

AI-supported double materiality assessment for voluntary sustainability reporting in SMEs: Enabling social and economic sustainability

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Abstract: Due to recently modified EU regulations, the vast majority of small and medium-sized enterprises (SMEs) are not legally obliged to produce sustainability reports. However, an increasing number of SMEs voluntarily engage in sustainability reporting to demonstrate their commitment to social and economic sustainability, improve transparency, and strengthen stakeholder trust. Many perceive voluntary sustainability reporting as a strategic asset to showcase responsible business practices and enhance competitive advantage. Within the project DiNaOpt4KMU, the digital prototype WILMA has been developed, combining user-centered design with artificial intelligence to support voluntary sustainability reporting

by SMEs, focusing on the double materiality assessment. WILMA guides users through the process of identifying and articulating relevant social and economic impacts, risks, and opportunities. A generative AI component assists this process, while semantic tools help explore and map complex reporting frameworks such as the European Sustainability Reporting Standard (ESRS) and the Voluntary Sustainability Reporting Standard for SMEs (VSME). Tailored to the diverse experience levels of SMEs, WILMA's design ensures usability and accessibility, thereby lowering barriers to digital sustainability reporting. By enabling SMEs to transparently report on their sustainability performance, the tool contributes to fostering more socially responsible and economically resilient business practices. This has been validated through comprehensive end-user evaluations involving a double-digit number of SMEs from various sectors. Ongoing research aims to further integrate social and economic sustainability aspects into SME business strategies through enhanced voluntary sustainability reporting.

Keywords: Double Materiality Assessment, Voluntary Sustainability Reporting, Small and Medium-sized Enterprises (SMEs), Artificial Intelligence (AI), User-Centered Design, Social Sustainability, Economic Sustainability, Business Informatics

1 Introduction

With the scope of the CSRD (Corporate Social Responsibility Directive) reduced by approximately 80 percent, the European Union (EU) is restructuring its sustainability reporting requirements. [1] The reporting obligation under the CSRD now applies to companies with more than 1,000 employees and revenue exceeding 450 million euros. [2] Consequently, many SMEs (small and medium-sized enterprises) are no longer subject to the legal reporting requirement. Nevertheless, a large proportion of companies are addressing the issue voluntarily due to its economic relevance (e.g., indirect impact on the supply chain) and its strategic potential (e.g., risk management). The VSME standard (Voluntary Sustainability Reporting Standard for non-listed Small and Medium-sized Enterprises) [3] thus serves as the voluntary counterpart to mandatory CSRD reporting. The VSME standard is divided into a basic and a comprehensive module. In the context of the CSRD, content standards and metrics are regulated by the European Sustainability Reporting Standards (ESRS). [4] The goal of sustainability reporting is, among other things, to ensure comparability, transparency, and reliability, as well as to illustrate the impacts on society, the environment, and corporate structures. [5]

Companies face the challenge of disclosing their sustainability efforts in the form of a digital report. In this context, the double materiality assessment typically represents the first step. [6] However, this process is only vaguely defined, as there is a lack of precise guidelines or recommendations, and SMEs often face uncertainty. This was made evident, among other things, in a scientific study

conducted in the West-Münsterland region (North Rhine-Westphalia, Germany) on the state of sustainability reporting. [7] This study served as the foundation for a funded project aimed at identifying tailored support options and providing resources such as guidelines, best practices, or digital AI-supported (Artificial Intelligence) tools accessible to SMEs. Representing the target group, six selected companies participate in the project as associate partners.

2 Sustainability Reporting, Double Materiality Assessment, and ESG

In 2023, the ESRS were published by the EU primarily as an uniform standard for sustainability reporting, covering both general and topic specific content (see table 1). According to the ESRS, companies are required to disclose specific content and data points in their reports on relevant sustainability topics. The ESRS specifies in detail what information must be disclosed and also recommends the involvement of stakeholders. Conducting a double materiality assessment is mandatory and serves as the central starting point for sustainability reporting. [8] The practical implementation of these new requirements poses a significant challenge, since SMEs generally lack the necessary human and time-related resources. [9] Furthermore, the content of this standard is not very tangible for many companies and leaves considerable room for interpretation.

