

DIGITALIZATION AS A DRIVER OF SUSTAINABILITY: NEW PERSPECTIVES ON ESG REPORTING

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Abstract

Sustainability is an essential concept that promotes a future in which the balance between the environment, the economy and society is maintained to ensure a better and fairer life for all. We must consider at least three essential aspects that support the importance of sustainability: environmental protection, economic benefits and social equity.

Sustainability reporting is today an essential tool through which organizations communicate their economic, social and environmental performance, providing transparency and accountability to all stakeholders.

Digitalization and the use of artificial intelligence are profoundly transforming the way companies collect, process and report sustainability-related information. These technologies not only streamline reporting processes, but also contribute to increasing the transparency, accuracy and comparability of non-financial data. As regulations become more uniform at the European level, the emergence of integrated digital platforms is expected to connect companies' ESG data with the systems of tax and financial authorities.

Keywords: Sustainability, sustainability reporting, report of sustainability, impact of digitalization.

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1. Introduction

Sustainability is an essential concept that promotes a future in which the balance between the environment, economy and society is maintained to ensure a better and more equitable life for all. It is a collective responsibility to adopt sustainable practices in all aspects of life, from daily activities to global policies.

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Sustainability refers to the ability to maintain or support processes, systems and activities in a way that does not harm the environment, economy or society in the long term. The concept is often associated with finding a balance between the needs of the present and protecting resources for future generations. We must consider at least three essential aspects that support the importance of sustainability: environmental protection, economic benefits and social equity.

- Environmental protection: Without sustainable measures, natural resources will be depleted and the negative impact on the environment will become irreversible.
- Economic benefits: Sustainable practices can lead to long-term savings, innovation and the creation of new business opportunities.
- Social equity: Social sustainability ensures that economic resources and benefits are distributed fairly and that all people can live in a more just and balanced society.

Thus, sustainability involves an integrated approach that takes into account three essential pillars:

- a) Ecological (or environmental) sustainability refers to protecting the environment and using natural resources in a responsible way, so that they remain available and viable for the future. In this category we find: reducing greenhouse gas emissions; preserving biodiversity; managing water resources and agricultural land; promoting renewable energy and reducing dependence on fossil energy sources.
- b) Economic sustainability means creating an economic system that supports long-term prosperity, without eroding natural resources or encouraging risky financial practices. Economic sustainability includes: creating sustainable jobs; promoting economic growth that does not depend on limited resources; encouraging innovation and economic efficiency; balancing income distribution to reduce economic inequalities.
- c) Social sustainability refers to creating a fair, inclusive and stable society. This includes respecting fundamental human rights, ensuring a decent living and improving the quality of life for all people. Key aspects are: access to education and health; reducing poverty and promoting social justice; respecting cultural diversity and workers' rights; promoting active participation and community involvement in decision-making processes.

2. The Evolution of Sustainability Reporting Over Time

Sustainability reporting is today an essential tool through which organizations communicate their economic, social and environmental performance, providing transparency and accountability to all stakeholders. This practice has evolved gradually, in parallel with the development of environmental awareness and the requirements of modern society regarding business ethics.

