

Helbig, Raphaela; von Höveling, Sven; Solsbach, Andreas; Marx Gómez, Jorge

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RESEARCH ARTICLE

Strategic analysis of providing corporate sustainability open data

Raphaela Helbig^{1,2}  | Sven von Höveling²  | Andreas Solsbach²  |
Jorge Marx Gómez² 

¹Volkswagen Aktiengesellschaft, Wolfsburg, Germany

²Department of Computing Science, Business Information Systems/VLBA, Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany

Correspondence

Raphaela Helbig, Carl von Ossietzky Universität Oldenburg, Fakultät II - Department für Informatik, Abt. Wirtschaftsinformatik/VLBA, Ammerländer Heerstr. 114-118, 26129. Oldenburg, Germany.
Email: raphaela.helbig@uol.de

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Summary

How companies report their data is undergoing digitization and sustainable transformation. Sustainability is important; therefore, various stakeholders are interested in sustainability information. Companies provide the required information and strive toward the use of information systems to ensure efficient data processing. A possible approach for information provision is open data. This research introduces the idea of corporate sustainability open data (CSOD) as one new mechanism of companies' sustainability self-reporting. Since CSOD is not yet commonly practiced by companies, a strategic analysis of the situation and its possible consequences is conducted with an analysis of strengths, weaknesses, opportunities, and threats. This research provides an overview of companies' sustainable development through open data. Moreover, it identifies drivers, challenges, and reasonable strategies for CSOD adoption. Thus, the research contributes to the establishment of an innovative application of open data in the private sector to support sustainable transformation worldwide.

KEYWORDS

corporate sustainability reporting, data availability, knowledge management, nonfinancial disclosure, open data

1 | INTRODUCTION

Digitization is establishing a society in which knowledge is accessible and verifiable at any time via the Internet. This knowledge society

increasingly expects companies to make their information available digitally and freely, which are characteristics of the open data concept. Such expectations go beyond the existing sustainability information supply by companies.

Sustainability has gained relevance in society and world politics; for example, the “well below 2°C above pre-industrial levels” goal of the Paris Agreement (United Nations, 2015) and the United Nations Sustainable Development Goals (UN General Assembly, 2015). To reach such sustainability goals, the sustainable transformation of companies is particularly important. The transformation of large companies is of utmost importance because it influences the vast majority of sustainability worldwide.

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Disclaimer: The results, opinions, and conclusions expressed are not necessarily those of Volkswagen Aktiengesellschaft.

Note: A part of this research has been presented in a workshop on September 24, 2019, and published as work in progress in the adjunct proceedings of the hosting conference (Helbig & von Höveling, 2019).

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Owing to the relevance of sustainability, it is common for various stakeholders (e.g., investors, employees, customer, supplier, government) to assess companies based on their level of sustainability. In order to evaluate the sustainability performance of companies from their perspective, stakeholders need information on the impact of corporate activities and behavior according to their interests. Therefore, stakeholders increasingly ask companies to provide information on how they deal with sustainability-related issues. Investors are a specific stakeholder group. They hold the necessary capital for companies' sustainable transformations and depend on receiving information regarding how companies are coping with sustainability-relevant issues in order to steer the existing flow of financial resources into promising projects to achieve sustainable transformation. Currently, more than a quarter of all assets under management have been invested sustainably (Global Sustainable Investment Alliance [GSIA], 2017; GSIA, 2019). Consequently, the financial community is a stakeholder group with particular interest in sustainability data about companies (EU High-Level Expert Group on Sustainable Finance, 2018).

This research explores a new potential application of digitization for sustainability reporting, and thus the knowledge management of companies: corporate sustainability open data (CSOD). The idea of CSOD is that companies make their sustainability information available using their own media in a transparent, freely accessible way, ready for further use. This research addresses two main challenges in companies' reporting: the use of digital reporting pathways, and the provision of self-reported, sustainability-relevant content.

In this research, we approach the subject of CSOD as an innovative form of a strategic reporting mechanism from a pragmatic perspective. Here, CSOD is a by-product of dedicated digitized sustainability reporting and communication between companies and one specific stakeholder group (investors) that is made publicly available for other stakeholder groups. Our approach follows the natural motivation of profit-oriented organizations, in which digitization of sustainability reporting leads to efficiency for the reporting team. We suggest that companies should introduce a digital sustainability communication for particularly relevant stakeholder groups, such as the financial community. Once primary corporate sustainability data is better prepared for digital use, these data are public and consequently opened for other stakeholders—defined as open data.

This article reflects a partial outcome of our ongoing research project, “eco4fin—enabling environmental, social and governance (ESG) interaction”,¹ which investigates the approach of using a digital data platform to support companies' sustainability reporting and communication. It is a research collaboration between the University of Oldenburg and Volkswagen AG. The project's main goal is to investigate concepts that work toward digitized corporate sustainability communication, especially improving sustainability communication between large companies and the financial community (Carl von Ossietzky Universität Oldenburg, 2021). Our research addresses, among other things, targeted provision of corporate sustainability

information and the potential of open data. This article focuses on the approach of making sustainability data that are relevant for investors and analysts publicly available.

A former stage of this strategic analysis has already been presented as work in progress at the Environmental Management Information Systems workshop and published in the adjunct conference proceedings (Helbig & von Höveling, 2019). This article presents further developed findings.

In this section, we begin by outlining the concepts of open data and corporate sustainability data disclosure (Sections 1.1 and 1.2). Then, we discuss related work (Section 1.3) and outline our research issue (Section 1.4) and contributions of this article (Section 1.5).

1.1 | Concept of open data

In this research, open data is defined as a concept for the supply of information with the aim of making machine-readable digital data available in a way that is easy, free, and open to the public and ready for further use by third parties without restrictions. Generally, studies use different definitions for open data (Huyer & van Knippenberg, 2020). According to the European Commission, “open data is data that anyone can access, use and share. Governments, businesses and individuals can use open data to bring about social, economic and environmental benefits” (European Commission, 2019a). Overall, the term open data is applied to data that can be used by everyone for every purpose, including processing and publishing (Kassen, 2013; Kubler et al., 2016). Early applications of open data occurred in the fields of geophysical and environmental data (Chignard, 2013; Gray, 2014). Open data is related to other terms like big data, online data, linked data, and government data (Charalabidis et al., 2018). By using open data, third parties can create value and develop new business models (Magalhaes & Roseira, 2017; Zuiderwijk et al., 2015).

As part of open data, the term data is not to be confused with information and/or knowledge. The terms data, information, and knowledge are similar but still distinct. Data is the raw information in the form of bits; information is the organized data in a context; and knowledge is the assimilation of information, including an understanding of how to use the information (Machlup, 1983).

Data in many fields, like climate and resource efficiency, have great potential. However, data are seldom primarily collected for these purposes, but instead are often a by-product of the digital revolution. Still, the enormous potential of data is not yet understood (Charalabidis et al., 2018).

A recent report from the European Data Portal analyzed the economic value created by open data in Europe (Huyer & van Knippenberg, 2020). The report estimated the market size to cover €184 billion to-date and expects a growth of 15.7%. Growth is predicted in high-impact sectors such as transportation, public administration, and information (including communication); it is also predicted in high-potential sectors such as real estate, health, and finance (including insurance). Moreover, the report stated that gains in

efficiency (e.g., environmental benefits) are linked to savings in households' energy consumption of equivalent to 5.8 million tons of oil. Additionally, the report included a survey showing that 46% of organizations see their overall revenue impacted by open data, and 73% expect an increased impact. This survey included 103 organizations representing 21 European countries, of which one-third belong to the information and communication sector (Huyer & van Knippenberg, 2020).

There is an unequal development in adopting open data in public services and businesses. Open data from public services is increasing, while open data provided by the private sector are less evolved. Public services increasingly provide public data in an open format (Charalabidis et al., 2018; Hartmann et al., 2016; Immonen et al., 2014; Kubler et al., 2016; Magalhaes & Roseira, 2017). In comparison, companies seem to be more cautious about sharing open data (Immonen et al., 2014; Kitsios et al., 2017).

Given the conventional view that corporate data are mostly kept private, the concept of open data is sometimes contrary to popular opinion. Thus, corporate data tend to conflict with open data. Companies hesitate to adopt an open data policy for their own data. In the remainder of this section, we compile some possible explanations for the unequal developments in the adoption of open data.

1.1.1 | Adoption of open data from the perspective of public services

Open data can bring concrete benefits but also concrete drawbacks. Janssen et al. (2012) list benefits and adoption barriers of open data for public services, based on empirical research involving several interviews and a workshop. Key benefits of open data provided by public services include strengthening accountability and improving trust of citizens.

The traditional boundary—between a public service and citizens—is to some extent broken when everyone has access to data. This enables feedback loops from which both sides can benefit. Furthermore, an important benefit is that the openness of data can result in an economic boost, since citizens and private companies can support new services and make better decisions (Janssen et al., 2012). There are also barriers to open data. For example, the lack of resources (e.g., budget, human, technical) and knowledge, as well as an unknown return on investment, make the support of open data questionable. Moreover, an important barrier is the concern about consequences, which is especially deterring for a risk-averse culture. The contact with various stakeholders, often in the form of critical questions, must be handled carefully, as it leads to a negative change in business (Janssen et al., 2012). Furthermore, existing data sets—not only the primary data, but also the metadata—often fail to meet requirements for completeness, reproducibility, and uniqueness (Knetsch, 2013).