The Omnibus Initiative, launched in early 2025, aims to reduce the complexity of sustainability reporting, and proposes the VSME as a voluntary, significantly simplified standard. This standard has not been finalized yet, but according to the current proposal, the double materiality assessment will no longer be mandatory. Nevertheless, it remains of significant strategic value for companies, as it helps focus on key issues, and enhances the credibility and quality of sustainability reporting.

For companies seeking to embed sustainability into their corporate culture in the long term, conducting a double materiality assessment serves as a suitable tool for identifying issues relevant to the company and incorporating them into a sustainability strategy. This process can be divided into the following steps: Identifying relevant issues, as well as formulating and assessing IROs (impacts, risks, and opportunities). In particular, the identification process is often highly valuable, as it encourages discussion within SMEs and is ideally conducted in a participatory manner with selected stakeholders. In this way, the double materiality assessment can help companies consider different perspectives and develop awareness of sustainability issues.

The double materiality assessment takes two perspectives into account, the inside-out perspective (the company's impacts on the environment and society) and the

outside-in perspective (the impacts of external sustainability factors on the company). This enables a holistic view of IROs. An issue is considered material if it is relevant from at least one of the two perspectives. Through the double materiality assessment, well-founded sustainability-related decisions can be made, allowing the company to position itself in the market in a future-proof and competitive way.

In this context, the three pillars of sustainability (environmental, economic, and social) play a central role. The goal of sustainable development is to bring these three equally important areas into balance. [10] The three pillars of sustainability and the term ESG (Environmental, Social and Governance) used in the ESRS and VSME are closely related and complement each other. Ecological sustainability, for example, includes topics such as environmental protection, biodiversity conservation, and resource conservation. Social sustainability encompasses, among other things, the common good, equality, and justice. Economic sustainability should take social and environmental goals into account in order to be economically viable in the long term. Social and economic sustainability are closely interconnected: Economic stability creates the financial foundation for investing in socially relevant areas such as education, health, and social justice. [11]

Within the double materiality assessment, ESG defines the content of reporting and provides the thematic framework for what constitutes sustainability issues. The materiality assessment helps determine which topics are material and thus subject to reporting. The ESRS or VSME reporting standard specifies how these topics must be reported. With the help of the two perspectives (outside-in and inside-out) within the double materiality assessment, the social responsibility of companies becomes methodologically transparent and manageable.

The following figure shows the thematic overlaps between the two standards, ESRS and VSME, in relation to the three pillars (ESG).

Three pillars	ESRS-Standard	VSME-Standard (Basic module)
Environment	E1: Climate change E2: Pollution E3: Water and marine resources E4: Biodiversity and ecosystems E5: Resource use and circular economy	B3: Energy and greenhouse gas emissions B4: Pollution of air, water and soil B5: Biodiversity B6: Water B7: Resource use, circular economy and waste management
Social	S1: Own workforce S2: Workers in the value chain S3: Affected communities S4: Consumers and end-users	B8: Workforce – General characteristics B9: Workforce – Health and Safety B10: Workforce – Remuneration, collective bargaining and training
Governance	G1: Business conduct	B11: Convictions and fines for corruption and bribery

Table 1
Thematic Overlaps: ESG, ESRS, and VSME
Source: Author's own illustration

3 Digital tools to support materiality assessment and sustainability reporting

There is a particular need for tool assistance especially for SMEs. Various commercial and free digital tools are available on the market for sustainability reporting. Commercial tools include, for example, Leadity [12], Planted [13], and Tanso [14]. Free options are provided, for instance, by the digital DNK platform from the German Sustainability Code (DNK) [15] as well as Excel tools and guidance materials from the Information Centre for Environment and Economy (IZU) [16] or the Institute of Applied Industrial Engineering and Ergonomics (ifaa) [17]. The European Financial Reporting Advisory Group (EFRAG) [18] also offers various support options, such as a digital VSME Excel template. Companies are faced with the challenge of selecting the software or support option that best meets their needs.

On the one hand, there are comprehensive tools that take a broad approach to sustainability and include additional functions such as monitoring key performance

indicators. On the other hand, there are tools that focus purely on reporting and explicitly exclude the topic of double materiality assessment or only provide it as an Excel worksheet. Thus, there is a lack of focused digital support options for double materiality assessment that are specifically tailored to SMEs and freely accessible. The following section presents a research project in which a digital tool for conducting a double materiality assessment has been developed.

