Although the analysis of the performance outcomes is not the main contribution of this study, it is important to mention some of its limitations. Non-significant outcomes could be rooted in the small sample size and the homogeneity of the report quality, which can significantly impact the results. Since the quality of reports did not differ much among the firms, the quality difference might not be large enough to contribute to performance. Moreover, there is the possibility of reverse causality. The study assumed that high-quality reporting influences financial performance outcomes. However, causality might go the other way, meaning that firms that generate better performance outcomes have more resources to dedicate to the publication of better environmental reports. The exclusion of firms with missing performance data might have introduced a selection bias. Another bias that the model specification might suffer from is omitted variable bias as there might be other factors at play influencing the firm's performance outcomes that were not considered in the model. This can lead to problems with endogeneity but this is a problem that is difficult to resolve in simple datasets with few variables, providing an opportunity for future research to address those problems using an instrumental variable approach (Binstock & George, 2011).

The model is simplified through the limited data available for performance outcomes and could be improved upon by studying performance outcomes and the quality of reports over time with panel data or control groups. Another way to test the robustness of the model or to expand the study would be by using different measures of performance outcomes like return on equity and return on sales as suggested by the literature (He et al. 2015).

Despite those limiting circumstances, other studies have also not found significant effects on performance outcomes. No significant effect of the adoption of management systems like EMAS on performance outcomes was found by Frondel, Krätschell and Zwick; Iraldo, Testa and Frey (2018; 2009) and Guidry and Patten (2010) were unable to detect an effect of publishing a report for the first time. Although Iraldo, Testa and Frey (2009) expressed some hope that the EMAS III revision would provide the improvements needed for more immediate performance benefits, this study was unable to confirm this for a more recent sample of organisations. The theoretical approach of institutional theory suggests that the benefit of conforming with regulative norms that firms get from a standard will not necessarily show in traditional analyses of economic outcomes (Connelly, Ketchen & Slater, 2011). Together with the previously outlined limitations, this can explain why this study was unable to find statistically significant effects of report quality. However, following signalling theory, the costs of an environmental standard like EMAS could be justified even if there are no direct economic benefits as they serve as a communication tool to inform stakeholders about the firm's efforts (Connelly, Ketchen & Slater, 2011).

The findings of this study support the need for more standardisation and further improvement of the EMAS standard (Skouloudis et al. 2013). The standard is to be viewed as part of the overall objective to integrate policy equally among member states (European Union Law, 2017). However, the results of this study are further evidence of weak convergence among member states (Skouloudis et al. 2013). The difficulty in improving standards such as EMAS lies in ensuring comparability of reporting while not making it unattractive for firms to join since it is mandatory to disclose sensitive information or the reporting guidelines becoming so extensive that the firms are only occupied with reporting, instead of improving their environmental management (Daddi et al. 2018). The study manages to fill the gap of more research needed on the implementation of EMAS in Germany as a forerunner in the standard and can provide insights for other countries too. Nonetheless, it is not suitable to fill the gap identified for the performance outcomes, so more research on the standard is needed.

7 Conclusion

The main contribution of this study is the collection of new data on the contents of EMAS reports in Germany using a creative approach that provides in-depth insights into the reporting practices. This was achieved using the newly developed framework for content analysis and provides important insights that led to implications for future research, policy, and the design of the standard itself.

This study set out with the research question of how well German organisations report on the required elements. The study fulfilled the aim to gain insights on report quality, as measured by the inclusion of the identified items. The inclusion of the required items was found to be satisfying, especially considering the core indicators. The inclusion of the other identified items was more varied but satisfying especially for those that have been required for a longer time. Overall, the quality of the EMAS reports of German firms was found to be higher than expected from previous research. This was supplemented by information on the country specifics of Germany that might explain those differences. These results can be viewed as supporting signalling theory and EMAS certification indicating high environmental performance of Papoutsi and Sodhi (2020). However, the outcomes for comparability of the indicators indicate some firms might act more according to institutional theory and use EMAS as an opportunity to depict themselves as environmentally conscious despite a lack of commitment to the standard.

The study was unable to support the expectations of theory for differences among different sizes of firms and firms that have been certified for a longer time using ANOVA and KW-Tests. The only significant difference was found for firms belonging to the manufacturing sector, indicating that they might be subjected to more scrutiny by the public than other sectors. The additional regression for the differences between firms using continuous variables was not significant for other items only for the inclusion of core indicators. Due to the opposing effects of the number of sites and the number of employees no straightforward statement can be made based on this analysis. Therefore, the second research question about differences by types of firms remains open to further research.

The study did not find significant differences between the firms' economic performance that could be explained by the quality of their environmental reports. The outcomes of the regression model on firm performance need to be interpreted with caution due to the previously explained limitations of the method and the fact that it has no significant explanatory power. Consequently, the third research question could not be answered and needs to be analysed using a different model.

This leads to some important implications for future researchers, policymakers, and businesses. The limited availability of the reports calls for more investigation on the impacts of non-disclosure. Further research on performance outcomes could use firms that do not publish

reports as a control group. A distinction between the disclosure of harmful and beneficial information in environmental reports like Zharfpeykan (2021) did, distinguishing between representation and greenwashing can also yield interesting insights. Since this study differs from previous analyses conducted in different European regions, an interesting avenue for future research could also be a comparison between organisations in several European countries to investigate the differences between countries in detail.

Previous research by Iraldo, Testa and Frey (2009) has criticised deficiencies in the layout of the standards that have prevented organisations from perceiving performance benefits. They called on policymakers to alert stakeholders towards acknowledging those standards, while certified firms should work on their communication strategy. To improve the quality of the reports, public institutions should make their regulatory reliefs and benefits conditional to not only the registration with EMAS but also the disclosure of related information in the reports, as Germany does with waste management (European Commission, 2015). The insights from this study indicate the necessity to further improve the standard, making it more attractive for firms to get certified if they can expect clear performance benefits (Daddi et al. 2018).