There are more reasons explaining the increased use of open data by public services than the fact that they far-outweigh the barriers. In recent years, the increasing pressure from public bodies, civil society, and the private sector pushed public services toward open data

(Bates, 2012; Charalabidis et al., 2018; Lathrop & Ruma, 2010; Magalhaes & Roseira, 2017). Additionally, public bodies are primary data suppliers of data in several domains, such as meteorology and geology (Magalhaes & Roseira, 2017; Pollock, 2009). As a result, data (e.g., weather data) are collected and processed for the public anyway. Moreover, the service is also paid for by the public sector. Thus, in some cases, making the data fully available is a natural next step (Lindman & Nyman, 2014).

1.1.2 | Adoption of open data from the perspective of companies

When dealing with open data, companies seem to be more cautious about sharing their data, in comparison with public services (Immonen et al., 2014; Kitsios et al., 2017). In general, the concept of open data is contrary to the conventional corporate view that corporate data are mostly kept private. However, the OpenCorporates intends to improve the accessibility, quality, and reuse of data about corporates (OpenCorporates, 2019).

Benefits and barriers of open data are similar for companies and public services. Similar to the situation for the public services, open data introduces several changes. In fact, most arguments can be directly transferred. Open data can create trust and feedback loops, and it enables collaboration, which saves time, effort, and money; additionally, companies can benefit from services that are built on top (Lindman & Nyman, 2014).

One reason why companies are hesitant to open their data is that a large portion of their data is personal customer data that is protected by privacy rules (Immonen et al., 2014). This may strengthen hesitation against open data, given stricter regulations like the EU General Data Protection Legislation (Charalabidis et al., 2018). Another important reason why companies cautiously adopt open data is the lack of business models (Immonen et al., 2014). Different from public services, corporate data places importance on return on investment. The aforementioned benefits can be part of the return on investment; however, more direct business models are also conceivable. Lindman and Nyman (2014) described some conceivable business models (e.g., premium access) that can allow for higher granularity, faster access, and machine-readable access. Another business model could be a purchasable downstream application offering more comfortable access (Lindman & Nyman, 2014). However, a barrier is that these kinds of business models are still in a pioneer phase (Kitsios et al., 2017; Lindman & Nyman, 2014). Moreover, the barriers mentioned for public services also apply for companies (Kitsios et al., 2017).

1.2 | Concept of corporate sustainability data and its disclosure

Sustainability is complex because it involves many factors. In this research, we focus on sustainability data about companies. Usually, a

company's sustainability information includes environmental and social information, such as greenhouse gas emissions, recycled material, and employee satisfaction. In addition to specific indicators, this information includes risks, management concepts, and controversies. Among various sustainability models (Elkington, 1994; Pfennig & Müller-Schoppen, 2018; Raworth, 2017; Rockström et al., 2009), the triple bottom-line approach has been applied in companies' sustainability reporting for decades (KPMG, 2017; Wheeler & Elkington, 2001). The triple bottom line describes sustainability as a combination of three partially overlapping dimensions: environmental, social, and economical. In the financial sector, sustainability data is called ESG data, involving the environmental and social dimensions and the dimension of corporate governance (EU High-Level Expert Group on Sustainable Finance, 2017). ESG data are also referred to as nonfinancial data, in order to show the difference from restricted financial reporting that companies face.

Companies are becoming increasingly transparent about how they approach sustainability issues, and they make their sustainability data available to their stakeholders in several ways. We describe various means of corporate disclosure in the following, while excluding other forms of communication, such as meetings and talks. Today, a growing number of companies disclose sustainability information, either voluntarily or mandatorily. They may disclose it directly, via their own media (e.g., sustainability report, company website, brochures), or indirectly, via public registries or intermediaries.

The manner and methods (e.g., calculation standards) by which companies provide sustainability data are only partially consistent with our understanding of open data at this time. First, the digital preparation of a company's sustainability reports is usually limited to PDF files or a presentation on a website. Consequently, although a sustainability report is generally freely accessible, the information provided is usually not machine readable and, therefore, does not meet our definition of open data. Also, a corporate disclosure via the intermediary platform of the Carbon Disclosure Project (CDP) is not considered to be open data provision. CDP is a nongovernmental organization and has been independently disclosing collected environmental data since the year 2000, whereas the public disclosure of corporate data is dependent on individual permission. Though CDP started as an open data project, it still publicly and freely provides data from many countries, regions, and cities (CDP, 2019d). Access to the data is provided via the website, but no data extraction is offered, either via application programming interface (API) or others. By contrast, access to corporate data has been commercialized. For a membership fee, investors, business customers, and other interested parties receive raw data in spreadsheets (CDP, 2019d). Although often ignored, registries of public authorities are another source of corporate information. These registries are produced by mandatory reporting, which varies depending on national regulations and industry sector. Some public authorities make these corporate information sources available to the public digitally. Currently, corporate sustainability information in the form of open data is only provided by some public administrations, such as the online platform of the Toxic Release Inventory from the US Government.

1.3 | Related work

1.3.1 | Transfer of sustainability data between reporting companies and the financial community

In a recent study, Helbig and Marx Gómez (2019) described the transfer of sustainability data and exchange on sustainability issues between companies and investors. Sustainability information is offered directly by companies themselves, as well as indirectly by intermediaries, such as various sustainability research and rating agencies, information providers, and brokers. We refer to investors and intermediaries as the financial community.

Intermediaries are predominant within the transfer of sustainability data, in both data provision and interpretation (Helbig & Marx Gómez, 2019). Other recent research confirms this predominant position for sustainability research and rating agencies, stating that the underlying sustainability-related data, rather than the rating results, are of particular interest for the financial community (Petroy & Wong, 2020). Moreover, data provided by sustainability research and rating agencies also provide challenges for users, such as being inaccurate and/or old (Petroy & Wong, 2020).

To improve the current situation of corporate sustainability data transfer and provision, Helbig and Marx Gómez (2019) recommended a more proactive sustainability communication. For example, they recommended the support of information and communication technology and disclosure in the form of open data.

1.3.2 | Toward the use of information systems

For the efficient provision of sustainability information, companies strive toward the use of information systems. To produce information that meets the requirements of reporting standards, conventional sustainability management software (e.g., ID-Report by Abat, and Enablon publisher by Enablon) includes reporting modules. The data output can then be made available in various forms. In this case, open data would be theoretically possible; but as previously stated, this is not observed in corporate practice. In practice and research on corporate sustainability reporting, developments in information and communication technology do not tend to conflict with open data.

1.3.3 | Research does not contradict open data implementation

There are only a few studies that focus on providing corporate sustainability data through open data. Some research trends in sustainability reporting already facilitate open data, such as emphasis on the potential of the Internet and the automated provision of tailor-made information (Isenmann et al., 2011; Isenmann & Marx Gómez, 2008; Solsbach et al., 2013). In addition, Solsbach (2015) demonstrated with an approach of interorganizational and harmonized sustainability reporting that sustainability data can also be aggregated beyond

company boundaries using standardized digital formats. This provides a solid basis for collecting sustainability information along the value chain and involves suppliers (Solsbach, 2015). For the digital self-reporting of sustainability data by companies, eXtensible Business Reporting Language (XBRL) is a suitable human- and machine-readable format. Based on XML, the markup language XBRL is used for digital financial reporting (Kesselmeyer & Leibfried, 2008; XBRL, 2019). La Torre et al. (2018) identified concepts for the use of XBRL in sustainability reporting. Furthermore, XBRL has the potential to be a suitable format for implementing sustainability data in the form of open data. For example, Mora-Rodriguez et al. (2017) developed an effective transparency model that enabled them to prepare, combine, and publicize existing XBRL data with linked data aiming to foster sustainable business growth.

1.3.4 | Several studies using corporate sustainability data

Over the past decades, various research studies have been conducted using sustainability data that companies have self-reported, both directly and indirectly through public administrations. Many of these studies belong to the research fields of accounting and finance, and the majority of them use quantitative methods. For operationalization, some index values were created based on this data (e.g., via content analysis), and some relative indicators were developed using combinations of different data, sometimes with financial parameters. In addition, some studies used further data on companies, either gathered from information service providers or supplemented by their own surveys. On the one hand, the results of these studies provided information about the potential of this data and to what extent it reveals sustainable development and transformation of companies. On the other hand, these research projects are only comparable to a limited extent because they consider different levels of sustainability. For example, some studies limit themselves to the ecological dimension (Ali Fekrat et al., 1996; Barbu et al., 2014; Cho et al., 2012; Clarkson et al., 2011; Cowan & Deegan, 2011; Freedman & Wasley, 1990; Hughes et al., 2001; Patten, 2002). Many other studies within the environmental field specialize in greenhouse gas emissions, and thus focus exclusively on climate change (Andrew & Cortese, 2011; Dawkins & Fraas, 2011; Guenther et al., 2016; Hahn et al., 2015; Luo, 2019; Luo & Tang, 2014; Matisoff et al., 2013; Qian & Schaltegger, 2017). Still other studies additionally or exclusively examine the social dimension of sustainability (Font et al., 2012; Noronha & Wang, 2015). These studies have revealed evidence on different factors encouraging companies to disclose corporate sustainability information themselves (e.g., industry sector, visibility, financial and human resources of the company, the country of origin, stakeholder pressure).