Within the DiNaOpt4KMU research project [19], support tools specifically tailored to SMEs are under development and will later be released as an open-source solution. One of these prototypes is WILMA. WILMA stands for “Assisted and simple Identification of Material Topics” (in German: “Wesentliche Themen identifizieren leicht gemacht mit Assistenz”). Companies can choose whether to conduct a materiality assessment according to the ESRS or the VSME. The fundamental idea behind this prototype is to offer companies as much assistance as possible in conducting the double materiality assessment, thereby bringing structure to a process that is described in rather vague terms. To achieve this goal, it is particularly important to thoroughly understand the needs of SMEs and actively involve stakeholders in the process. The user-centered approach, in which the target group is an integral part of the development process, is well-suited for this purpose. This approach is described in Section 3.2, before the guided evaluation and initial results are discussed in more detail. The following provides a brief overview of the basic structure and selected functionalities.

3.1 Design and functionality

WILMA is a cloud-based solution that provides each company with its own individual access. From the home screen, SMEs can view their company-specific progress. In addition to the steps of the double materiality assessment, the prototype offers two comprehensive modules for preparation and sustainability management. The preparation module, for example, covers the company profile, documentation of the sustainability officers or core team, and the most important stakeholders. This empowers SMEs to deepen stakeholder engagement and integrate sustainability as a strategic pillar throughout the company. In the area of sustainability management, content such as best practices, an action plan, a sustainability strategy, and risk management has been implemented. Additionally, a documentation step has been implemented featuring the automatic generation of a report. This is of particular importance for the ESRS, as from an audit perspective, the entire process of the double materiality assessment must be documented, and all decisions must be presented in a manner that is plausible and comprehensible to the auditor.

Companies are guided step-by-step through the materiality assessment. Additionally, various support tools are available, such as, an AI solution designed tool to assist SMEs in conducting the double materiality assessment. During the analysis phase, it became increasingly apparent that formulating the IROs posed a challenge for companies, making dedicated support for this step necessary. The

ESRS and VSME do not provide any examples for guidance, nor do they provide specific guidelines regarding the level of detail. For this reason, the prototype displays AI-generated suggestions for IROs on the right side of the user interface, which can be edited or adopted directly as needed (see figure 1). These are general, industry independent examples that are automatically generated by a predefined prompt and are intended to provide an initial impulse for formulating the IROs.

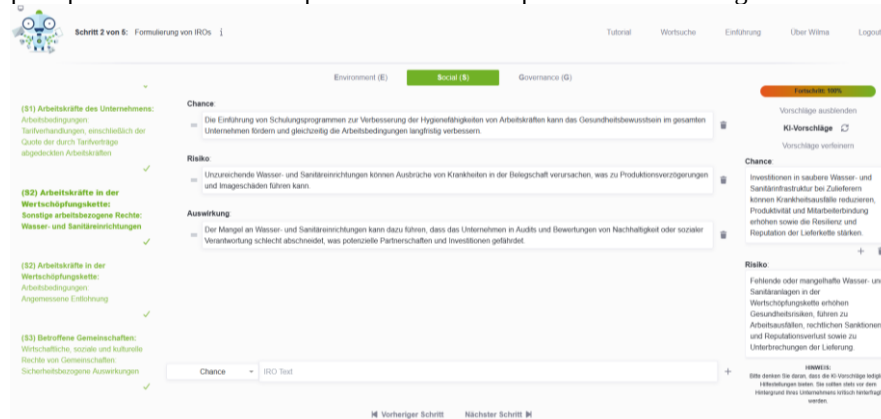


Figure 1
Support through AI Integration – Tool Insight WILMA
Source: Author's own illustration

With the help of AI, SMEs are supported in generating initial ideas and formulation IROs. The use of AI reduces the burden on companies, can increase efficiency, and improve report quality. Furthermore, AI can structure large amounts of heterogeneous data and accelerate the identification of relevant ESG topics. Especially for SMEs with limited resources, AI can reduce the time and effort required. In this context, the use of AI technologies as a potential support and implementation tool is gaining significant relevance.