The collection of new data for this study allows for some interesting insights into the adoption of the EMAS standard, especially concerning the quality of the environmental reports, the firm's communication strategies, and the credibility and transparency of the reports. This fills an important gap by providing unique and up to date data on a highly relevant country case. This study confirms the notion of previous research that not only public awareness but also the firm's awareness about environmental issues is on the rise (Arthur et al. 2017). The importance for firms to be able to communicate their efforts to the public will only become more relevant in the future.

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Appendix A

Table A-1 Number of EMAS registrations in EU countries

Country	June 21	Oct 21	Trend
Austria	263	268	5
Belgium	63	55	-8
Bulgaria	17	17	0
Croatia	3	3	0
Cyprus	72	73	1
Czech Republic	19	18	-1
Denmark	13	14	1
Estonia	14	17	3
Finland	4	4	0
France	30	30	0
Germany	1111	1115	4
Greece	35	35	0
Hungary	27	27	0
Ireland	1	1	0
Italy	1028	1034	6
Lithuania	4	5	1
Luxembourg	7	7	0
Malta	1	1	0
Norway	3	3	0
Poland	69	67	-2
Portugal	47	47	0
Romania	5	5	0
Spain	955	966	11
Sweden	12	12	0
Slovenia	10	10	0
Slovakia	38	53	15

Table A-2 Core indicators, inclusion in the reports suggested by EMAS (author's elaboration adopted from (European Union Law, 2017))

Core indicator	Measure
Energy	Annual consumption (MWh, GJ)/ unit of output
Materials	Annual mass flow of different materials (tonnes)/ unit of output
Water	Annual consumption (m^3)/ unit of output
Waste	Annual generation of waste (tonnes)/ unit of output
Land-use regarding biodiversity	Use of land, (m^2) of built-up area/unit of output
Emissions	Annual GHG emissions (tonnes CO_2)/ unit of output

Table A-3 Descriptive statistics inclusion of core indicators (author's elaboration)

Variable	Min	Max	Mean	Std. dev.	Variance
Energy	2	4	3.31	0.56	0.32
Materials	0	3	2.54	0.87	0.75
Water	0	3	2.78	0.57	0.33
Waste	1	4	3.20	0.98	0.96
Land	0	3	2.16	0.89	0.79
GHG	0	3	2.73	0.57	0.33

Notes: The inclusion of a value for renewable energy consumption based on a green electricity contract with an electricity provider without accounting for self-produced renewables did not lead to receiving the additional point for the Energy indicator. If a firm did not elaborate on some topics but instead referred the reader to a previous environmental statement it was counted as not included.

Table A-4 Supplementary statistics on core indicator inclusion (author's elaboration)

	0	1	2	3	4
Variable	%	%	%	%	%
Energy	-	-	4.94	59.26	35.80
Materials	7.41	2.47	18.52	71.60	n.r
Water-use	1.23	3.70	11.11	83.95	n.r
Waste	-	7.41	17.28	23.46	51.85
Land-use	9.88	2.47	49.38	38.27	n.r
Emissions	1.23	2.47	18.52	77.78	n.r

Table A-5 Descriptive statistics inclusion of other items (author's elaboration)

Variable	Min	Max	Mean	Std. dev.	Variance
Identification of goals	0	1	0.81	0.39	0.15
Indirect impacts	0	1	0.73	0.45	0.20
Significance of impacts	0	1	0.77	0.43	0.18
Context analysis	0	1	0.60	0.49	0.24
Interested parties	0	1	0.53	0.50	0.25
Life-cycle analysis	0	1	0.43	0.50	0.25
Risks and Opportunities	0	1	0.32	0.47	0.22
Social sustainability	0	1	0.26	0.44	0.19

Notes: Indirect impacts were only considered as included if they were elaborated on. Simply stating that indirect impacts were considered without explaining what they are in the firm's context did not lead to a point for inclusion. Since the firms do not have to publish their entire life cycle analysis, mentioning the use of the perspective was considered enough to count as the inclusion of the new regulation.

Table A-6 Descriptive statistics number of pages and aggregate quality indices (author's elaboration)

Variable	Min	Max	Mean	Std. dev.	Variance
Nr. Pages	11	106	38.49	19.12	365.62
Quality Core Indicators	0.38	1	0.84	0.15	0.02
Quality other items	0.11	1	0.61	0.20	0.04
Overall quality	0.41	0.98	0.72	0.12	0.02

Notes: The aggregate indices were calculated one by one and then aggregated to ensure that there is no more weight given to indicators rated from 0-4 instead of 0-3.