1.4 | Outline of the research issue

Sustainability-relevant data about corporations has the potential to support the sustainable development and transformation of

companies. Companies are becoming increasingly transparent about how they approach sustainability via various media. Open data is a plausible concept for the digital delivery of information. While public administrations have already begun to implement the concept of open data, companies hesitate to adopt this concept for their own primary data. Open data is therefore applied less to companies' internal data, and this is also true for sustainability data. Only some forms of self-reported corporate sustainability data are provided in the form of open data by public authorities.

We propose an innovative form of a strategic self-reporting mechanism, CSOD, where companies make their primary sustainability information available with their own media in a transparent, freely accessible, machine-readable way that is ready for further third-party use. Consequently, we classify CSOD as a subsection of sustainability disclosure.

Before companies take steps toward the approach of CSOD, decision-makers require a strategic analysis. We address the following research questions: Which factors define the situation regarding the adoption of CSOD and possible consequences? Which strategies support CSOD adoption in this context? Our research goals are to provide a structured view on CSOD, including a current and a future perspective, and to provide an overview of factors that potentially drive or challenge the adoption and use of the CSOD provision.

1.5 | Contributions

The contributions of this article address both practitioners and scholars. Our research provides a simple overview of the situation and reasonable strategies regarding a potential adoption of CSOD.

This article supports practitioners working with companies that consider taking steps toward the concept of CSOD in the future. First, we provide an overview of current approaches to corporate sustainability reporting. Next, we use our findings as a basis for the argument toward the use of CSOD. For any company considering the adoption of CSOD, this research provides guidance as to how companies can make their own sustainability data freely available, machine-readable, and ready for further use. The detailed outline of our findings, including textual presentation and a structured scheme, can assist decision-makers in developing awareness of the strategic situation their companies face. To support CSOD adoption and implementation, we also propose strategies that fit the various individual corporate strategic positions. Furthermore, by pointing out relevant drivers and challenges (e.g., digitization and cultural preferences), we are able to inform companies about how to prepare for CSOD adoption and use.

Despite an obvious practical orientation, our research also contributes to academia. This research extends existing academic research dealing with the adoption of open data in both the private sector and from the corporate perspective. We present a pragmatic approach to increase the acceptance of sharing open data in the private sector, which proposes the digitization of relevant sustainability data for the financial community while simultaneously considering its provision to the public. This contributes to the increasing popularity of open data in the private sector, since it supplies companies with

insights about a potential implementation of CSOD in a concrete, strategically important context. Furthermore, our research aims for transparent and useful supply of sustainability data from the private sector. For other academics, our research paves the way for a wide range of disclosed sustainability data beneficial for future research in many academic fields, including knowledge management, software development, sustainability management, controlling, and corporate strategy.

2 | METHODS

To meet our research goals, we performed a strategic assessment involving CSOD as a proposed reporting strategy mechanism. In this section, we first introduce the strategic tool used, including a brief critical review (Section 2.1). Next, we describe the corresponding scheme that structures the findings' presentation (Section 2.2). Finally, we discuss how we applied the method in our research (Section 2.3).

2.1 | Strategic tool

Generally, a scenario can be examined in a structured way by analyzing the strengths, weaknesses, opportunities, and risks. This method is known as a strengths, weaknesses, opportunities, and threats (SWOT) analysis (Gürel & Tat, 2017; Panagiotou, 2003), a method of strategic planning (Weihrich, 1982). It is also known as a situational analysis or, less commonly, as TOWS (Weihrich, 1982). Many authors refer to the method as environmental analysis (Ghazinoory et al., 2011; Mintzberg, 1990; Pickton & Wright, 1998). This article uses the term SWOT to avoid confusion between the method being utilized and the general topic of environmental sustainability.

SWOT analysis is a popular instrument in academia and practice (Ghazinoory et al., 2011; Hill & Westbrook, 1997; Pickton & Wright, 1998), often used as a method of strategic planning well beyond organizational strategy. SWOT analysis represents the central idea of strategy, in general, since it describes and evaluates an organization's current situation and plans in their internal and external contexts (Grant, 1991). In comparison with intuitive reflection, SWOT analysis helps to reveal blind spots through its structure. During the process, internal and external factors are analyzed separately; this is important, since organizations have control over their internal, but not their external, situations (Ghazinoory et al., 2011). The method's popularity is, in part, due to its simplicity (Pickton & Wright, 1998). A SWOT matrix regularly represents the key findings of a SWOT analysis.

Despite the advantages of a SWOT analysis, academic discourse takes a critical perspective of the method. For example, SWOT is criticized by Pickton and Wright (1998) for encouraging researchers to create lists instead of applying an analytical process, and this might lead to poor decisions. They suggest complementing the strategy process with weighting of concepts by relevance (Pickton & Wright, 1998). Similarly, Panagiotou and van Wijnen (2005) criticized that the simplicity of the method and the lack of prioritization might

encourage negligent use, which, at worst, could produce general statements. In addition, Ghazinoory et al. (2007) highlighted structural weaknesses of SWOT, such as not accounting for uncertainties and classifying ambiguous factors (e.g., opportunity or threat) on the basis of individual valuations. However, Pickton and Wright (1998) emphasized that SWOT analysis has the potential to assist management processes. They suggested shifting the focus away from using the final SWOT matrix as a main analysis output and toward the process of creation while performing a SWOT analysis (Pickton & Wright, 1998). From this, we conclude that the final SWOT matrix does not provide an action plan and merely serves to support decision-making by reflecting on a situation and its different strategies.

2.2 | Schematic structure

The SWOT analysis results in a matrix, as shown in Figure 1. Initially, an internal analysis is conducted (e.g., organization, management, finances, operations, marketing), and its results are classified into strengths and weaknesses. Independently of this, factors of the external setting (contextual situation) are examined in the external analysis (e.g., economy, social affairs, demography, politics, technology, products, competition, environment, law), and its findings are then classified into opportunities and threats. Finally, by combining the findings of the internal and external analyses, one can identify appropriate strategies to address each of the four quadrants in the central 2×2 matrix (David, 2011; Weihrich, 1982).

The most challenging part of conducting a SWOT analysis is identifying appropriate strategies. The strategies for each of the four quadrants are referenced differently. The strength-opportunity (SO) strategies aim to exploit internal strengths to benefit from existing opportunities. In contrast, weakness-opportunity (WO) strategies seek to overcome internal weaknesses to take advantage of existing opportunities. Strength-threat (ST) strategies are designed to utilize internal strengths effectively to prevent existing threats. And finally, weakness-threat (WT) strategies focus on the defensive, because they are aimed at reducing or eliminating weaknesses to avoid existing threats (David, 2011).

2.3 | Applying SWOT analysis

This research uses SWOT analysis to (a) evaluate the strategic position of CSOD and (b) to derive strategies that would become relevant if companies were to adopt CSOD. We assess the current situation and reflect on future developments, as well as possible consequences of adoption. However, our research does not address particular technical details, since we do not assess a specific implementation of our concept.

When considering the objectives of this study, it becomes clear that the advantages of the SWOT method predominate any of its potential weaknesses. SWOT analysis is an appropriate instrument because it allows a structured and comprehensible evaluation process.

		INTERNAL FACTORS	
		INTERNAL STRENGTHS (S)	INTERNAL WEAKNESSES (W)
EXTERNAL FACTORS	EXTERNAL OPPORTUNITIES (O)	Opportunities that can be taken advantage of with strengths → SO strategies: use strengths	Opportunities that are missed due to weaknesses → WO strategies: overcome weaknesses
	EXTERNAL THREATS (T)	Threats that can be countered by strengths → ST strategies: apply strengths	Threats that are favored by weaknesses → WT strategies: prevent weaknesses

FIGURE 1 Basic SWOT matrix. Figure from Helbig and von Höveling (2019), which was created by utilizing Chermack and Kasshanna (2007, p. 387), Weihrich (1982, p. 60), and David (2011, p. 180)

The strategic analysis consists of different analyses, supporting a structured and verifiable assessment. First, we conduct an internal analysis of the proposed strategic reporting mechanism, followed by an external analysis of the contextual situation. In the internal analysis, we examine the strengths and weaknesses of a CSOD provision approach from the perspective of a hypothetical company. In the external analysis, we assess the opportunities and threats (i.e., risks) of the hypothetical company's context by using a political, economic, social, technological, environmental, and legal (PESTEL) analysis. By combining the findings of both internal and external analyses, we are able to develop action strategies for a hypothetical company. The strategies should be applicable in any situation that results from a combination of the internal and external factors identified.

This study is based on a review of sources and practical experience. The findings presented are the result of several working sessions of collecting, reviewing, and analyzing information, both as individuals and as a team.

3 | FINDINGS

Our research on the strategic situation of CSOD provision findings is developed using a SWOT matrix, shown in Figure 2. Findings of all analyses are presented and developed within the text. We refer to letter-number codes found within the SWOT matrix (e.g., S#01 for strength number one) to help guide the reader. First, we identify internal factors after introducing our approach of providing CSOD from the company's perspective (Section 3.1). Second, we identify external factors by conducting an analysis of the company's context (Section 3.2). Finally, we combine the identified individual internal and external factors to develop strategies (Section 3.3).

