

Assessment of the Digital Maturity of ESG Reporting in the Context of Digitalization

Kiril Luchkov

Department of Economics, Industrial
Engineering and Management
Technical University of Sofia
Sofia, Bulgaria
kiril.luchkov@tu-sofia.bg

Abstract — This study examines the digitization of ESG reporting through the lens of its digital maturity. The Digital ESG Reporting Maturity Index (DERMI) was developed for the quantitative assessment of the level of digitalization of ESG reporting. It is based on a set of measurable indicators combined into an index that covers five dimensions: format and machine readability, structuring according to the ESRS, degree of quantitative disclosure, presence of targets, and mechanisms for traceability and external assurance. The proposed index was tested on a sample of ESG reports to determine levels of digital maturity. The results indicate a moderate level of digital maturity, with significant variability among individual observations. It is found that digitalization is not limited to the implementation of technological solutions but is linked to the degree of data structuring, quantitative disclosure, and the presence of control and external assurance mechanisms.

Keywords — ESG reporting, digitization, digital maturity, sustainable development

I. INTRODUCTION

Over the past few years, the digitization of ESG reporting has transformed the way sustainability-related information is created, structured, and used [1]. Earlier studies on corporate social responsibility reporting have likewise emphasized that the quality of sustainability disclosure strongly depends on the design and reliability of supporting information systems [2]. The introduction of the European Sustainability Reporting Standards (ESRS) sets specific requirements for the content and organization of data, including its comparability and machine-readability [3]. In this context, digitization is not merely a matter of choosing a format [4]. It implies a certain level of structuring and internal consistency of information. This raises the question of measuring the digital maturity of ESG reporting, which is determined by technological solutions, data structuring, and process management [5], [6]. Recent reviews of artificial intelligence in digital infrastructures further show that data structuring, interoperability and

automated analytics are becoming central elements of modern reporting and control systems [7].

Existing studies primarily examine the regulatory framework and technological aspects of ESG reporting [8], [9]. Meanwhile, the quantitative measurement of its digital maturity remains in the background. There is a lack of tools that would allow for a systematic assessment and comparison of ESG reports across different companies [10], [11].

This study addresses this gap by developing a methodology for assessing the digital maturity of ESG reporting. The methodology is based on clearly defined indicators and leads to the construction of an index that enables quantitative measurement and comparative analysis of ESG reports.

II. THEORETICAL AND REGULATORY FOUNDATIONS OF THE DIGITALIZATION OF ESG REPORTING

The digitalization of ESG reporting should not be seen as a secondary technical layer, but as a change in the very architecture of corporate reporting. If the traditional model of non-financial reporting was oriented mainly towards the presentation of textual disclosures, the modern logic of sustainable reporting requires that data be structured in a way that allows digital processing, validation, and comparison.

The digital transformation of ESG reporting in the European Union is associated with the Corporate Sustainability Reporting Directive (CSRD). The European Commission emphasizes that the CSRD introduces more detailed requirements regarding sustainable reporting, which gradually cover different groups of enterprises. The ESRS specify the content and logic of these disclosures. For example, they address the general and thematic requirements for the presentation of information on impacts, risks, and opportunities [12].

The role of the European Securities and Markets Authority (ESMA) and the European Single Electronic Format (ESEF) in the digitalization process is particularly important. ESMA sees the digitalization of sustainability

Online ISSN 3044-7771

<https://doi.org/10.68302/std2026.vol3.169>

© 2026 The Author(s). Published by Green Future Technologies.

This is an open-access article under the [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

reporting within the ESEF framework as part of a broader electronic reporting infrastructure. This means that ESG reporting is gradually integrated into existing digital corporate disclosure mechanisms. It does not develop as a separate and disconnected format. Such integration creates the prerequisites for higher comparability, controllability, and regulatory traceability of sustainable disclosures [13].

A significant feature of the current period is the dynamics of the regulatory framework itself. In 2025, the European Commission took action to simplify the rules for sustainability reporting through the Omnibus I package and the related changes to the first set of ESRS. As of spring 2026, the institutional process of revising the standards is ongoing, with the European Commission declaring its intention to adopt a delegated act with simplified ESRS before summer 2026 [14]. Therefore, the analysis of digitalization should take into account not only the current rules, but also the regime of their gradual improvement.

The international context complements this picture. The IFRS Sustainability Disclosure Taxonomy aims to transform sustainability-related disclosures into machine-readable information. This shows that the European process is not isolated, but is part of a broader global trend towards the digital structuring of sustainability reporting [15].