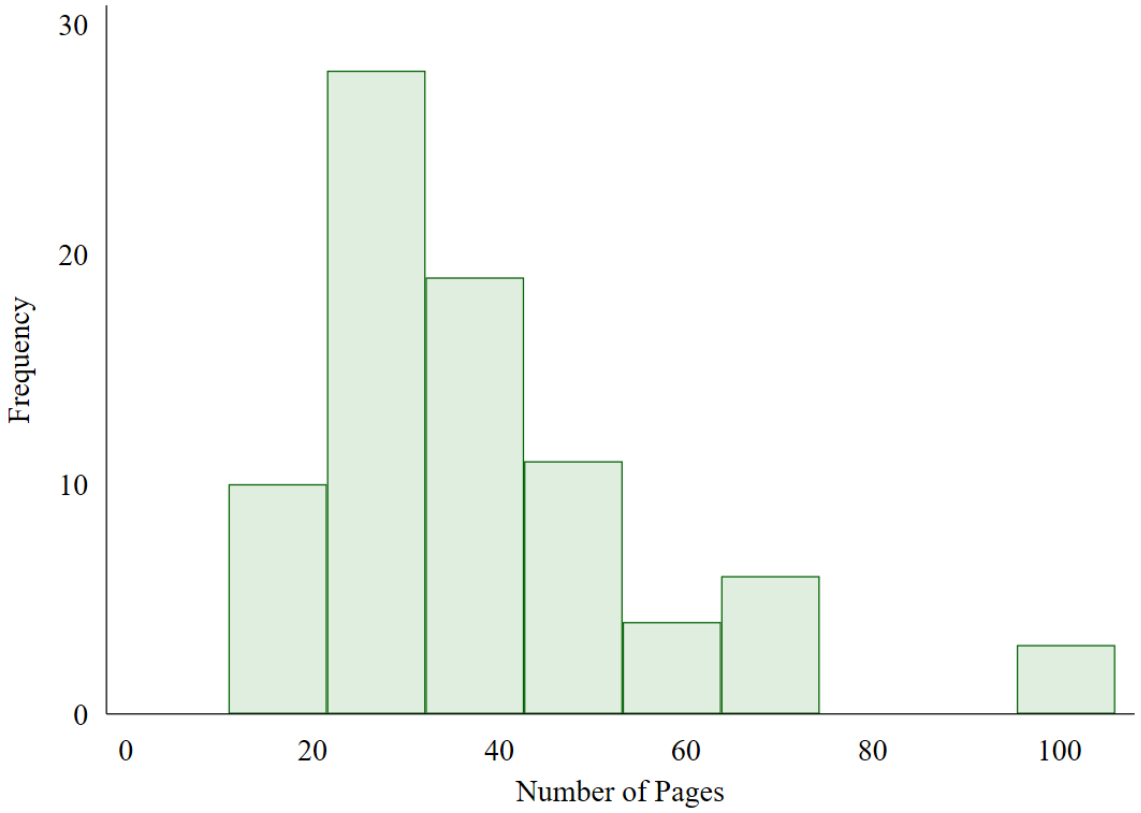

Figure A-1 Number of pages of the sample firm's environmental reports

Appendix B

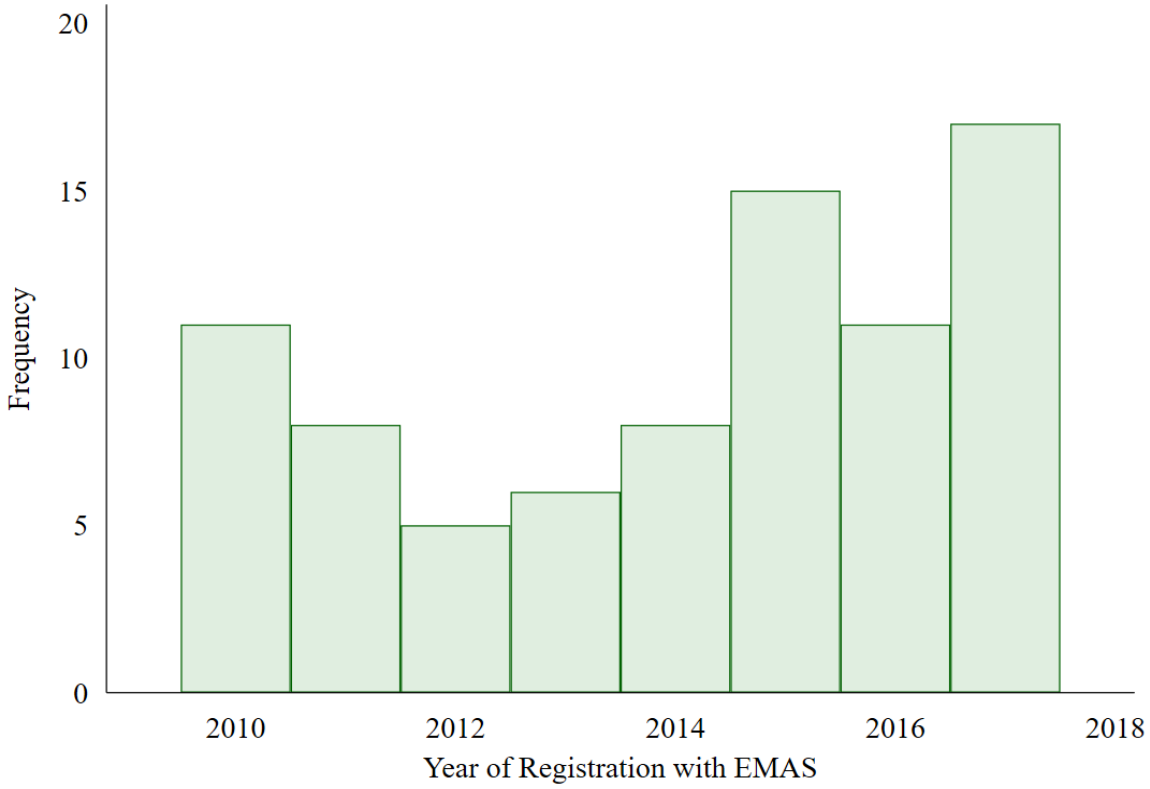

Figure B-1 Sample firm's year of registration with EMAS

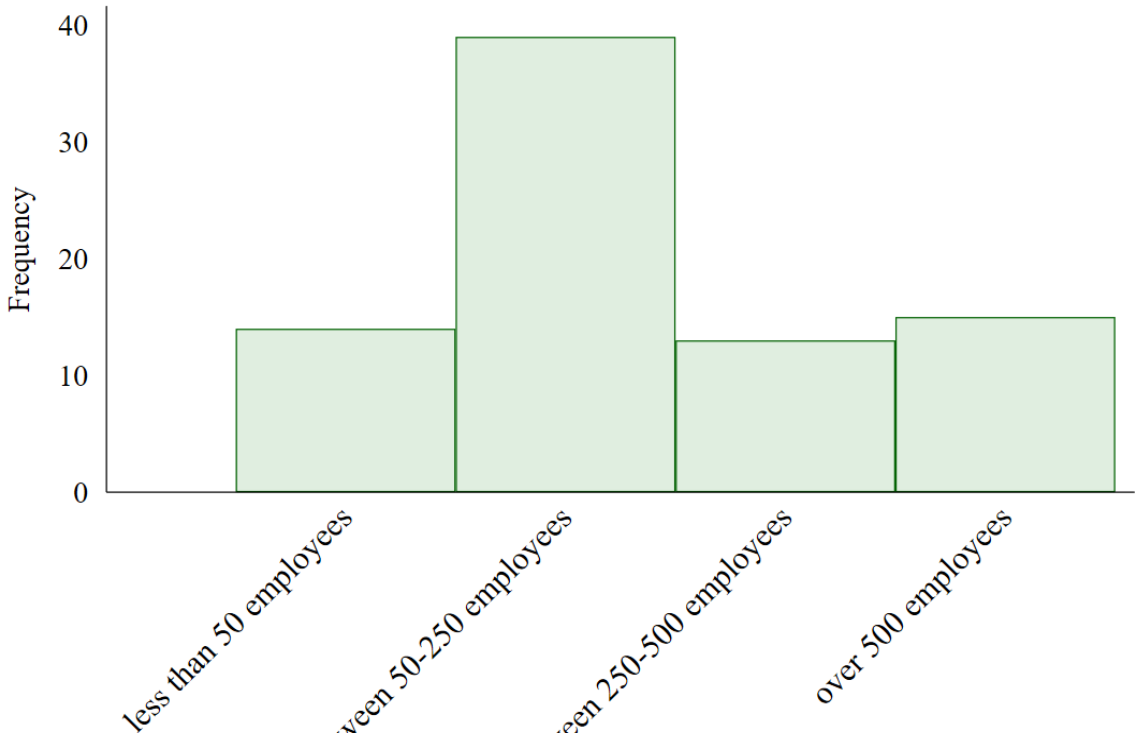

Figure B-2 Sample firm's number of employees