3.1 | Providing CSOD

The internal analysis examines the proposed reporting mechanism of CSOD. We first describe the approach of CSOD in detail. Then we

outline the findings of the internal analysis by describing the internal factors identified. The subject of the internal analysis is an information technology (IT)-supported provision of a company's CSOD. Here, CSOD includes data that were originally processed to target the needs of the financial community and that are available to the public as well (including any other stakeholder group).

3.1.1 | CSOD via public access to a digital reporting tool

We introduce a hypothetical setting that enables open data transfer of primary corporate sustainability data digitally. Our approach allows public users to access CSOD via an online reporting tool of an individual company, implemented as a data communication platform. The analyzed open data approach of sustainability data provision is part of a more extensive concept of an IT solution as explored in the eco4fin research project, focused on enabling ESG interaction. Overall, the eco4fin research project intends to build a prototype of an ESG communication data platform for the financial community that supports stakeholder-oriented, targeted, and individualized sustainability reporting and communication (Carl von Ossietzky Universität Oldenburg, 2021). The prototype will involve two data-consuming user groups: the financial community and the general public. By providing public information, this solution prevents exposing insider information and assures compliance with regulations in financial communication.

The primary focus of the CSOD provision in this research is the public availability of data that have already been processed and stored digitally. Here, the CSOD provision is considered a by-product of making data intended for the financial community readily available. The realization of the stakeholder-oriented sustainability communication as intended by the eco4fin research project requires data that are adapted to the financial community's needs, consistent in time series, and machine-readable. The processed data are to be collected and stored (e.g., in a database), so it is ready for use in IT solutions. The reporting company is free to open this database for public access. By applying public access rights to all of the data, more stakeholders

INTERNAL FACTORS of providing own Corporate Sustainability Open Data from the perspective of a hypothetical company		
INTERNAL STRENGTHS (S) Developed from internal analysis S#01: Original corporate data provided first-hand S#02: Central platform collects and provides all corporate sustainability data S#03: Company has control over data content and delivery S#04: No access barriers for the public S#05: Time series S#06: Traceability of data origin and data processing S#07: Possibility for rapid updates S#08: Output of individualized reports S#09: Fast delivery of data for similar or recurring queries S#10: Intuitive, web-based graphical user interface S#11: Machine-readable S#12: External interfaces for integration and extraction of data		INTERNAL WEAKNESSES (W) Developed from internal analysis W#01: Rather risk-averse corporate culture regarding reporting W#02: Data quality is poor W#03: Some data may not be available W#04: Data collection requires resources W#05: Dependence on technical realization W#06: Facilitates biased queries W#07: Provided data is only partially comparable that of other companies
EXTERNAL FACTORS of the context		
EXTERNAL OPPORTUNITIES (O) Developed from external analysis O#01: Global agreed Sustainability Development Goals O#02: Worldwide agreement for climate protection O#03: Governmental Open Data increasingly widespread O#04/T#04: Sustainability is gaining in competitive importance [among companies] for capital O#05: Players of the financial community request sustainability information from companies O#06: Intermediary organizations conduct requests/surveys for sustainability information and get support from relevant stakeholders O#07: Heterogeneous players within the financial community O#08: Increasing public awareness for sustainability and need for information O#09/T#09: Increasing importance of data quality O#10/T#10: Dynamic development of the content in sustainability reporting O#11: Crisis of confidence regarding companies O#14: Benefit from swarm intelligence O#16: Digitalization as a megatrend O#17: Digital processing of information is common O#18: Exchange format XBRL (eXtensible Business Reporting Language) O#19: Internet access widely ensured O#22: Relevance of Open Data for realization of Sustainable Development Goals O#23: Climate change as a global environmental challenge O#24: Possibility of self-regulation of corporate sustainability performance O#25: Mandatory sustainability reporting O#26: Public access to environmental information O#28: European Union considers integration of sustainability into the finance sector	SO STRATEGIES Use strengths in order to take advantage of opportunities SO-01: Establish stable and asynchronous ability to provide information via platform [S#01, S#02, S#04, S#09 / O#04, O#05, O#06, O#08, O#10, O#11, O#14, O#16, O#19, O#25, O#26] SO-02: Realize higher efficiency at reporting by centralized data repository [S#01, S#02, S#07, S#08, S#09, S#11 / O#05, O#06, O#10, O#16, O#17] SO-03: Allow individual reporting via a individual parameters and the usage of algorithms [S#05, S#08, S#11 / O#04, O#05, O#06, O#07, O#10, O#16, O#17, O#26] SO-04: Exploit potential rapidity of information provision [S#07, S#09 / O#11, O#16] SO-05: Implementation of transparency toward stakeholders [S#01, S#02, S#04, S#06 / O#03, O#08, O#11, O#22, O#26] SO-06: Provide interface for data integration in software products [S#11, S#12 / O#04, O#05, O#06, O#14, O#16, O#17, O#19, O#28] SO-07: Exploit the disruptive element of digitalization by implementing direct communication with investors [S#01, S#03, S#04 / O#05, O#06, O#16, O#17, O#19] SO-08: Exploit added value of digital formats and digital forms of presentation [e.g., machine-readable, time series] [S#05, S#06, S#07, S#09, S#11, S#12 / O#10, O#16, O#17, O#18, O#19] SO-09: Realize proactive sustainability reporting and communication [e.g., present corporate goals and provide monitoring] [S#03, S#06 / O#04, O#10, O#11, O#24] SO-10: Align reporting with future issues and develop it thematically along many (and new) dimensions [S#02 / O#01, O#02, O#08, O#10, O#22, O#23, O#26, O#28]	WO STRATEGIES Overcome weaknesses in order to take advantage of opportunities WO-01: Provide information proactively instead of hiding it [e.g., also disclose negative information] [W#01, W#02, W#03 / O#04, O#10, O#11, O#24] WO-02: Initiate a change in corporate culture for more openness toward Open Data [W#01 / O#03, O#04, O#11, O#16, O#17, O#18, O#19] WO-03: Establish or strengthen governance structures for a transparent data collection [W#01, W#02, W#03, / O#09, O#25, O#26] WO-04: Verify data quality [content, collection processes] by external auditors and label revised data [W#02 / O#04, O#09, O#11, O#24, O#25] WO-05: Build awareness for the companies' environmental impact among employees [e.g., monitoring of relevant data] [W#02, W#03 / O#08, O#09, O#11, O#24] WO-06: Always include key information about important topics in every report [W#05, W#06 / O#04, O#05, O#07] WO-07: Evaluate conventional formats for sustainability reporting and eliminate them if appropriate [W#04 / O#10, O#16, O#17]
EXTERNAL THREATS (T) Developed from external analysis T#04/O#04: Sustainability is gaining in importance in the competition [among companies] for capital T#09/O#09: Data quality becomes more and more important T#10/O#10: Dynamic development of the content of sustainability reporting T#12: Lack of expertise limits usage of information T#13: Misinterpretation or different interpretation than that from the company T#15: Skepticism toward technical progress T#20: User misses later updates of incorrect data T#21: Cybercrime [e.g., data manipulation] T#27: Data protection regulations may hinder disclosure	ST STRATEGIES Apply strengths in order to counter threats ST-01: Enable and implement user feedback [S#02, S#10 / T#04, T#09, T#10, T#27] ST-02: Use clear and understandable description for the individual data sets [S#01, S#02, S#03, S#06 / T#09, T#12, T#13] ST-03: Design a scalable and extensible platform [S#02, S#07, S#09 / T#04, T#09, T#10, T#27] ST-04: Provide traceable and transparent data updates via time stamps and fields for explanations [S#01, S#02, S#03, S#05, S#06, S#07, S#09 / T#09, T#15] ST-05: Design the graphical user interface for intuitive use [e.g., simple data, better understanding of the data] [S#04, S#10 / T#12, T#13, T#15]	WT STRATEGIES Reduce weaknesses in order to prevent threats WT-01: Participate in standardization processes [e.g., sustainability reporting] [W#04, W#07 / T#04, T#09, T#13] WT-02: Provide explanations [e.g., for data fluctuations and changes] and management strategies if useful [W#01, W#02, W#03, W#05, W#07 / T#12, T#13, T#15] WT-03: Offer assistance about how to use the platform and the data [e.g., tutorials, sample profiles and filters] [W#05, W#06, W#07 / T#04, T#12, T#15] WT-04: Establish security concept for data integrity [W#01, W#05 / T#09, T#15, T#21] WT-05: Build up a culture of transparent error management for reporting [e.g., emphasize possible subsequent updates, label updates transparently] [W#01, W#02, W#05 / T#20]

FIGURE 2 SWOT matrix analyzing the provision of CSOD. Updated figure from Helbig and von Höveling (2019)

could benefit from this innovative data supply, even if the data are not initially adapted to their needs. Consequently, the public (i.e., stakeholders not further characterized and not part of the financial community) could get access to a data supply that differs from the conventional data supply (e.g., sustainability reports in PDF, HTML, or

paper formats), since these data are processed and provided in formats that support further digital use.