The result of conducting a materiality assessment for an example company is the materiality matrix shown below in figure 2. This matrix, identifies which topics are material.

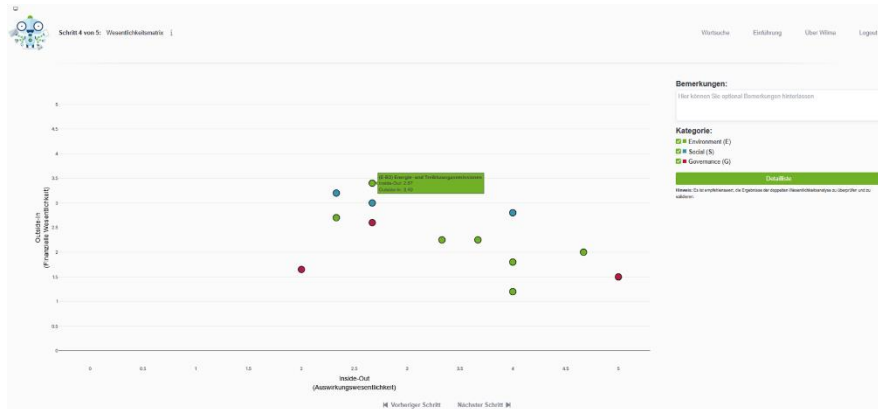


Figure 2
Materiality Matrix – Tool Insight WILMA
Source: Author's own illustration

The above makes clear that during the prototypical implementation, special focus was placed on usability and reducing process complexity so that SMEs can use the tool intuitively without significant cognitive effort. To ensure this, a user-centered, agile approach was chosen, which is described in more detail as follows.

3.2 Research Design and User-Centered Development Methodology

The development of WILMA followed a qualitative, iterative research design with a user-centered approach [20] to ensure intuitive usability and high acceptance. The overarching goal was to develop and evaluate the WILMA prototype, which demonstrably addresses practical challenges that SMEs face when conducting a materiality analysis. The focus was on ensuring practical applicability and utility within SMEs. The research proceeded in three main phases: (1) needs analysis and requirements gathering, (2) prototyping and iterative development, and (3) evaluation with formative and summative assessment components. This design was chosen to ensure that the resulting tool is grounded in empirically identified user needs and is continuously refined based on feedback from real-world practice.

The sample was selected specifically to ensure a diverse representation of industries, company sizes, and prior experience in sustainability reporting. Six associated regional partner companies were involved throughout the entire project period; subsequently, the group of evaluation companies was expanded through workshops and associations to include a high number of SMEs representing manufacturing, service, and trade sectors and varying in size from small to medium-sized and some large enterprises. Participants included sustainability managers,

managing directors, and employees responsible for ESG reporting. This reflects a phased and planned approach.

Data was collected using a mixed-methods approach: semi-structured interviews with sustainability officers or responsible executives identified challenges and expectations related to materiality analysis. Participatory workshops were used to jointly develop and validate requirements. In user tests, participants navigated WILMA without formal training and using only the integrated help functions; structured interviews were conducted immediately following each step. Additionally, the project team evaluated the user interface based on Nielsen's ten usability heuristics [21].

The evaluation protocol combined formative and summative elements: ongoing iteration cycles ensuring continuous alignment between user needs and tool functionality. The final evaluation assessed the extent to which the prototype met predefined criteria: intuitive usability without training, acceptance of AI support, effectiveness of interaction options, and perceived usefulness compared to non-AI-supported methods. Interview and workshop data were analyzed using qualitative content analysis and usability issues were prioritized.

3.3 Initial Evaluation Results

Considering the feedback from the companies so far, it is evident that the user-centered approach has contributed to the prototype receiving strong acceptance. This can be attributed, among other things, to the fact that there were hardly any interaction difficulties. This is a clear advantage of iterative evaluation. With regard to the defined evaluation criteria, the following results were obtained:

- 1. Intuitive usability without training effort:** The prototype could be used without any problems and without specific training. In many cases, the guided tour or tutorial was used to fill in knowledge gaps.
- 2. Acceptance of the assistance provided:** Users actively utilized the assistance provided and found it beneficial. In particular, the guided tour and the global word search, as well as the generation of AI suggestions, provided valuable support to SMEs. Highlighting completed steps and displaying a progress bar further improved navigation.
- 3. Interaction options:** Both views of the prototype were used by SMEs. However, it became apparent that additional explanations are necessary, as the difference between the variants was not immediately apparent. Additionally, integrated visualizations (e.g., matrix, representation focus) help to further illustrate the process. The dynamics of the process were perceived as particularly positive, as users can return at any time and also delete topics retroactively during the process.