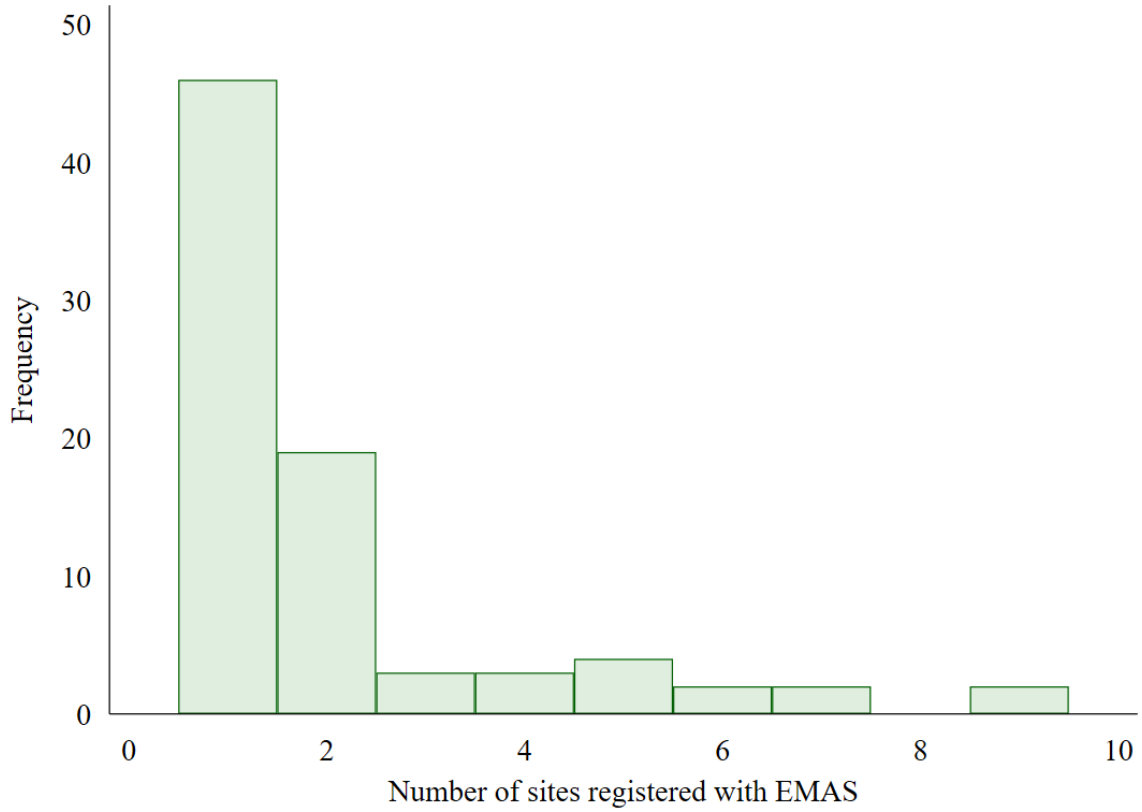

Figure B-3 Number of sites firms have registered with EMAS

Notes: To analyse the industry codes the firms had to first be assigned to one of the NACE group codes (European Union, 2022) according to the several codes the register provided for them.