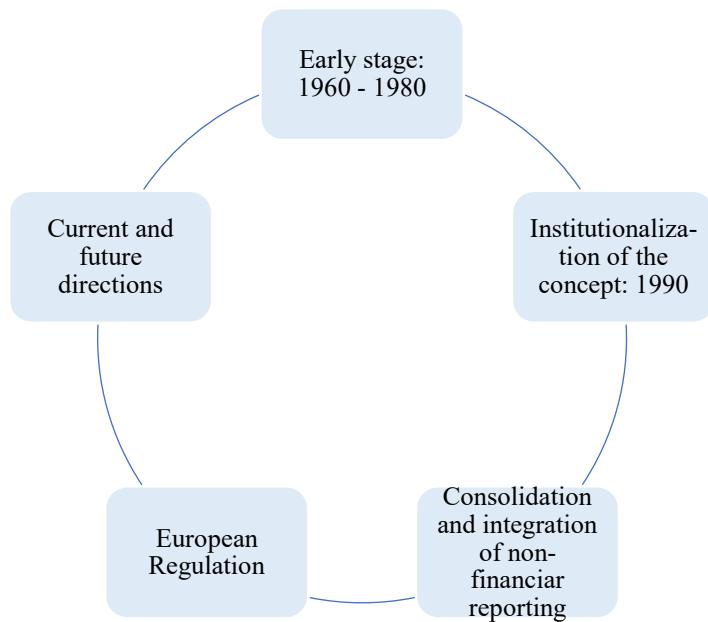


Figure 1. The Evolution of Sustainability Reporting Over Time

A) Early stage: 1960s–1980s

The first forms of reporting that can be considered precursors to sustainability reporting emerged in the context of growing environmental concerns in the 1960s–1970s. During this period, companies were increasingly accused of pollution and the irresponsible exploitation of natural resources, and public pressure led to the emergence of the first “environmental reports” — documents through which organizations tried to show that they complied with environmental protection regulations [1]. However, these reports were limited, focusing exclusively on legal compliance, not on performance or impact.

B) Institutionalization of the concept: the 1990s

The 1990s marked a turning point in the evolution of sustainability reporting. Growing awareness of climate change, as well as the globalization of capital markets, led to the need for standardization. In 1997, the Global Reporting Initiative (GRI) was launched, an international framework designed to provide companies with clear guidelines for reporting on their economic, environmental and social impacts [2]. It quickly became a global benchmark, allowing for comparability between reports from different organizations.

Also during this period, the idea of the “triple bottom line” — economic, social and environmental performance — was popularized by John Elkington, bringing a new

perspective on corporate success [3]. Companies were no longer evaluated solely on their profits, but also on their contribution to society and how they protected the environment.

C) Consolidation and Integration of Non-Financial Reporting: 2000–2010

In the 2000s, sustainability reporting began to be gradually integrated into business strategies. Publishing GRI reports became common practice for large multinational companies, and financial organizations and investors began to include ESG (Environmental, Social, Governance) criteria in investment decisions [4].

In 2010, the concept of integrated reporting was formalized with the creation of the International Integrated Reporting Council (IIRC), which promoted the idea of combining financial and non-financial information into a single strategic document [5]. This approach reflected the recognition that sustainability directly influences economic performance and long-term resilience.

D) European Regulation: 2014–2022

The European Union played a decisive role in transforming sustainability reporting from a voluntary initiative into a legal obligation. In 2014, Directive 2014/95/EU on non-financial reporting was adopted, requiring large companies to disclose information on the environment, social aspects, human rights and the fight against corruption [6]. This directive was a major step in standardizing reporting practices and increasing corporate transparency.

Subsequently, in 2022, the European Commission adopted the Corporate Sustainability Reporting Directive (CSRD), which significantly expands reporting requirements and introduces common European standards — European Sustainability Reporting Standards (ESRS) [7]. Thus, sustainability reporting has become a central element of corporate governance, not just a component of external communication.

E) Current and Future Directions

Today, sustainability reporting is closely linked to the green and digital transition. The new standards require an approach based on dual materiality — assessing the impact of the organization on the environment and society, but also how environmental and social factors influence its economic performance [8]. Technology, artificial intelligence and data analytics also contribute to increasing the accuracy and transparency of reporting.

The global trend is towards the full integration of sustainability into decision-making processes, reflecting the fact that the long-term success of an organization is inextricably linked to the health of the environment and the society in which it operates.

3. Sustainability Reporting

Globally, sustainability is supported by international agreements, such as the 2030 Agenda for Sustainable Development adopted by the United Nations, which includes the Sustainable Development Goals (SDGs). These goals address a wide range of global issues, from eradicating poverty and hunger to combating climate change and protecting ecosystems.