Figure 3 shows participants and their main interactions in the central concept of the eco4fin digital platform. The figure is a result of applying the general approach of Jaekel (2017) to our concept for the

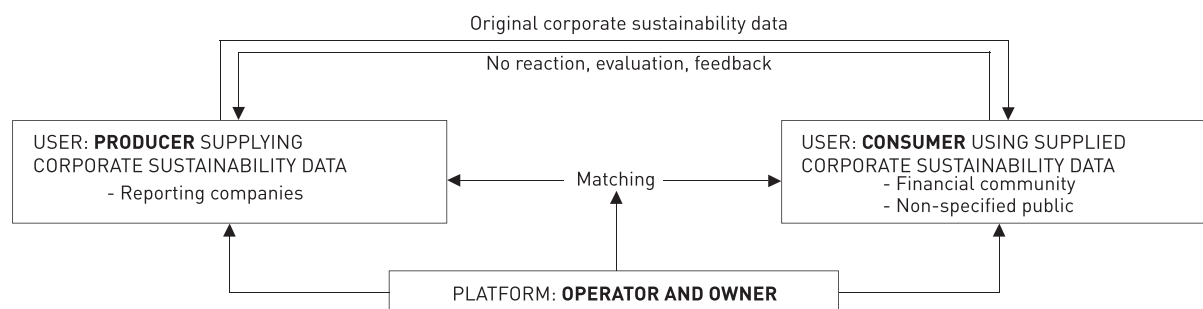


FIGURE 3 Participants and their main interactions on the digital tool of the eco4fin research. The figure is based on the general schematic representation for a platform by Jaekel (2017, p. 49)

domain-specific application. In general, a platform relies on the core interactions provided for users. The core interaction of our digital platform is the transfer of sustainability data from companies (producing the data) to both members of the financial community and the public (consuming the data). Companies use the platform's core interaction as a service to assist their stakeholders from the financial community and to enhance voluntary or mandatory sustainability reporting and communication. Additionally, this service is to be extended to nonspecific users, who are referred to as public users in this context. Accordingly, we assign public users to the user group of consumers. The platform operator's tasks are to (a) implement a successful match between users and their desired core interaction and (b) offer suitable interfaces. The platform owner handles the core interaction and access options. In addition to its core interaction, this platform may also support other functions requested either by the platform owner/operator or by third-party IT applications.

In the eco4fin research context, CSOD has been implemented via creating a public area for public users while the mainly targeted stakeholders are investors and analysts. We briefly describe the current state of implementation; however, a detailed presentation of our eco4fin concept, its individual functions, and prototype implementation is not the focus of this article. The first version of the prototype has been developed. It demonstrates an open data ESG communication tool intended for dedicated stakeholders from the financial community but which also open to the public. The prototype uses a simple three-tier IT architecture that includes a database, a back end, and a front end. It also offers APIs, facilitating further data use by third-party IT applications. On the access level, the tool has a specialized area that is only accessible for authorized users from reporting companies, in order to ensure smooth data input (producing the data). The current prototype also provides special functionalities for all users. These functions address the requirements empirically collected from the main user groups. Functions on the graphical user interface consist of an elaborated search, temporary dashboard, export functions, blog capabilities, and guidance. Additionally, an automated data provision is also included, in an effort to target the individual needs of investors and analysts; this feature is also open to nonspecific public users. Moreover, users could benefit from API export of open data.

3.1.2 | Internal factors

The internal analysis examines the potential implementation of providing CSOD, as previously mentioned. For this purpose, we examine things from the perspective of a user from a hypothetical company. Individual strengths and weaknesses are the outcome of this analysis. All internal factors identified are shown in Figure 2, identified by numbers and classified as strengths (S) or weaknesses (W). We use the remainder of this section to discuss the findings.

First, we address the strengths. Investors and intermediaries will find original, primary corporate data sets firsthand (S#01) in an Internet-based, corporate big data platform. This is a central data platform where a large company collects all corporate sustainability data and proactively makes it available to the stakeholders for self-service (S#02). As a result, the company has control over its data content and manner of delivery (S#03). Even if the data platform and its database are primarily established and made available for the stakeholder group of the financial community, open data does not set any access barrier for the public even if they are not the target group (S#04). The content provided covers key indicators from the sustainability report (e.g., greenhouse gas emissions, recycling rate), but also information on risks and controversies. As a result, there are quantitative and qualitative data sets stored as time series (S#05). The database is vast, both in width (different data sets) and in depth (time series). Moreover, data output is possible at different levels owing to the fine granularity of the data. Because different algorithms of data aggregation are used for different levels, the data origin and processing are traceable (S#06). Companies have the possibility for rapid updates (S#07; e.g., for regular updates of the data sets, and more importantly, when the situation has changed). Various members from the financial community use the platform. They gather information of interest via this platform and get it tailored in individualized reports (S#08); for example, as described by Isenmann and Marx Gómez (2008). Owing to automatization, similar or recurring data queries can be delivered quickly (S#09). There are two ways of accessing the data. First, a web-based, graphical user interface is used to present data interactively and intuitively; this cockpit approach allows handling without deep technical understanding (S#10). Second, there are external interfaces that allow users to automatically integrate and extract machine-

readable (S#11, S#12) data sets and, if required, incorporate the data into existing software applications.

However, the setting described does not reflect the reality of most companies yet, likely due to the weaknesses of CSOD. Companies rarely exceed mandatory reporting to such an extent. This may be linked to a risk-averse corporate culture regarding reporting (W#01), which may be linked to business secrets and liability issues. Additionally, the data quality may continue to lack (W#02) both content and availability (W#03) in the future. In order for the collection of data to be reliable, one needs resources, such as money and labor (W#04). Also, successful acceptance of the data platform depends on technical realization (W#05), especially the graphical user interface and the programming interface for data export. Furthermore, tailored reporting facilitates biased queries (W#06), which could result in providing incomplete information and blind spots. Even if one company introduces CSOD, the data provided will only be partially comparable to those of other companies (W#07) because other companies will not provide the same granularity and amount of information.

3.2 | Contextual situation

The context of corporate sustainability disclosure is out of the control of reporting companies. The external analysis examines the context, tends to include the current situation as well as future developments, and remains open for various forms of corporate sustainability disclosure. We apply the PESTEL approach to structure our view on the context and to ensure a high level of completeness. While conducting the analysis of the external situation, we identify external factors that describe and define the context. This analysis includes obvious and hidden factors, it considers current circumstances, and tries to anticipate future development. The outcome is a list of external factors that are numbered and classified into opportunities (O) and threats (T), especially regarding sustainable development, digitization, and open data. In a few cases, external factors were classified both as opportunities and threats.

3.2.1 | Political factors

Current developments in politics encourage sustainability and digitization. Sustainability issues have gained relevance in world politics, so participants in world politics are addressing the issue of sustainability more seriously. They have agreed to global goals, such as the United Nations Sustainable Development Goals (UN General Assembly, 2015) (O*01) and agreed upon serious climate protection in the Paris Agreement, which aims to limit global warming well below 2°C (United Nations, 2015) (O*02).

Moreover, open data is considered an important element of democracy and public participation (Ruijter et al., 2017). In recent years, public services have started sharing public data as open data (Charalabidis et al., 2018; Hartmann et al., 2016; Immonen et al., 2014; Kubler et al., 2016; Magalhaes & Roseira, 2017) and tend

to establish open data platforms (O*03). There is an increasing number of freely accessible databases with ever-increasing content. For example, there are several German initiatives for governmental open data that allow the public to inform itself on different topics such as public, society, education, culture, sports, and energy. Examples of German open data platforms are GovData (Geschäfts- und Koordinierungsstelle GovData, 2019) and Berlin OpenData (Senatsverwaltung für Wissenschaft, Energie und Betriebe, 2019). Further examples of international open data platforms are Data Europa (European Commission, 2021), Data Portals (Open Knowledge Foundation, 2019) or Open Data Inception (2019). Both the latter open data platforms can be accessed via an interactive world map on a website displaying the number of registered open data platforms for different regions; the user zooms into the map and selects items of interest. Additionally, some public authorities make mandatory collected corporate sustainability information on chemical emissions available in the form of open data; for example, the online platform of the Australian National Pollutant Inventory (Australian Government Department of the Environment and Energy, 2019), the online platform of the US American Toxic Release Inventory (US Environmental Protection Agency, n.d.), and the online platform of REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) of the European Chemicals Agency. Moreover, the trend of open data becomes clear by taking into account the high number of adoptions and studies initiated by public and government in this topic (e.g., Dapp et al., 2016; Klessmann et al., 2012).