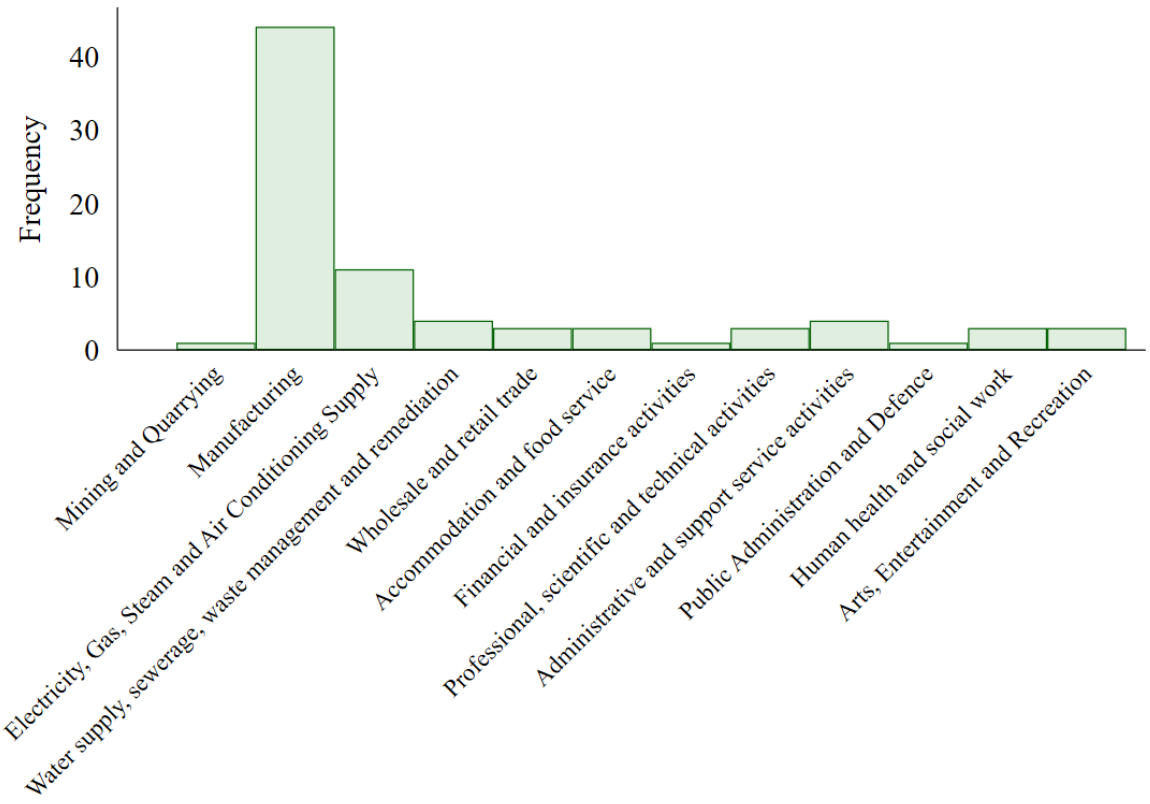

Figure B-4 Detailed overview of industries in the sample

Table B-1 Shapiro-Wilk-Test for normality (author's elaboration)

Variable	Obs	W	V	z	Prob>z
Quality core indicators	81	0.88	8.50	4.69	0.00000
Quality other items	81	0.99	0.21	-3.39	0.99

Table B-2 ANOVA analysis (author's elaboration)

Dependent Variable	Independent Variable		Sum of Squares	df	Mean Square	F	Sig.
Quality Core Indicators	Industry	Between	0.14	2	0.07	3.43	0.04**
		Within	1.56	78	0.02		
		Total	1.70	80	0.02		
	Nr. of Employees	Between	0.08	3	0.03	1.33	0.27
		Within	1.62	77	0.02		
		Total	1.70	80	0.02		
	Nr. of Sites	Between	0.48	7	0.07	4.15	0.00**
		Within	1.22	73	0.02		
		Total	1.70	80	0.02		
	Years since Certification	Between	0.10	7	0.01	0.66	0.71
		Within	1.60	73	0.02		
		Total	1.70	80	0.02		
Quality of other items	Industry	Between	0.06	2	0.03	0.72	0.49
		Within	3.01	78	0.04		
		Total	3.06	80	0.04		
	Nr. of Employees	Between	0.10	3	0.03	0.88	0.46
		Within	2.96	77	0.04		
		Total	3.06	80	0.04		
	Nr. of certified sites	Between	0.18	7	0.03	0.66	0.71
		Within	2.88	73	0.04		
		Total	3.06	80	0.04		
	Year of certification	Between	0.33	7	0.05	1.27	0.28
		Within	2.73	73	0.04		
		Total	3.06	80	0.04		

*** p<0.01, ** p<0.05, * p<0.1

Notes: Within and Between refer to the respective groups.

Table B-3 ANOVA comparison of means for industry groups on quality of core indicators

Summary of Quality Percentage on Core Indicators			
Industry group	Mean	Std. dev.	Freq.
Electricity	0.79	0.16	16
Manufacturing	0.87	0.12	44
Services	0.80	0.15	21
Total	0.84	0.14	81

Notes: The comparison of means is used to indicate which of the groups, that are significantly different from each other according to ANOVA have higher quality. This indicates that the manufacturing sector is different from the other sectors and has a higher mean quality of reports.

Table B-4 Bonferroni for ANOVA comparison of means for industry groups on quality of core indicators

Row Mean – Col Mean	Electricity	Manufacturing
Manufacturing	0.09	
	(0.11)	
Services	0.01	-0.08
	(1.00)	(0.11)

P-values in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B-5 Firm characteristics associations with report quality (Autor's elaboration)

VARIABLES	(1) Quality core indicators	(2) Quality other items
Thousands of employees	0.0430*	0.0245
	(0.0222)	(0.0330)
Years since certification	-0.00546	0.00493
	(0.00624)	(0.00925)
Nr. sites	-0.0385***	0.00302
	(0.0110)	(0.0163)
Manufacturing	0.0498	0.0304
	(0.0407)	(0.0604)
Services	-0.0140	0.0650
	(0.0464)	(0.0689)
Constant	0.908***	0.526***
	(0.0603)	(0.0894)
Observations	81	81
R-squared	0.21	0.04
Adj R-squared	0.16	-0.03