Sustainability reporting (also called non-financial reporting or ESG reporting) is the process by which an organization publicly communicates the impact of its activities on the environment, society and corporate governance (Environmental, Social, Governance – ESG). The main goal is to provide transparency and accountability to stakeholders — investors, employees, customers, authorities and the community — regarding how the company: uses natural resources, treats employees and communities, complies with ethical and governance principles, contributes to long-term sustainable development. Sustainability reporting typically includes three main pillars:

- ✚ Environmental: energy and water consumption, greenhouse gas (CO₂) emissions, waste management and recycling, impact on biodiversity;
- ✚ Social: working conditions and employee health, diversity and inclusion, human rights in the supply chain, community involvement;
- ✚ Governance: business ethics and integrity, governance structure, combating corruption, transparency of decisions and legal compliance.

A sustainability report is the document through which an organization communicates its economic, environmental and social impacts, as well as how it manages them. The structure and content may vary (depending on the standard used — GRI, ESRS, Romanian Sustainability Code, etc.), but in general, the recommendation is to consider the following aspects according to the table below.

Chapter	Details
Overview	<ul style="list-style-type: none"><input type="checkbox"/> Declaration of the management (CEO or General Manager) about the commitment to sustainability.<input type="checkbox"/> Organization profile: name, headquarters, main activity, shareholding structure, markets served.<input type="checkbox"/> Sustainability context: trends, objectives, overall strategy.<input type="checkbox"/> Reporting period and scope (entities included/excluded).
Governance and sustainability strategy	<ul style="list-style-type: none"><input type="checkbox"/> Governance structure (who is responsible for sustainability, ESG committees, etc.).<input type="checkbox"/> Policies and codes of ethics.<input type="checkbox"/> The link between strategy and sustainability.<input type="checkbox"/> ESG strategic objectives and key performance indicators (KPIs).

	<input type="checkbox"/> Assessment of ESG risks and opportunities.
Materiality analysis	<input type="checkbox"/> Materiality analysis process (methodology, stakeholder engagement). <input type="checkbox"/> List of material topics (climate change, diversity, ethics, value chain). <input type="checkbox"/> Materiality matrix (impact on the organization vs. impact on the environment/society). <p>(The ESRS and the Romanian Sustainability Code require a “double materiality” approach – impact and financial risk.)</p>
Stakeholder engagement	<input type="checkbox"/> Identification of the main groups (employees, customers, suppliers, community, investors, authorities). <input type="checkbox"/> Consultation methods (surveys, interviews, partnerships). <input type="checkbox"/> The main concerns expressed by stakeholders and the organization's response.
ESG areas	<p>A. Environment</p> <ul style="list-style-type: none"> ▪ Environmental policies and objectives. ▪ Greenhouse gas emissions ▪ Energy efficiency and energy consumption. ▪ Water consumption, waste management, recycling. ▪ Biodiversity protection. ▪ Circular economy initiatives. <p>B. Social</p> <ul style="list-style-type: none"> ▪ Workforce: number of employees, diversity, equity, workplace safety. ▪ Vocational training, health and safety. ▪ Human rights and ethics in the supply chain. ▪ Impact on local communities. ▪ Social dialogue, volunteering, donations, education. <p>C. Governance</p> <ul style="list-style-type: none"> ▪ Management structure and ESG committees. ▪ Anti-corruption policies, ethics, compliance. ▪ Data protection and cybersecurity. ▪ Transparency of decisions, financial and non-financial reporting.

Indicators, objectives, results	<input type="checkbox"/> Quantitative indicators (CO ₂ emissions, energy consumption, accident rates). <input type="checkbox"/> Targets set and progress towards them. <input type="checkbox"/> Comparisons with previous years. <input type="checkbox"/> Explanations for significant variations.
Methodology and reporting standard	<input type="checkbox"/> Standards used: GRI, ESRS, SASB, Romanian Sustainability Code, etc. <input type="checkbox"/> Limitations and calculation assumptions. <input type="checkbox"/> Database, sources, collection methods. <input type="checkbox"/> Verification (internal or external).
Annexes and additional information	<input type="checkbox"/> Glossary of ESG terms. <input type="checkbox"/> Tables with detailed indicators. <input type="checkbox"/> References to policies, certifications (e.g. ISO 14001, ISO 45001). <input type="checkbox"/> Contacts for feedback.