4. Use and Added Value of AI Integration: During the evaluation, there were different opinions regarding the integration of AI. On the one hand, many SMEs found it helpful as a starting point, since formulating the IROs is a major challenge. On the other hand, companies reported that the constant display of AI suggestions inhibits independent thinking. As a result, in a subsequent version of the prototype, the AI suggestions were hidden by default and can be accessed as needed. Additionally, the companies expressed a desire to be able to create their own prompts, as they found the AI suggestions provided to be too general.

5. Reducing complexity: Within the ESRS and VSME, there are no guidelines regarding the order of processing for a double materiality assessment, which leads to uncertainty among companies. This was addressed through step-by-step navigation. Each of the participating companies found the step-by-step process to be very effective. The step-by-step approach allows users to focus on the current step while also taking breaks during their daily work routine.

The evaluation results described show that the user-centered approach enabled companies to start the process quickly and with little effort, and to complete the double materiality assessment within a manageable timeframe. With the help of suitable support tools and intuitive navigation, it was possible to reduce the complexity of the requirements and thus optimize the process.

4 Discussion and Outlook

For a tool to be accepted, it is particularly important that it meets the actual needs and expectations of the target users. For this reason, the principles of user-centered design were applied. A central aspect of this approach is the early involvement of future users in the development process. Feedback sessions helped identify and address weaknesses quickly. A diverse user group was selected for the evaluation to comprehensively cover various needs and perspectives. Open communication is also essential, as technical feasibility does not always align with user requirements. Ongoing evaluation is important because the research prototype undergoes continuous refinement to provide users with genuine added value in the field of sustainability reporting.

In summary, the user-centered approach proves highly effective in delivering solutions that are practical, intuitive, and genuinely responsive to user needs. Future plans include further optimizing the interaction between the research prototype and users and continuously developing the tool. The prototype for the double materiality assessment has provided an entry point into sustainability reporting.

Conclusions

The present work investigated the extent to which AI-supported approaches can help SMEs conduct the double materiality assessment within the framework of (voluntary) sustainability reporting. Key obstacles in practice included resource constraints, methodological complexity, and a lack of expertise. The results show that AI can facilitate certain steps of the materiality assessment. Conducting a double materiality assessment makes an important contribution to social and economic sustainability. From a social perspective, it promotes open stakeholder-dialogue, strengthens the social reputation of SMEs, and makes their responsibilities visible along the entire company specific value chain. From an economic perspective, it opens up new sustainability-oriented financing opportunities, improves competitiveness, and increases resilience to regulatory and market-related changes.

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References

- [1] EFRAG, “Cost-benefit analysis on the Draft Amended European Sustainability Reporting Standards,” 2025. [Online]. Available: <https://www.efrag.org/sites/default/files/media/document/2025-12/Cost-benefit%20Analysis%20on%20Draft%20Amended%20ESRS.pdf>
- [2] European Commission, “Directive (EU) 2026/470 of the European Parliament and of the Council of 24 February 2026 amending Directives 2006/43/EC, 2013/34/EU, (EU) 2022/2464 and (EU) 2024/1760 as regards certain corporate sustainability reporting requirements and certain corporate sustainability due diligence requirements,” Official Journal of the European Union, L 2026/470, 2026. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202600470
- [3] EFRAG, “EFRAG Voluntary Sustainability Reporting Standard for non-listed SMEs (VSME),” 2024. [Online]. Available:

<https://www.efrag.org/sites/default/files/sites/webpublishing/SiteAssets/VSME%20Standard.pdf>