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B-6 Stepwise modelling process for association of firm characteristics and quality of core indicators

VARIABLES	(1) Model1	(2) Model2	(3) Model3	(4) Model4
Thousands of employees	-0.0102	-0.0102	0.0444**	0.0430*
	(0.0180)	(0.0181)	(0.0215)	(0.0222)
Years since certification		-0.000524	-0.00521	-0.00546
		(0.00668)	(0.00624)	(0.00624)
Nr. sites			-0.0425***	-0.0385***
			(0.0107)	(0.0110)
Manufacturing				0.0498
				(0.0407)
Services				-0.0140
				(0.0464)
Constant	0.843***	0.846***	0.938***	0.908***
	(0.0182)	(0.0439)	(0.0464)	(0.0603)
Observations	81	81	81	81
R-squared	0.004	0.004	0.174	0.212
Adj R-squared	-0.086	-0.021	0.142	0.159

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The low R-squared is significantly improved by adding the controls for industry and the final model has some explanatory power.

Table B-7 Stepwise modelling process for association of firm characteristics and quality of other items

VARIABLES	(1) Model1	(2) Model2	(3) Model3	(4) Model4
Thousands of employees	0.0338	0.0339	0.0326	0.0245
	(0.0239)	(0.0240)	(0.0314)	(0.0330)
Years since certification		0.00356	0.00367	0.00493
		(0.00887)	(0.00909)	(0.00925)
Nr. sites			0.00101	0.00302
			(0.0156)	(0.0163)
Manufacturing				0.0304
				(0.0604)
Services				0.0650
				(0.0689)
Constant	0.591***	0.570***	0.568***	0.526***
	(0.0241)	(0.0582)	(0.0676)	(0.0894)
Observations	81	81	81	81
R-squared	0.025	0.027	0.027	0.039
Adj R-squared	0.012	0.002	-0.011	-0.025

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The low R-squared values indicate the low explanatory power of the model.

Appendix C

White’s test

H0: Homoskedasticity

chi2(71) = 21.95

Prob > chi2 = 0.58

Table C-2 White's test for homoskedasticity

Source	Chi2	df	p
Heteroskedasticity	21.95	24	0.58
Skewness	1.71	6	0.94
Kurtosis	5.23	1	0.02
Total	28.89	63	0.57