Table 1: A sustainability report model

In the European Union, sustainability reporting is mandatory for certain companies through:

- CSRD (Corporate Sustainability Reporting Directive) – gradually applicable from 2024–2026;
- ESRS (European Sustainability Reporting Standards), which establish the specific reporting method.

At the international level, other standards are also used such as:

- GRI (Global Reporting Initiative)
- SASB (Sustainability Accounting Standards Board)
- TCFD (Task Force on Climate-related Financial Disclosures)

EU Directive 2022/2464 (known as the Corporate Sustainability Reporting Directive - CSRD) establishes that large companies must report information on sustainability (environment, social, governance). In Romania, the Order of the Ministry of Public Finance no. 85/2024 defined the deadlines for the application of sustainability reporting for the entities concerned. The Romanian Sustainability Code was also established as a voluntary, but reference, instrument for entities wishing to report in the field of sustainability. The Romanian Sustainability Code Platform provides support for entities, including those not legally obliged, to prepare the report. Sustainability reporting in Romania goes through the following stages:

- ✓ From January 1, 2024, public interest entities, such as listed companies or parent companies of groups, that have over 500 employees, prepare a sustainability report for the financial year 2024 (published in 2025).
- ✓ From January 1, 2025, the obligation is extended to medium/large entities with over 50 employees and that meet the criteria of turnover (over 50 million lei) and assets (over 25 million lei). The related report will be prepared in 2026.)
- ✓ From January 1, 2026, the obligation will also be extended to listed SMEs, the report being published in 2027.

The Romanian Sustainability Code represents a methodology for sustainability reporting in Romania. It provides clear guidance on the content and process of preparing sustainability reports for entities. It was adopted by Government Decision no. 1117/2023 (Methodology for sustainability reporting – Romanian Sustainability Code – CRS). Its purpose is to meet legislative obligations regarding non-financial reporting and sustainability, in the European and national context. The CRS also has the role of increasing the transparency, comparability and accessibility of sustainability data reported by entities, but also of supporting entities in preparing sustainability reports. It is mandatory for entities that, at the balance sheet date, exceed 500 employees during the financial year to submit a sustainability report. These entities have a legal obligation to prepare a non-financial statement that includes at least: environmental, social and personnel aspects, respect for human rights, combating corruption and bribery. However, this type of report can be submitted voluntarily by any other entity (smaller companies, public or private sector entities) that wishes to voluntarily report information on sustainability.

The following table details the sustainability reporting requirements:

Country	Requirements
United States	There is no single federal law, but: The SEC (Securities and Exchange Commission) is proposing mandatory climate reporting rules for listed companies. Many companies voluntarily report according to SASB, GRI or TCFD. Institutional investors (e.g. BlackRock) are already demanding detailed ESG data.
Canada	ESG reporting is gradually becoming mandatory for financial institutions and listed companies. Aligns with TCFD and ISSB.
United Kingdom	Large companies must report non-financial information (climate, energy, governance). Standard: TCFD (Task Force on Climate-related Financial Disclosures) – mandatory for listed companies from 2022.

	Transition to the new ISSB (IFRS Sustainability Disclosure Standards) framework is being prepared.
Japonia	Mandatory ESG reporting for listed companies; guidelines from the Financial Services Agency
China	Climate reporting obligations for large state-owned companies; ESG standards in development.
South Korea	Mandatory ESG reporting for listed companies by 2030.
Australia	Mandatory climate reporting rules from 2025 for large companies
Brazilia	B3 Stock Exchange requires listed companies to publish ESG reports
Chile	TCFD rules implemented for financial companies
Africa de Sud	Since 2010, companies listed on the Johannesburg Stock Exchange have been required to publish integrated reports (financial + ESG).
United Arab Emirates, Saudi Arabia, Qatar	They have ESG rules in development for listed companies.

Table 2: Details regarding sustainability reporting

4. The Impact of Digitalization and Artificial Intelligence on Sustainability Reporting

Digitalization and the use of artificial intelligence are profoundly transforming the way companies collect, process, and report sustainability information. These technologies not only streamline reporting processes, but also contribute to increasing the transparency, accuracy, and comparability of non-financial data.