III. MATERIALS AND METHODS

To assess the level of digital maturity in ESG reporting, a quantitative methodology based on a set of measurable indicators has been developed and applied. Indicator-based approaches are also widely used for evaluating the effectiveness of enterprise information-system implementation and digital organizational readiness [16]. The methodology is not intended to produce representative generalizations for the aggregate of companies across various economic sectors. Its purpose is to determine to what extent the digitalization of ESG reporting can be assessed using a set of indicators. On this basis, a comparative assessment index is constructed. Comparable indicator-based approaches have also been used to assess the effectiveness of digital platforms and technology-enabled organizational systems [17].

The unit of analysis is the individual ESG report. The study covers 12 observations, designated as R1–R12. The sample was formed through targeted selection to ensure variability across key characteristics of ESG reporting. The approach is analytical in nature and is not aimed at achieving statistical representativeness.

The number of ESRS thematic areas covered is used as an empirical indicator of the degree to which ESG reporting is structured in accordance with ESRS requirements. The indicator reflects the extent to which the ESG report aligns thematically with the ESRS disclosure framework, without directly measuring the quality of that alignment.

The assessment is conducted using a proprietary index for the digital maturity of ESG reporting (Digital ESG Reporting Maturity Index, DERMI), which includes five components:

- (1) format and degree of machine readability;
- (2) structuring in accordance with the requirements of the ESRS;

(3) proportion of quantitatively presented ESG indicators;

(4) presence of targets with a baseline value and a timeline; and

(5) traceability and external assurance of the information.

The proportion of quantitatively reported KPIs is calculated as the ratio of quantitatively disclosed ESG indicators to the total number of identified indicators within the relevant ESG report. Indicators presented solely in a descriptive or qualitative form are not treated as quantitatively disclosed. The identification of indicators was based on the structure of ESG disclosures and the relevant thematic areas under the ESRS.

Each component is assessed on a scale of 0 to 2 points, and the total index score ranges from 0 to 10 points. The individual components and evaluation criteria are presented in Table 1.

TABLE 1 COMPONENTS OF THE DERMI INDEX

Component	Evaluation criterion	Scale
Format and machine readability	Assessing the suitability of the ESG report for digital processing	0 = static document format; 1 = structured digital representation; 2 = machine-readable format (iXBRL/XBRL)
Structuring according to ESRS	The degree of thematic structuring and alignment of the ESG report with ESRS disclosure requirements is assessed.	0 = low; 1 = partial; 2 = high
Quantitative coverage of KPIs	The proportion of indicators presented in quantitative form is assessed.	0 = below 50%; 1 = 50–69%; 2 = 70% and above
Objectives, baseline and deadline	Assesses whether the ESG report contains measurable objectives, baseline and time horizon.	0 = absent; 1 = partial; 2 = all three present
Traceability and external assurance	The degree of traceability of ESG disclosures, including source referencing, methodological transparency and external assurance availability, is assessed.	0 = both missing; 1 = only one element is present; 2 = both are present

Source: Authors' own research.

Traceability refers to the possibility of linking ESG disclosures to identifiable data sources, methodological explanations and supporting documentation. The assessment considers the presence of internal referencing mechanisms, transparency of disclosure methodology and the verifiability of reported information.

Formally, the index can be expressed as follows:

$$\text{DERMI} = \text{FR} + \text{ESRS} + \text{KPI} + \text{TG} + \text{CT},$$

where:

- (1) FR is the component for format and machine readability;
- (2) ESRS is the component for thematic structuring, KPI is the component for quantitative coverage,
- (3) TG is the component for goal setting, and
- (4) CT is the component for traceability and external assurance.

For the purposes of interpreting the results, three levels of digital maturity were used: low (0–3 points), medium (4–6 points), and high (7–10 points). The thresholds were analytically defined in order to distinguish between limited, transitional and advanced levels of ESG reporting digital maturity based on the cumulative fulfillment of DERMI components.

IV. RESULTS

Table 2 presents information on the observations included in the sample. It includes selected ESG reporting indicators and the corresponding DERMI index values. The table serves as an empirical basis for the subsequent comparative analysis of digital maturity.

TABLE 2 ESG REPORTS ANALYZED AND DERMI INDEX VALUES

ID	Volume (pages)	Number of ESRS thematic areas covered	KPIs (%)	External assurance	DERMI
R1	120	10	78	Yes	10
R2	110	9	74	Yes	10
R3	98	8	72	Yes	9
R4	95	8	69	No	7
R5	87	7	66	No	7
R6	82	7	61	Yes	7
R7	76	6	58	No	5
R8	74	6	54	Yes	5
R9	69	5	47	No	3
R10	63	4	45	Yes	2
R11	68	5	49	No	1
R12	65	4	40	No	1

Note: 1/ Sort by DERMI (descending).

2/ The KPI share (%) is calculated as the ratio between the quantified indicators and the total number of indicators identified in the report.

Source: Authors' own research.

The results indicate a moderate average level of digital maturity, combined with significant internal variation. The average DERMI index score is 5.58 out of a possible 10 points. This indicates that the transition to more mature digital ESG reporting is visible but not yet uniform. Six of the twelve observations show high digital maturity, two show moderate maturity, and four show low maturity.