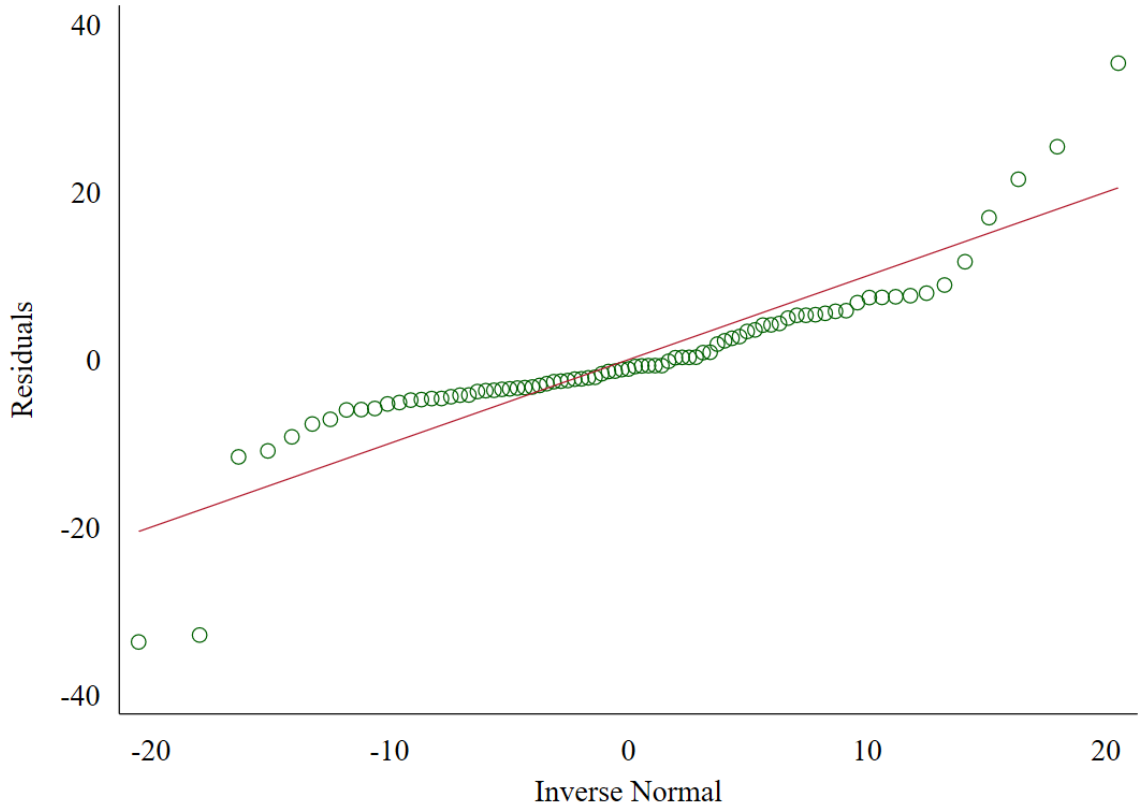

Figure C-1 Normality of residuals Q-Qplot

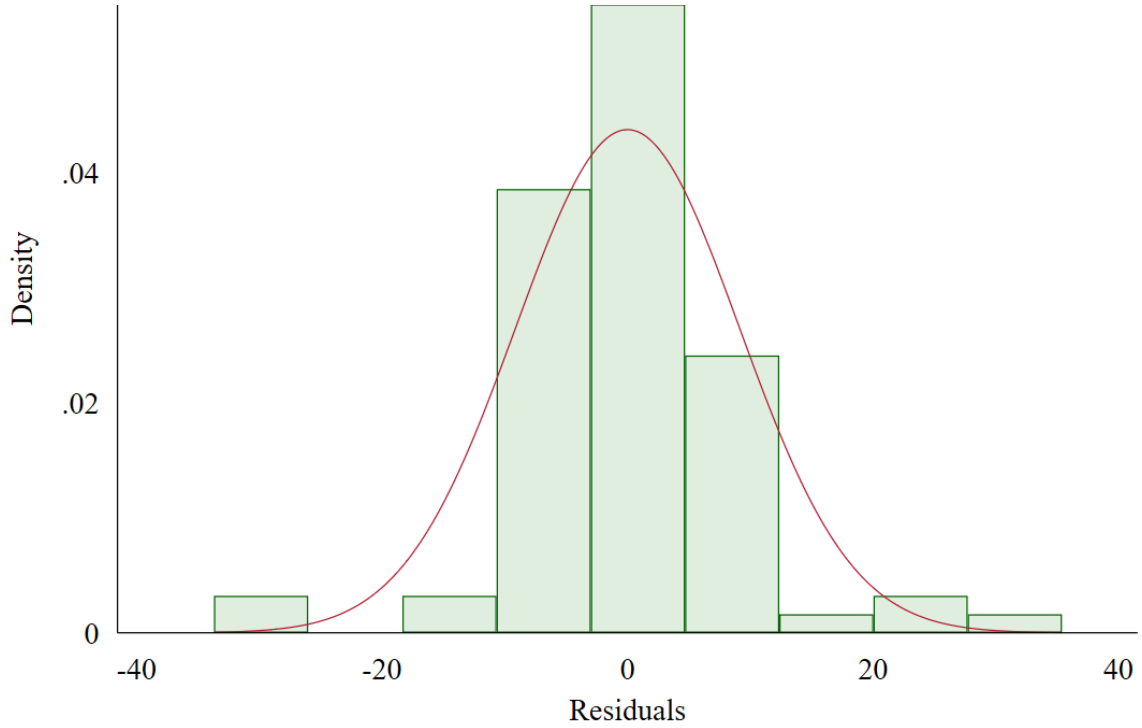

Figure C-2 Normality of residuals histogram

Appendix D

Table D-1 Overview of previous literature (author's elaboration)

Year	Author	Area	Period analysed	Method	Topic
Content Analysis					
2005	(Erkko, Melanen & Mickwitz)	Finland	1999-2001	Content analysis	Inclusion of the eco-efficiency concept in EMAS reports
2007	(Daub)	Switzerland	2001-2002	Content analysis	Analysis of large Swiss companies' environmental reports to gain insight into reporting practices
2008	(Bonilla-Priego & Avilés-Palacios)	Spain	2005	Content analysis and regression	Hotels, differences between groups, managerial/operational indicators
2012	(Mazzi et al.)	Italy	Firms registered until 2008	Documents-based survey methodology	Municipalities' inclusion of indicators in EMAS reports
2012	(Roca & Searcy)	Canada	2008	Content analysis	Disclosure of indicators in sustainability reports
2013	(Skouloudis et al.)	Greece	2011	Content analysis	Scoring EMAS statement quality and looking for differences between groups
2017	(Arthur et al.)	Ghana	2008-2012	Content analysis	Extent of GRI performance indicators by mining companies
2017	(Boiral & Henri)	No regional focus	2007	Content analysis	Mining companies' disclosure of GRI indicators

2019	(Aggarwal & Singh)	India	2013-2014	Content analysis	Analyse corporate social sustainability and sustainability reporting
2019	(Boiral, Heras-Saizarbitoria & Brotherton)	No regional focus	2006-2013	Content analysis	Mining and energy companies focus on what assurance statements by independent verifiers say
2020	(Heras-Saizarbitoria et al.)	Southern Europe	2003-2008 & 2013-2017	Content analysis	Inclusion of best practices and performance benchmarks
2020(2020)	(Papoutsi & Sodhi)	European, US American, and Canadian Firms	2013-2014	Content analysis and regression on sustainability performance	Investigating differences in quality and quantity of CSR reports
	Performance outcomes				
2009	(Iraldo, Testa & Frey)	EU	2005	Analysis of Data from an EU study	Environmental performance of EMAS certified firms as well as competitive advantages
2018	(Frondel, Krätschell & Zwick)	Canada, France, Germany, Hungary, Japan, Norway, USA	2000-2003	Matching and regression	Impact of adoption vs certification of an EMS on performance outcomes
2019	(Erauskin-Tolosa et al.)	No regional focus	2019	Meta analysis of the literature	Impacts of ISO and EMAS certification on environmental performance

2021	(Arocena, Orcos & Zouaghi)	No regional focus	2009-2018	Regression analysis	ISO impact on firm environmental and economic performance
2021	(Marrucci & Daddi)	Italy	2016-2018	Collecting data from reports	Impact of EMAS on manufacturing firms' environmental performance
Combining approaches					
2007	(Montabon, Sroufe & Narasimhan)	-	-	Content analysis	Impact of environmental management practices in reports on firm performance
2010	(Guidry & Patten)	USA	2001-2008	Content analysis	Impacts of publishing a standalone report and the quality of the report on market reactions

Continued: Table D-1 Overview of previous literature (author's elaboration)

Table D-2 Overview of sample firms and the quality of reports

Organisation	Quality of core indicators	Quality of other items	Overall percentage
Hawanger Käsegenuss GmbH	0.96	0.33	0.65
Schnorr GmbH	1.00	0.56	0.78
DUROtherm Kunststoff-verarbeitung GmbH	0.96	0.44	0.70
REMSGOLD Chemie GmbH & Co. KG	1.00	0.56	0.78