If in the past non-financial data was collected manually, fragmentedly and often without uniform standards, digital technologies today allow the automation of the entire workflow. IoT devices, monitoring platforms and integrated ERP systems collect information on resource consumption, emissions, waste management or social performance in real time, considerably reducing errors and operational costs. In addition to digitalization, artificial intelligence plays an essential role in processing large volumes of data, identifying patterns and generating relevant insights. Machine learning algorithms can predict future developments in environmental indicators, detect anomalies or areas with high negative impact and provide recommendations for optimizing ESG (Environmental, Social, Governance) strategies. This advanced analytical capacity not only streamlines internal processes, but also supports the adoption of informed decisions, aligned with sustainability objectives.

In addition, technological solutions facilitate increased transparency, accuracy and comparability of non-financial data. Digital platforms enable standardized reporting in accordance with the requirements of legislation and international frameworks such as CSRD, GRI or SASB, and artificial intelligence-based tools can verify data consistency and

generate automated reports. Thus, organizations provide stakeholders with more credible and easily assessable information, which is essential for building trust and attracting responsible investments. Overall, digitalization and artificial intelligence are not just technical tools, but strategic elements that support the sustainable transformation of companies. They enable stronger governance, continuous monitoring of ESG performance and rapid adaptation to the increasingly complex requirements of the business environment and society.

i) Automate data collection and processing

Sustainability reporting involves a considerable volume of data from various sources: energy consumption, carbon emissions, waste management, supply chain, employee data or corporate governance. Through digitalization, this information can be collected automatically, in real time, through ERP systems, IoT (Internet of Things) and integrated analytics platforms [9]. Artificial intelligence facilitates the processing of this data, identifying relevant patterns, inconsistencies or trends. For example, machine learning algorithms can estimate indirect emissions (scope 3) or assess climate risks in supply chains, reducing the time and costs associated with manual reporting [10]. Some of the most important climate risks in supply chains, grouped by categories [15, 16], are: acute physical risks (extreme events), chronic physical risks (progressive changes), transition risks, reputational risks, operational and logistical risks, Risks related to dependence on vulnerable suppliers.

The most important climate risks in supply chains:	Examples:
■ Acute physical risks (extreme events), these are immediate effects of extreme weather phenomena on the supply flow.	<ul style="list-style-type: none">• Floods that destroy factories, logistics centers or transportation routes;• Storms, hurricanes, tornadoes that affect port and maritime infrastructure;• Heat waves that reduce the productivity of factory workers or increase the rate of equipment failure;• Wildfires that disrupt access to raw materials;• Severe droughts that limit agricultural production.
■ Chronic physical risks (progressive changes), these gradually affect	<ul style="list-style-type: none">• Increase in average temperatures, which reduces crop yields;• Depletion of water resources, affecting the food, textile and chemical industries;

production capacity and costs.	<ul style="list-style-type: none"> • Rising sea levels, threatening factories located in coastal areas; • Degradation of soil quality, with an impact on agricultural raw materials; • Change in climate zones, which forces production to move to other regions.
<ul style="list-style-type: none"> ■ Transition risks that are generated by legislative, technological and market changes necessary for the transition to a low-emission economy. 	<ul style="list-style-type: none"> • Strict emissions regulations that increase suppliers' costs; • Increased demand for "green" materials, which can create shortages in sustainable raw material markets; • Restrictions on certain polluting substances or processes, forcing companies to change their suppliers; • Rising energy costs for fossil fuel-dependent suppliers; • Changes in ESG standards requiring additional investment in reporting and compliance.
<ul style="list-style-type: none"> ■ Reputational risks 	<p>arise when supply chain partners do not comply with climate or social requirements.</p> <ul style="list-style-type: none"> • Suppliers that do not comply with environmental standards, which can affect brand image; • Lack of transparency on Scope 3 emissions; • Negative disclosures regarding upstream pollution or environmental degradation.
<ul style="list-style-type: none"> ■ Operational and logistical risks with a direct impact on material flows and business continuity. 	<ul style="list-style-type: none"> • Transport delays caused by extreme weather events; • Increased transport costs due to longer alternative routes; • Low availability of raw materials from climate-affected areas; • Price volatility due to reduced production in certain regions.
<ul style="list-style-type: none"> ■ Risks related to dependence on vulnerable suppliers 	<ul style="list-style-type: none"> • Single suppliers located in areas with high climate risk; • Concentration of production in regions exposed to drought, flooding or extreme weather cycles; • Lack of suppliers' climate continuity plans.