For a more detailed description of the sample, Table 3 presents summary statistics for each variable. The data show a moderate volume of reports and an average level of coverage of ESRS thematic areas and the quantitative

indicators presented. There is significant variability among the individual observations.

TABLE 3 SUMMARY STATISTICS

Indicator	Average value	Median	Standard deviation	Minimum value	Maximum value
Report volume (pages)	83.9	79.0	18.5	63	120
Number of ESRS thematic areas covered	6.6	6.5	1.9	4	10
Quantified KPIs (%)	59.4	59.5	12.6	40	78
DERMI Index (0-10)	5.6	6.0	3.3	1	10

Source: Authors' own research.

The average length of the ESG reports in the sample is 83.92 pages, the average number of ESRS thematic areas covered is 6.58, and the average proportion of KPIs presented quantitatively is 59.42%. Reports with external assurance achieve an average DERMI score of 7.17 points, while reports without assurance achieve an average score of 4.00 points. The observed difference should be interpreted with due caution given the limited sample size. The study found that digital maturity is not determined solely by technological characteristics. It is associated with a higher degree of data structuring, quantitative disclosure, and external assurance.

V. DISCUSSION

Empirical results show that higher DERMI scores are associated with more robust quantitative disclosure practices. These scores are also linked to broader thematic alignment with ESRS requirements and the presence of external assurance mechanisms. In contrast, reports with lower DERMI scores are characterized by a fragmented structure of ESG information. They also exhibit a lower proportion of quantitative indicators and less pronounced traceability characteristics. These findings are broadly consistent with previous studies emphasizing the importance of structured ESG data governance, interoperability, and assurance mechanisms in digitally mature reporting systems [18], [19].

The overall analysis shows that the digitalization of ESG reporting should not be presented as a quick technological fix or a purely administrative burden. Rather, it should be perceived as a process of institutional and organizational maturation, in which regulatory requirements, taxonomies, digital tools, and internal processes evolve simultaneously. In ESG practice, there are opportunities to increase the transparency and comparability of information. At the same time, there are also challenges in the early implementation of ESG reporting requirements.

It has been found that the digital format does not guarantee the quality of ESG reporting. It can make the

information easier to use, but only if this information is the result of structured internal processes. Otherwise, digitalization tends to increase the visibility of already existing organizational weaknesses. Therefore, the real subject of digital ESG reporting is not just the published file, but the data architecture behind it [10].

From this perspective, sustainable progress in this area will depend not so much on the quantity of technological solutions, but on the ability of enterprises to build consistent data management systems, internal controls, proportionate processes and interoperable formats [9], [20]. This turns the digitalization of ESG reporting into an intersection between regulation, accounting logic, information management and sustainability-related policies.

VI. CONCLUSIONS

Based on the analysis, it can be concluded that the digitalization of ESG reporting is a natural stage in the development of corporate reporting. This process reflects a clear trend towards standardization, digital structuring and increased usability of sustainable information. The results show that machine-readable ESG reporting can help improve the comparability, traceability, and analytical usability of sustainability disclosures.

The results of the study indicate that the positive effect of digitalization is not guaranteed. It was found that it depends on the quality of primary data, the maturity of internal processes, and the clear distribution of responsibilities. Of additional importance is the ability of enterprises to function in a changing regulatory environment. To ensure transparency and comparability of data, the use of digital tools is recommended, provided that they are supported by a reliable organizational framework that includes processes, responsibilities, and control mechanisms.

From a practical point of view, several key recommendations can be formulated. First, companies should start structuring ESG data at the stage of its collection, and not only when preparing the final report. Second, it is necessary to prefer open and standardized formats and avoid unnecessary dependence on difficult-to-portable solutions. Third, it is necessary to build a clear internal system that guarantees data ownership, management, verification and control. Fourth, for smaller companies, proportionate tools and templates should be applied that reduce complexity without compromising quality.

VII. ACKNOWLEDGEMENTS

This research was funded by the Bulgarian National Science Fund at the Ministry of Education and Science of Bulgaria under the Funding Competition for Fundamental Scientific Research Projects 2025, based on Administrative Contract № KP-06-N95/16 of 10 December 2025, for the implementation of Research Project № KP-06-PN95/45, SUNI № BG-175467353-2025-08-0248, titled „Epistemic robustness of artificial intelligence: A universal framework for evaluation in industrial and management systems“.