3.2.2 | Economic factors

In the economic context, sustainability is gaining in materiality and, consequently, in relevance. In a competitive market economy, companies compete for capital, and the importance of sustainability in investment decisions, concerning both equity or debt capital (Climate Bonds Initiative, 2019a; Climate Bonds Initiative, 2019b; GSIA, 2017), has increased significantly in recent years (O*04/T*04).²

Stakeholders increasingly ask companies to provide information on how they deal with sustainability-related issues and consider this information for risk assessment. Participants of the financial community are increasingly interested in sustainability information and increasingly pose requests to companies about sustainability information (O*05). For example, many investors are committed to the Principles for Responsible Investment (n.d.). Also, business customers pose many requests to their suppliers about sustainability information. Organizations specialized in sustainability research and rating incorporate the companies' self-reported sustainability information into their data collections, process it, and make prepared data sets available to investors (Helbig & Marx Gómez, 2019) and other stakeholders (O*06). These specialized organizations forward primary data (e.g., CDP) as well as process the primary data and create new secondary data sets (e.g., Sustainalytics, ISS ESG [former oekom], VigeoEiris, MSCI ESG Research, CDP, S&P Global [former RobecoSAM Corporate Sustainability Assessment]). As it is known, many information service

providers use CDP data, such as Sustainalytics, MSCI ESG Research, and Bloomberg (CDP, 2019c). Google Finance and Deutsche Börse (German stock exchange) have integrated the current rating results of CDP climate data into the public profile screens of individual companies (CDP, 2019e). Large companies, in particular, are confronted with requests from rating agencies and sustainability analysts as well as asset managers and financial analysts; the completion of such requests takes a lot of time (von Flotow & Kachel, 2011). Consequently, resources of a company determine the options of data collection and disclosure of corporate sustainability data (e.g., Dawkins & Fraas, 2011; Hahn et al., 2015; Matisoff et al., 2013). Often, these requests are supported by investors and other economically relevant stakeholders. For example, the requests of CDP are supported by more than 500 institutional investors with total assets of almost 100 trillion USD (CDP, 2019b). Over the last few years, CDP has also been supported by large business customers who specifically request their strategic suppliers to report on the CDP platform. Currently, more than 100 companies with a cumulative purchasing volume of 3.3 trillion USD are participating through the so-called CDP Supply Chain Program (CDP, 2019a). As a benefit, the supporters receive the company data requested by CDP and the ratings given by the CDP scores—allowing the companies to proceed further with the data (CDP, 2019a).

Investors differ in their need for information depending on their focus and strategy, and this also affects the need for sustainability-related information (Sullivan, 2011). Also, research on classic capital market communication observes an increasing heterogeneity among investors (Weber et al., 2017). There are varying opinions (heterogeneity) among intermediaries regarding the need for sustainability-related information within information products. Conversely, sustainability research and rating agencies have consolidated rapidly in recent years (Avetisyan & Hockerts, 2017; Escrig-Olmedo et al., 2019). Overall, we assume heterogeneous participants within the financial community (O*07).

3.2.3 | Social factors

Furthermore, there are various social factors. A growing public awareness for sustainability, such as the global climate movement of students ("Fridays for Future"), has led to an increased demand for sustainability information about companies and products (O*08). Consequently, data quality has become more and more relevant (O*09/T*09).³ For example, sustainability data have been characterized by research to be unreliable, incomplete, or imprecise (Hartmann, Maas, & Perego, 2016), and voluntarily disclosed corporate greenhouse gas emission data have been criticized for not being mutually comparable (Andrew & Cortese, 2011; Luo, 2019). The data quality of voluntarily disclosed corporate sustainability data continues to cause criticism. Researchers have long debated whether or not disclosed content corresponds to actual performance (Noronha & Wang, 2015). Noronha and Wang (2015) identified a clear discrepancy between disclosure and the actual performance through a qualitative study and,

consequently, blamed companies for greenwashing⁴ in sustainability corporate reporting. Font et al. (2012) also noticed such a gap in tourism companies, which was particularly evident at the environmental level.

The content of sustainability reporting and communication in companies is constantly evolving (O*10/T*10),⁵ which can be observed in several facets. Stakeholder requirements for corporate sustainability can be reflected by laws, standards, and so on (Behncke et al., 2017). For example, there are many standards, frameworks, and tools for sustainability reporting (Siew, 2015), such as the United Nations Global Compact (2011), AA 1000 (AccountAbility, 2021), ISO 14001 (Deutsches Institut für Normung, 2015), and the Global Reporting Initiative (2021). The latter is a long-established quasi-standard used by the majority of companies in sustainability reporting (KPMG, 2017). But only a few of these frameworks explicitly address the stakeholder group of investors (Bassen & Senkl, 2010; European Federation of Financial Analysts Societies & Deutsche Vereinigung für Finanzanalyse und Asset-Management, 2010; Schäfer et al., 2011; Task Force on Climate-Related Financial Disclosures, 2017). Some frameworks have been further developed or newly established (e.g., Task Force on Climate-Related Financial Disclosures, 2017). The dynamic development is also reflected by intermediaries changing or expanding their thematic focus. For example, the CDP has been collecting climate-relevant data for almost two decades and has started collecting data on water and deforestation for a few years (CDP, 2021).

Moreover, there is an ongoing crisis of confidence regarding companies and markets in general (O*11), but implementing sustainability could help to overcome this (Lins et al., 2019). Companies that do sustainability reporting or who disclose sustainability-related information voluntarily may follow nonmaterial motives, such as consequences for reputation (Cho et al., 2012; Luo, 2019), credibility, trust, and image (Arnold, 2011). Moreover, the visibility of a company has an impact (e.g., Dawkins & Fraas, 2011; Hahn et al., 2015; Matisoff et al., 2013).

The use of provided sustainability information is restricted by existing expertise (T*12), which is rare among most investors (Sullivan, 2011). It is in open data's nature to allow various interpretation of the data. Unfortunately, a lack of expertise could lead to misinterpretations (T*13) or interpretations that differ from the companies' perspectives when combined with open data. However, open data also allows beneficial swarm intelligence (O*14).

Another social threat might be general skepticism toward technical progress and digitization (T*15). For example, in a German study, 34% of participants expect their lives to deteriorate as a result of digitization (Kirchner, 2019). Mistrust of new data offers can create hurdles for usage. Other hurdles can be an assumption of manipulation or even fraud (Zimmermann, 2018).

3.2.4 | Technological factors

The technological context shows some obvious and hidden external factors such as the observable megatrend of digitization (O*16). In a recent survey, 56% of the financial analysts surveyed considered the

task of data management their task (KPMG & Fraunhofer-Institute für Angewandte Informationstechnik, 2017), and this leads to the insight that processing information digitally is also utilized by financial analysts (O*17). For digital financial reporting, the XBRL exchange format (Kesselmeyer & Leibfried, 2008; XBRL, 2019) exists (O*18), and it has been previously adapted for sustainability reporting (La Torre et al., 2018). Additionally, Internet access is nearly ubiquitous in parts of the world; for example, 80% coverage in Europe and North America (Miniwatts Marketing Group, 2019) (O*19). Also, cybercrime (T*21) becomes relevant; for example, open data could be exposed to data manipulation attacks. In contrast, open data seems to be a relevant approach to realize the United Nations Sustainable Development Goals (O*22), according to The Open Working Group 2015 cited by Charalabidis et al. (2018).

As a result of digitization, platform-based technologies are used to collect data from companies and make it available to other interested parties. For example, there are numerous online platforms assisting data collection and offering data. The majority belong to sustainability research and rating agencies. One such online reporting platform is maintained by the CDP, which collects environmental data by emailing and asking organizations to self-report via their platform. Collecting self-reported data into predefined online questionnaires allows efficient data collection, since the data are automatically structured according to the respective structure and framework. Other sustainability research and rating agencies prefill the structure and invite companies to check and correct the data. Also, in terms of data provision, most sustainability research and rating agencies rely on online platforms for their business model. Since they are profit oriented, they charge users subscription fees in order to get access to sustainability data, evaluation, and benchmarking. In contrast, open data platforms of public authorities are publicly accessible.

3.2.5 | Environmental factors

The environmental context offers some opportunities. First, climate change is considered a global challenge (O*23); for example, an internationally recognized study examined the impact of global warming and pointed out the risks for the generations to follow (IPCC, 2018). Second, better disclosure could be a catalyst for the self-regulation of companies' sustainability performances in the long term (O*24), which has already been observed within climate-related data. Several studies have shown a long-term correlation between improving disclosure and improving actual greenhouse gas performance, and they described the mechanism as self-regulation (Andrew & Cortese, 2011; Luo, 2019; Qian & Schaltegger, 2017). To explore the potential of data for analytics, we reviewed former research that states that better disclosure encourages the self-regulation of companies' sustainability performances. For a long time, there was no consensus on whether or not disclosure improved a company's actual sustainability performance in the long term. Most of the studies were cross-sectional studies (usually due to insufficient long-term data⁶). Recent studies based on global and cross-industry greenhouse gas data have revealed

that there is a long-term relationship between improving disclosure and improving actual performance (Luo, 2019; Qian & Schaltegger, 2017). The findings of Qian and Schaltegger (2017) supported a causal relationship for the level of greenhouse gas emissions, which they describe as an outside-in effect. Regardless of why disclosure initially started, it improves performance and does not merely serve the purpose of legitimacy. Using the example of greenhouse gas disclosure via the CDP platform, Qian and Schaltegger (2017) stressed the accelerating effect of disclosure, which can be used to actually improve greenhouse gas performance in companies. This mechanism of the CDP is referred to as self-regulation (Andrew & Cortese, 2011; Luo, 2019). This self-regulation could be extended to other levels of sustainability and gain traction, given data availability and reliability. Likewise, we conclude that the public disclosure of sustainability data is very important to encourage companies to become more sustainable.