Table 3: The most important climate risks in supply chains

ii) Increasing accuracy and transparency

One of the great advantages of AI is the ability to ensure traceability and verifiability of data. Blockchain and AI-based platforms can guarantee the integrity of reported information, providing a secure and digitally audited system for verifying ESG performance [11]. This makes reporting more credible and less susceptible to errors or intentional manipulation (“greenwashing”). Digitalization also allows for the automatic correlation of indicators with relevant standards, such as the European Sustainability Reporting Standards (ESRS) or the Global Reporting Initiative (GRI), reducing the risk of legislative non-compliance [12].

iii) Predictive analytics and decision support

Artificial intelligence is not limited to reporting on the past, but provides predictive analytics on future sustainability performance. Companies can simulate the impact of climate scenarios on their operations or estimate the costs of transitioning to climate neutrality.

By analyzing ESG data, AI can identify emerging risks and green investment opportunities, supporting strategic management decisions [13].

iv) Digitalization of CSRD and ESRS reporting

The new European requirements (CSRD and ESRS) encourage the adoption of a standardized digital reporting framework. Sustainability reports will have to be published in electronic format, using digital tags (XHTML and XBRL), to allow for automated processing and comparison of data at European level [7]. This digital transformation will facilitate surveillance, analysis and comparability between companies, investors and authorities.

5. Conclusions

While the benefits are significant, digitalization and AI also bring challenges. IT system integration, data security, lack of digital skills and upfront costs can limit the rapid adoption of these technologies, especially for SMEs.

Furthermore, over-reliance on algorithms can generate ethical risks — for example, decisions based on incomplete data or algorithmic bias [14]. Therefore, digital governance and accountability in the use of AI become essential for the credibility of sustainability reporting.

As regulations become more uniform across Europe, integrated digital platforms are expected to emerge that connect companies' ESG data with tax and financial authority systems. AI will increasingly become a strategic partner, not just a technological tool,

capable of supporting companies' transition to sustainable and circular business models. Thus, ESG is becoming mandatory for large companies in most developed countries. There is a global harmonisation between the standards: ESRS (EU) and ISSB (global). Investors and banks use ESG data to assess companies' risk and performance. Digital reporting will become the norm in the coming years.

Over 80 countries now have rules or recommendations on sustainability reporting.

The global trend is clear: moving from voluntary reporting to mandatory reporting.

Key standards used internationally: GRI – the most widespread globally; TCFD / ISSB (IFRS S1 & S2) – for climate and governance; ESRS (EU) – the most complete and detailed current framework.

Experts estimate that, by 2027, over 90 countries will have a formal ESG reporting framework, and the ESRS (EU) and ISSB (global) standards will become the common language of sustainability in the world.

In conclusion, we see that the most important developments and trends in sustainability reporting could be:

- Stronger regulation and expansion of obligations, as well as the expansion of entities subject to reporting;
- Convergence between international standards (ISSB) and impact standards (GRI, ESRS); there are active efforts for interoperability between them to reduce duplication of reporting.
- Verification requirements for sustainability information will become mandatory in principle in more and more jurisdictions (notably the EU); thus, financial auditors or third parties will have to attest to ESG data.
- Sustainability reporting will move to structured digital formats for comparability and integration with financial reports.
- Reporting on emissions and risks in the value chain (Scope 3) remains central — even if in some regions the exact requirements for Scope 3 are still debated or even contested.
- In addition to climate, new standards will increasingly address issues such as biodiversity, land use, workers' rights and impact on communities.
- There will be increasing pressure to connect non-financial information with financial information — risk and financial impact, scenarios, capital assessments.

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