- [4] European Commission, “Commission Delegated Regulation (EU) 2023/2772 of 31 July 2023 supplementing Directive 2013/34/EU of the European Parliament and of the Council as regards sustainability reporting standards,” Official Journal of the European Union, L 2023/2772, 2023. [Online]. Available: https://eur-lex.europa.eu/eli/reg_del/2023/2772/oj
- [5] J. Baumüller and K. Sopp, “Double materiality and the shift from non-financial to European sustainability reporting: review, outlook and implications,” Journal of Applied Accounting Research, vol. 23, no. 1, pp. 8-28, 2022, doi: [10.1108/JAAR-04-2021-0114](https://doi.org/10.1108/JAAR-04-2021-0114)
- [6] K. Hummel and N. Ley, “Die Wesentlichkeitsanalyse im Kontext der ESRS,” RWZ - Zeitschrift für Recht und Rechnungswesen, no. 11, 2024.
- [7] C. Kruse, U. Pietschmann, M. Kumpf and J. Wesseling, “Nachhaltigkeitsreporting für kleine und mittlere Unternehmen,” Westfälische Schriften zum Nachhaltigkeitsmanagement, Westfälische Hochschule, Bocholt, 2023. [Online]. Available: <https://nbn-resolving.org/urn:nbn:de:hbz:1010-opus4-42856>
- [8] F. E. Mezzanotte, “Corporate sustainability reporting: double materiality, impacts, and legal risk,” Journal of Corporate Law Studies, vol. 23, no. 2, pp. 633-663, 2023, doi: [10.1080/14735970.2024.2319058](https://doi.org/10.1080/14735970.2024.2319058)
- [9] S. Setyaningsih, R. Widjojo and P. Kelle, “Challenges and opportunities in sustainability reporting: a focus on small and medium enterprises (SMEs),” Cogent Business & Management, vol. 11, no. 1, 2024, doi: [10.1080/23311975.2023.2298215](https://doi.org/10.1080/23311975.2023.2298215)
- [10] B. Purvis, Y. Mao and D. Robinson, “Three pillars of sustainability: in search of conceptual origins,” Sustainability Science, vol. 14, pp. 681-695, 2019, doi: [10.1007/s11625-018-0627-5](https://doi.org/10.1007/s11625-018-0627-5)
- [11] S. Damhorst and M. Wilken, “Nachhaltigkeitsmanagement in KMU“. Berlin, Heidelberg: Springer, 2025, pp. 3, 7, doi: [10.1007/978-3-662-71535-2](https://doi.org/10.1007/978-3-662-71535-2)
- [12] Leadity GmbH, “Die Nr. 1 ESG- & CO₂-Software für den Mittelstand,” 2025. [Online]. Available: <https://leadity.de/>
- [13] Planted GmbH, “Mach Nachhaltigkeit zum Wettbewerbsvorteil,” 2025. [Online]. Available: <https://planted.green/>
- [14] Tanso Technologies GmbH, “ESG Berichtspflichten effizient umsetzen,” 2026. [Online]. Available: <https://www.tanso.de/produkt/esg-reporting>

- [15] German Sustainability Code (DNK), “DNK,” 2026. [Online]. Available: <https://www.deutscher-nachhaltigkeitskodex.de/de/>
- [16] Information Centre for Environment and Economy (IZU), “Nachhaltigkeitsmanagement für KMU,” n.d. [Online]. Available: <https://www.umweltpakt.bayern.de/werkzeuge/nachhaltigkeitsmanagement/module.htm?m=1>
- [17] Institute of Applied Industrial Engineering and Ergonomics (ifaa), “Wesentlichkeitsanalyse,” 2026. [Online]. Available: <https://www.arbeitswissenschaft.net/angebote-produkte/broschueren/uebro-wesentlichkeitsanalyse>
- [18] EFRAG, “VSME Digital Template,” n.d. [Online]. Available: <https://www.efrag.org/en/vsme-digital-template-and-xbrl-taxonomy>
- [19] DiNaOpt4KMU, “Digitales Nachhaltigkeitsreporting optimieren für kleine und mittlere Unternehmen,” 2026. [Online]. Available: www.dinaopt.w-hs.de
- [20] IxDF - Interaction Design Foundation, “What is User Centered Design (UCD)?,” 2016. [Online]. Available: <https://ixdf.org/literature/topics/user-centered-design>
- [21] J. Nielsen and R. Molich, “Heuristic evaluation of user interfaces,” in Proceedings of the ACM SIGCHI conference on Human factors in computing systems, 1990, pp. 249-256.