3.2.6 | Legal factors

Similarly, the analysis of the legal context offers more opportunities than threats. Studies have proved that disclosure of corporate sustainability information depends on the country of origin (e.g., Dawkins & Fraas, 2011; Hahn et al., 2015; Matisoff et al., 2013). In particular, it was observed that companies from countries with strict environmental reporting regulations disclose significantly more environmental data than companies from countries with softer regulations (Barbu et al., 2014). In some countries, a nonfinancial report has become mandatory (O*25). This applies in some countries of the EU, such as Germany (CSR-Richtlinie Umsetzungsgesetz, 2017), that have already implemented the EU Directive 2014/95/EU (European Commission, 2014) and mandate sustainability information provision of large companies. Other regulations concern a guarantee for public access to environmental information (O*26), as required by EU Directive 2003/4/EC (European Commission, 2003) which has been implemented in Germany by the Environmental Information Act. However, data protection regulations (e.g., the EU General Data Protection Regulation) may hinder disclosure of relevant sustainability-related information (T*27) since granular information may become person-related and protected as a result. In addition, the EU is currently examining if and how sustainability could be integrated into the financial sector (O*28) in order to finance sustainable growth (European Commission, 2019b).

3.3 | Strategies for providing CSOD

We develop strategies from the combination of individual internal and external factors. The following paragraphs emphasize some exemplary strategies from each of the four individual arrays. Additional strategies can be found in the SWOT matrix (Figure 2).

Strength–opportunity (SO) strategies enable companies to take advantage of the emerging opportunities by using particular

strengths of CSOD. These include strategies that are offered by digitization, such as exploiting efficiencies using a central data platform (SO-02). First, a platform supports the automated creation of individual reports for many different queries or standards (SO-03). Second, an Internet-based platform makes the requested data available as quickly as possible (SO-04). Thanks to maximum availability and with the help of interfaces (SO-06), data integration into third-party analysis software by the stakeholders would also be technologically feasible.

The analysis also shows weaknesses, and these weaknesses prevent some of the opportunities from being realized. However, there are some weakness–opportunity (WO) strategies that could help to overcome weaknesses and still take advantage of the opportunities. For example, strengthening governance structures (WO-03) permits the company to collect reliable sustainability information within the organization.

Strength–threat (ST) strategies allow companies to apply the strengths of CSOD to prevent some of the threats. One possible strategy for this is to make the data platform both scalable and constantly expandable, so that one can react flexibly to dynamic developments in the content of sustainability reporting (ST-03).

The results in which weaknesses meet threats merit a critical review. The weakness–threat (WT) strategies developed should help to eliminate weaknesses in order to avoid threats. Given this importance, the proposed strategies are described more detailed.

- To implement a high degree of comparability, proactive participation of companies is crucial to establish standards, at least on an industry level. Corporations can be more proactive in addition to their own direct reporting activities by participating in standardization committees and processes, such as contributing to workgroups within the World Business Council for Sustainable Development or reviewing exposure drafts for reporting standards or regulations. Owing to better availability of resources, this strategy is especially applicable for large corporations (WT-01).
- As a part of CSOD reporting, corporations might face data fluctuations as a result of merger and acquisition activities or adapted calculation. To increase transparency and contextual understanding, corporations can consider including explanations and, if useful, provide management strategies (WT-02).
- A new reporting medium is not necessarily met with acceptance among users, and corporations risk achieving the desired transparency. Potential barriers can be reduced by the company offering users explicit support, such as tutorials, sample profiles, and filters (WT-03).
- Attacks by cyber criminals pose a risk when they intend to manipulate data, and this may lead to liability consequences. A possible preventive strategy would be to establish a security policy for data integrity during the development of the data platform with requirements for technical implementation (WT-04).
- One possible obstacle for private companies releasing open data is fear of making mistakes. This affects the individual level, which applies to both the decision-maker and the employees responsible

for data collection and data input, and the corporate level. Depending on the prevailing corporate culture, a company should examine the extent to which the introduction of CSOD should be supported by organizational programs and consulting to promote a cultural change within the company. This is particularly helpful in cases where the organizational culture is a blame-heavy culture. Additionally, technical functions to correct errors in a transparent way help to increase acceptance for the release of data. Options for such technical functions are conceivable in versioning and explanations, both for individual data points and for comparable time series (WT-05).

4 | DISCUSSION

Our findings show the use of open data has extra strategic value for companies regarding corporate sustainability communication. Although companies are increasingly transparent about how they approach sustainability, this information is difficult for stakeholders to collect, compare, and evaluate. However, considering how companies make their own sustainability information available to today's knowledge society, only some public administrations provide corporate sustainability information as open data. CSOD has not yet been implemented in practice by companies consistently. We present a pragmatic idea for a new reporting mechanism: providing CSOD via public access to a data communication tool. This concept ensures efficient data provision to multiple stakeholder groups without resorting to a multi-stakeholder approach.

Regarding the adoption of CSOD and its possible consequences, several factors influence the extent to which companies make their digitally processed data available as open data. The most relevant potential drivers are the potential of digitization, stakeholder pressure, and regulations. It has been proven that stakeholder pressure (Font et al., 2012; Guenther et al., 2016) and regulations related to the country of origin (Barbu et al., 2014; Dawkins & Fraas, 2011; Hahn et al., 2015; Matisoff et al., 2013) impact corporate sustainability disclosure. In contrast, digitization has rarely been evaluated by other researchers as a factor that supports the sustainability disclosure of companies. Our findings resulting from analytical exploration show the strategic potential of digitization for external issues regarding a company's stakeholder relations, such as responding to stakeholder concerns. Open data supports data provision worldwide. This improves the ability to provide information for a scalable number of requests while simultaneously enabling efficiency, as open data does not require manpower within the company for each interaction with stakeholders. In this way, it would be possible for everyone in the world to observe and track the process of sustainable transformation of companies, as well as the achievement of set targets at any time. These are the same possibilities that digitized data management offers for internal monitoring and control.

The SWOT analysis is a tool for strategic analysis that has been used worldwide for a long time. After addressing the challenges of validation, we address methodical uncertainties in the limitations.

It is inherent in the nature of strategic analyses that they cannot be validated by reality at the time they are prepared. The extent to which strategic analyses correspond to reality can only be judged after a period of time has passed. As the situation progresses, factors that were unknown at the time of the strategic analysis may influence how it developed in reality. Since strategic decisions concern the long-term usefulness of a strategic analysis for a decision being made today, it is not guaranteed at a point in the future that the considered factors actually developed as expected when the strategic analysis was carried out. This shows the difference between strategic analysis and forecasts. The strategic analysis involves comprehensibly presented facts and anticipated developments (e.g., forecasts) in a structured view. Consequently, the quality of the strategic analysis is not measured by the future incidence of facts mentioned in the analysis. For this reason, a clear, comprehensible, and methodical procedure is particularly important.

This study is limited by the methodical approach and the way we conducted the research. Specifically, limitations included a lack of prioritization, incompleteness, subjectivity, and a lack of implementation. First, the method of SWOT analysis lacks any prioritization and can encourage superficial statements. General statements cannot be avoided entirely, as it is a matter of strategic analysis with a high degree of abstraction. We used SWOT analysis to examine the research subject extensively, so main statements were formulated without formalized prioritizations. Second, when applying the SWOT analysis, topics that would have led to different conclusions may have been overlooked in the analysis. We addressed critical incompleteness by applying the PESTEL approach in the external analysis. Additionally, we prevented excessive subjectivity by comparing and discussing individually prepared findings within our team of authors. The structure of our analysis facilitated a comprehensive presentation of the results and, thus, ensured that the factors identified and the strategies derived were reproducible findings, and not simply opinions of the authors. Furthermore, in this research, we did not consider a detailed specific implementation of the concept of CSOD. Before considering individual implementation, one needs to understand how the strategies developed can be realized appropriately. We suggest first taking the individual sociotechnical system into account before choosing suitable strategies, and then defining requirements for those strategies.

CSOD might be primarily a draft of strategic importance for the far future of sustainability reporting and communication from companies. There are many opportunities that encourage CSOD from a corporate perspective. The potential for digitization within the company becomes clear, which can be used for internal monitoring while having external impacts. Still, the lack of implementation indicates that companies are not convinced of the advantages of CSOD and have not yet recognized the added value for themselves. It remains unclear whether the CSOD approach suits companies. So far, it seems the barriers outweigh the advantages.

Perhaps companies are afraid of the consequences and would need to adopt a new manner of dealing with public exposure of their own data; however, this creates several advantages that come along

with CSOD for companies. One advantage is that CSOD has the ability to provide information when important information is always and easily available for stakeholders. Another advantage is that CSOD allows for creation and realization of efficiencies by digitized reporting. Third, sustainability reporting established directly between corporations, their investors, and sustainability research and rating agencies would erode the dependency on (for-profit) intermediaries in the flow of sustainability communication. As a result, this could also erode a potential interpretative predominance on sustainability information of intermediaries. A final advantage is that credibility and trust in the company could increase, since the information would be publicly available and verifiable by everyone (even the tiny detail could potentially be checked). This positive effect on how a company is perceived by its stakeholders could be realized even if the majority would not use or even access the data. In doing so, companies could use additional possibilities of digitization to address special stakeholder groups in an individualized way, thus building trust and credibility. Companies could assist the users by providing additional guidance and adequate tools to help find and manage data and build knowledge. Greenwashing is especially addressed by proactively providing negative information instead of hiding it, which increases data quality.