RMD Rhein-Main Deponie GmbH	0.83	0.78	0.81
Heiligenfeld GmbH	0.64	1.00	0.82
Conductix-Wampfler GmbH	0.96	0.56	0.76
Viasit Bürositzmöbel GmbH	0.96	0.78	0.87
adelphi consult GmbH	0.50	0.56	0.53
Rohde & Grahl GmbH	0.96	0.89	0.92
Umweltbank AG	0.90	0.67	0.78
Minderleinsmühle GmbH & Co. KG	0.96	1.00	0.98
medac Gesellschaft für klinische Spezialpräparate mbH	0.69	0.44	0.57
Arthrex GmbH	0.65	0.33	0.49
(GEKA mbH)	0.75	0.44	0.60
Städtisches Klinikum Karlsruhe gGmbH	0.86	0.22	0.54
Stadtwerk am See Verwaltungs GmbH	0.86	0.67	0.76
SEH Engineering GmbH	0.81	0.56	0.68
BODAN Großhandel für Naturkost GmbH	0.74	0.78	0.76
Gruner Aktiengesellschaft	0.96	0.56	0.76
Hess GmbH Licht + Form	0.85	0.67	0.76
DIAKO Ev. Diakonie-Krankenhaus gemeinnützige GmbH	0.72	0.67	0.69
Bruderhausdiakonie	1.00	0.67	0.83

GRG Services Berlin GmbH & Co. KG	0.44	0.89	0.67
Windwärts Energie GmbH	0.38	0.56	0.47
Thüga Energienetze GmbH	0.96	0.67	0.81
Allgäu Milch Käse eG	0.94	0.67	0.81
Carl Leipold GmbH	0.89	0.56	0.72
Stadtwerke Freising	0.89	0.44	0.67
Hechinger Automotive GmbH & Co.KG	0.74	0.89	0.81
Heidrive GmbH und	0.92	0.33	0.63
Energie und Wasser Potsdam GmbH	0.94	0.89	0.92
Kronen-Hotel GmbH	0.90	0.56	0.73
HUMAN Gesellschaft für Biochemica und Diagnostica mbH	1.00	0.56	0.78
GKS Gemeinschaftskraftwerk Schweinfurt GmbH	0.60	0.22	0.41
SPN Schwaben Präzision Fritz Hopf GmbH	0.90	0.67	0.78
Viaoptic GmbH	0.96	0.56	0.76
Hotel Langenwaldsee GmbH & Co. KG	0.81	0.56	0.68
INEOS Solvents Germany GmbH Werk Moers	0.90	0.56	0.73
Wesemann GmbH	0.96	0.56	0.76
POOLgroup GmbH	0.86	0.56	0.71

Gunvor Raffinerie Ingolstadt GmbH	0.96	0.11	0.53
Kräuter Mix GmbH	0.94	0.44	0.69
Richard Bergner Holding GmbH & Co. KG	0.61	0.44	0.53
Wassergewinnung Würzburg-Estenfeld GmbH	0.88	0.89	0.88
EUROQUARZ GmbH	0.69	0.22	0.46
Zoo Leipzig GmbH	0.92	0.44	0.68
Bauck GmbH	0.96	0.78	0.87
CITO-SYSTEM GmbH	0.58	0.67	0.63
Sternplastic Hellstern GmbH & Co KG	0.86	0.33	0.60
Laufenberg GmbH	0.69	0.67	0.68
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	0.96	1.00	0.98
Bürstenfabrik Faller GmbH	0.75	0.78	0.76
REISS Büromöbel GmbH	0.61	0.67	0.64
Kulturveranstaltungen des Bundes in Berlin (KBB) GmbH, Zentrale Verwaltung	0.90	0.67	0.78
Mack & Schühle AG	0.96	0.89	0.92
Kubota Baumaschinen GmbH	1.00	0.67	0.83
BESONDERE ORTE Umweltforum Berlin GmbH	0.63	0.78	0.70

ALTEN GmbH (Zentrale)	0.79	0.67	0.73
hanseWasser Bremen GmbH	0.90	0.67	0.78
Bonifatius GmbH Druck-Buch-Verlag	0.96	0.33	0.65
proTerra Umweltschutz- und Managementberatung GmbH Umweltgutachter	1.00	0.56	0.78
Tiefdruck Schwann-Bagel GmbH & Co. KG	0.92	0.44	0.68
Bagel Roto-Offset GmbH & Co. KG	0.96	0.89	0.92
Hohenwart Forum GmbH	0.75	0.44	0.60
Badische Drahtwerke GmbH	0.90	0.44	0.67
decor metall GmbH	0.54	0.78	0.66
SMP Deutschland GmbH	1.00	0.67	0.83
Mainzer Stadtwerke AG	0.85	0.78	0.81
KEK - Karlsruher Energie- und Klimaschutzagentur gGmbH	0.82	0.67	0.74
Schock GmbH	0.85	0.56	0.70
Trinkwasserversorgung Würzburg GmbH	0.82	0.78	0.80
Beck GmbH Druckkontrolltechnik	0.94	0.44	0.69
Heizkraftwerk Halle-Trotha GmbH	0.94	0.44	0.69
ZET-Chemie GmbH	0.81	0.56	0.68
EDELRID GmbH & Co. KG	0.86	0.78	0.82

O/D Ottweiler Druckerei und Verlag GmbH	0.90	0.67	0.78
energis GmbH inkl. energis- Netzgesellschaft mbH	0.82	0.33	0.58
Dr. Schumacher GmbH	0.90	0.89	0.90
GELSENWASSER Energienetze GmbH	0.50	0.33	0.42
Herbaria Kräuterparadies GmbH	0.76	0.78	0.77

Continued: Table 7-3 Overview of sample firms and the quality of reports