REFERENCES

- [1] Abhayawansa, S., Adams, C., Busulwa, R., & Shying, M. (2025). *The Digital Transformation of Sustainability Reporting: How Digital Technologies are Reshaping Sustainability Accounting, Data, and Disclosure*. Routledge. <https://doi.org/10.4324/9781032637938>
- [2] Stoyanov, P., Anguelov, K. (2025). Corporate Social Responsibility Reporting: Information System Requirements, 13th International Scientific Conference on Computer Science (COMSCI), Sozopol, Bulgaria, 2025, pp. 1-5, doi: [10.1109/COMSCI67172.2025.11225210](https://doi.org/10.1109/COMSCI67172.2025.11225210).
- [3] European Commission. (2022). Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 as regards corporate sustainability reporting. Official Journal of the European Union, L 322, 15–80. <http://data.europa.eu/eli/dir/2022/2464/oj>
- [4] Brenner, B. (2018). Transformative Sustainable Business Models in the Light of the Digital Imperative - A Global Business Economics Perspective. Sustainability, 10(12), 4428. <https://doi.org/10.3390/su10124428>
- [5] Christensen, H. B., Hail, L., & Leuz, C. (2021). Mandatory CSR and sustainability reporting: economic analysis and literature review. Review of Accounting Studies, 26, 1176–1248. <https://doi.org/10.1007/s11142-021-09609-5>
- [6] Yu, J., & Moon, T. (2021). Impact of Digital Strategic Orientation on Organizational Performance through Digital Competence. Sustainability, 13(17), 9766. <https://doi.org/10.3390/su13179766>
- [7] Zinoviev, V., Koeva, D., Tsankov, P., Kutkarska, R. (2026). Review of Artificial Intelligence Applications in the Digital Energy and Renewable Energy Infrastructures. Energies, 19, 1250. <https://doi.org/10.3390/en19051250>
- [8] Alles, M. G. (2015). Drivers of the Use and Facilitators and Obstacles of the Evolution of Big Data by the Audit Profession. Accounting Horizons, 29(2), 439–449. <https://doi.org/10.2308/acch-51067>
- [9] Lai, A., Melloni, G., & Stacchezzini, R. (2016). Corporate Sustainable Development: is 'Integrated Reporting' a Legitimation Strategy? Business Strategy and the Environment, 25, 165–177. <https://doi.org/10.1002/bse.1863>
- [10] Appelbaum, D., Kogan, A., Vasharhelyi, M., & Yan, Z. (2017). Impact of business analytics and enterprise systems on managerial accounting. International Journal of Accounting Information Systems, 25, 29–44. <https://doi.org/10.1016/j.accinf.2017.03.003>
- [11] Lock, I., & Seele, P. (2015). Analyzing Sector-Specific CSR Reporting: Social and Environmental Disclosure to Investors in the Chemicals and Banking and Insurance Industry. Corporate Social Responsibility and Environmental Management, 22, 113–128. <https://doi.org/10.1002/csr.1338>
- [12] European Commission. (2024). Corporate sustainability reporting. https://finance.ec.europa.eu/financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en
- [13] European Securities and Markets Authority. (2024). Electronic reporting. <https://www.esma.europa.eu/issuers-disclosure/electronic-reporting>
- [14] European Securities and Markets Authority. (2026). Opinion on revised ESRS. https://www.esma.europa.eu/sites/default/files/2026-02/ESMA32-846262651-5440_Opinion_on_revised_ESRS.pdf
- [15] IFRS Foundation. (2024). IFRS Sustainability Disclosure Taxonomy. <https://www.ifrs.org/issued-standards/ifrs-sustainability-taxonomy/>
- [16] K. Anguelov, Indicators for the Effectiveness and Efficiency of the Implementation of an Enterprise Resource Planning System, 2021 12th National Conference with International Participation (ELECTRONICA), Sofia, Bulgaria, 2021, pp. 1-4, doi: [10.1109/ELECTRONICA52725.2021.9513729](https://doi.org/10.1109/ELECTRONICA52725.2021.9513729).
- [17] M. Angelova, Indicators for Effectiveness and Efficiency of E-Platforms for Business Meetings, 2020 III International Conference on High Technology for Sustainable Development (HiTech), Sofia, Bulgaria, 2020, pp. 1-4, doi: [10.1109/HiTech51434.2020.9364000](https://doi.org/10.1109/HiTech51434.2020.9364000).

- [18] Perdana, A., Robb, A., & Rohde, F. (2015). An Integrative Review and Synthesis of XBRL Research in Academic Journals. *Journal of Information Systems*, 29(1), 115–153. <https://doi.org/10.2308/isis-50884>
- [19] Wu, S., & Li, Y. (2023). A Study on the Impact of Digital Transformation on Corporate ESG Performance: The Mediating Role of Green Innovation. *Sustainability*, 15(8), 6568. <https://doi.org/10.3390/su15086568>
- [20] Yang, Y., & Han, J. (2023). Digital transformation, financing constraints, and corporate environmental, social, and governance performance. *Corporate Social Responsibility and Environmental Management*, 30(6), 3189–3202. <https://doi.org/10.1002/csr.2546>