Despite the aforementioned advantages (push and pull factors), companies have not yet been convinced to adopt the concept of open data for their sustainability information. Future research is needed to reveal more advantages for companies. A company's final decision to introduce CSOD will be linked not only to questions about technical feasibility, but also to factors about the external context, such as economics, stakeholder pressure, and legislation. The point at which a company dares to take the first step toward leadership in open data regarding sustainability remains unclear. Given peer pressure and competition among companies, we expect that if one company starts then other competitors will follow suit.

This research offers an approach to digitizing corporate sustainability reporting. In the EU, regulators work toward transparency for sustainable finance. Regulation can help to convert flexibility in voluntary corporate reporting into constraints in mandatory reporting. We discuss some implications for regulations and public policies to support the development of corporate sustainability reporting toward the approach of CSOD. Some of the strategies identified presented in this research can serve as a basis for drafting mandatory regulations. For example, mandatory structures or standards—both in terms of content and format—would improve the comparability of the data provided across companies far more rapidly than voluntary standardization could achieve. In addition, the obligation to describe changes made in data that are already reported would help to create clear progress for transparency in reporting. Beyond the strategies outlined in this research, there are further implications for regulators that would help in preparing an implementation of CSOD on a mandatory national or EU level. As with regulations for financial data, we recommend that regulators define responsible central bodies at the national level through which the respective data can be accessed for various companies. A European database could, in turn, integrate those national data hubs into a central European data hub. As a result, either companies

could be obligated to initially report their data to these bodies, or defined exchange formats and interfaces could enable automated integration into these data hubs. Such an established central data hub seems to be a logical next step when following the existing and tightened EU regulations on sustainable finance that will be or have already been adopted.

Regarding the implementation of CSOD, there are many options for the technology stack due to a lack of technological restrictions. We suggest building a solution on top of existing open-source tools, especially from the field of open data (e.g., Comprehensive Knowledge Archive Network, DKAN, and Socrata). Moreover, we suggest supporting vocabularies like the Data Catalog Vocabulary, both to facilitate access by using an established option and to achieve a better interoperability with other solutions.

TABLE 1 Open research issues

Question	Aspects
How do public users assess CSOD provision and the offered content? What do public users expect from CSOD?	<ul style="list-style-type: none"> • Goals, needs, use cases • Acceptance and impact of CSOD provision • Content of interest regarding CSOD
How can data providers or reporting companies assist in comparing sector-wide and cross-sector data?	<ul style="list-style-type: none"> • Calculation standards • Reporting frameworks • Time-series and later adjustments • Data quality
How to facilitate a public users' CSOD use?	<ul style="list-style-type: none"> • Design principles • Handling • Orientation and guidance
How to ensure a long-term CSOD data provision?	<ul style="list-style-type: none"> • Design principles • Technical implementation • Finance, business models • Advantages for reporting companies • Incentive system
What content to include into CSOD?	<ul style="list-style-type: none"> • Content • Relevance • Data model • Reporting frameworks, mandatory content, self-commitment, demand of stakeholders
How to integrate companies' explanations into data provision, presentation, and transfer?	<ul style="list-style-type: none"> • Data format • Integration • Interfaces • Design principles
How to support easy and real-time reporting mechanisms? How to inform public users about new or updated data?	<ul style="list-style-type: none"> • Workflows • Notification mechanism • Update mechanism
How to protect corporate sustainability data from misuse and falsification?	<ul style="list-style-type: none"> • Security concept • Potential of open data provision

CSOD: corporate sustainability open data.

5 | CONCLUSIONS AND OUTLOOK

In the domain of corporate sustainability communication, this article focused on a potential strategic application of information provision and knowledge management in companies: CSOD. By adopting this strategic reporting mechanism, companies can ensure both (a) that stakeholders find primary sustainability data about their own company and (b) that data are consistent, simple, open, freely and digitally available, machine-readable, and accessible for further use. CSOD provides answers to new challenges by addressing future digital knowledge needs, as well as the increasing worldwide focus on sustainability issues. In this article, we presented CSOD as a strategically relevant side-product of digitizing corporate sustainability reporting and communication. The focus on the provision of company data and sustainability in combination with open data indicates a concrete future application.

In a structured process, we developed concrete thoughts about how companies could adopt CSOD, considering both current and future external situations. We showed that the implementation of an open data approach to sustainability data may provide many new opportunities and potential challenges, while considering both internal and external perspectives for this research.

Ultimately, we consider CSOD to be a plausible concept for promoting self-regulation of sustainability-related issues, which can promote companies' sustainability performance and possibly long-term sustainable global transformation. Several studies have explored the self-regulation mechanism with climate-related data publicly reported by companies; this exploration of self-regulation could be replicated with other corporate sustainability data. As a result, companies could reduce their negative sustainability impacts as soon as they are competing with the disclosed information of their peers. Since reliability of information is necessary for successful self-regulation, we identify key challenges associated with the quality and comparability (within and across sectors) of data, as well as options for further digital use.

Companies are increasingly transparent about how they approach sustainability, but the quality of corporate sustainability data is not sufficient to allow self-regulation of sustainability indicators (beyond climate data) to occur through competition among companies. Still, it remains unclear whether or not self-regulation could lead to changes in the impact companies have on relevant global sustainability issues in the near future. Owing to the fact that sustainability has become increasingly relevant for the financial sector (investors, in particular), there is a new competition emerging because self-regulation depends on benchmarking among competing corporations. This might have a positive impact on CSOD adoption and on the traction of self-regulation. If this is not the case, governmental intervention might become necessary, since the disclosed data could be used to monitor and manage the achievement of international goals and agreements.

Given the increased interest of various stakeholders in sustainability topics, the implementation of a corporate open data approach with sustainability data is particularly relevant. Open data enables stakeholders to conduct their own research, analyze their own data, and draw their own conclusions about company sustainability

practices. Eventually, stakeholders may demand more participation in sustainability practice, justifying this requirement by considering a company to be embedded in society and the environment. This might hold companies back from realizing CSOD. However, our findings suggest that other, more proactive strategies exist. For example, companies could anticipate this and proactively offer stakeholders dialogue and participation.

This research introduces a new mechanism of corporate self-reporting in the field of sustainability by using open data. The research contributes to the small amount of academic work addressing the problem of releasing open data from the private sector.

We are planning to conduct further research on the topic of CSOD. As a part of our eco4fin research project, we consider open data provision. In order to include some CSOD into our prototype, we are going to select appropriate strategies as presented in this article and define corresponding requirements. This will help to further develop the conceptual idea and the prototype. Since finding data is crucial for the actual use of data, we will identify tools that support rapid and targeted data-finding in the open data context. Additionally, we will empirically evaluate the acceptance of the open data functions provided.

As summarized in Table 1, we highlight questions and challenges that need further research. Scholars and practitioners are asked to support adoption of open data in the private sector by answering these open research questions. Currently, our CSOD approach focuses on content originally slated for the financial community; however, we recommend expanding the CSOD approach to include content that targets the needs of other stakeholder groups, as well. Moreover, there is a need for concrete ideas about how to realize the strategies presented in our SWOT matrix. On a practical level, the answers to these open research questions will help to adapt content and the provision of sustainability data. In academia, further research is needed to gain more theoretical insights about the provision of sustainability data. This would contribute to a solid foundation for answering specific research questions related to sustainable transformation with both short-term and long-term perspectives.

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ENDNOTES

- ¹ Eco4fin is the acronym for our research cooperation: Environmental, Social and Governance (ESG) Communication Data Platform for the Financial Community.
- ² If the information meets stakeholders' expectations, this is seen as an opportunity (O*04); otherwise, it is a threat (T*04).
- ³ The implementation of good data quality is seen as an opportunity (O*09), whereas poor data quality is assessed as a risk (T*09).
- ⁴ The term greenwashing describes when a company claims a sustainable and responsible image using marketing and public relations without taking any actions to affect the actual sustainability impact and sustainability performance of the company.

- ⁵ The dynamic development of the contents of sustainability reporting becomes an opportunity (O*10) when the company is able to provide information within a reasonable period of time and utilize the information for early recognition. The dynamic development of content becomes a threat (T*10) when intermediaries (whose business model is the provision of corporate sustainability information) regularly request new content from companies in order to differentiate themselves from their competitors with their information services. There is also a threat that companies will not recognize information important to stakeholders and provide insufficient information as a result.
- ⁶ Regarding the short-term association between voluntary disclosure and the performance (sustainability, environmental, or greenhouse gas) no clear consensus has been found so far in academia. Some studies found no link between disclosure and performance (e.g., Ali Fekrat et al., 1996; Freedman & Wasley, 1990), others showed for the short-term relation that companies with poor performance were more likely to opt for disclosure (e.g., Cowan & Deegan, 2011; Hughes et al., 2001; Patten, 2002). However, other studies contradict this, showing that companies with good performance tended to opt for voluntary disclosure (e.g., Clarkson et al., 2011; Dawkins & Fraas, 2011; Guenther et al., 2016).

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

ORCID

Raphaella Helbig  <https://orcid.org/0000-0003-3139-5562>

Sven von Höveling  <https://orcid.org/0000-0003-3937-2429>

Andreas Solsbach  <https://orcid.org/0000-0002-8799-0478>

Jorge Marx Gómez  <https://orcid.org/0000-0002-7833-7549>

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