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СВИЩОВ

Катедра „Индустриален бизнес
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СБОРНИК

с доклади от кръгла маса

ИНДУСТРИАЛНИЯТ БИЗНЕС И ПРЕДПРИЕМАЧЕСТВОТО В УСЛОВИЯТА НА ГЛОБАЛНИ ТРАНСФОРМАЦИИ

16 октомври 2026 г.



СТОПАНСКА АКАДЕМИЯ „Д. А. ЦЕНОВ“ – СВИЩОВ

Сборник с доклади от кръгла маса:

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СЪДЪРЖАНИЕ

КАЧЕСТВОТО КАТО КАТЕГОРИЯ **10**
Анета Денева

МАНИПУЛИРАНЕТО НА РАБОТНОТО МЯСТО – ПРЕЗ ПОГЛЕДА НА СТУДЕНТИТЕ **19**
Венета Христова

СОЦИАЛНИЯ КАПИТАЛ КАТО ФАКТОР ЗА ПРЕДПРИЕМАЧЕСКИЯ УСПЕХ – ЕМПИРИЧНО ИЗСЛЕДВАНЕ СРЕД МЛАДИ БЪЛГАРСКИ ПРЕДПРИЕМАЧИ **34**
Любчо Варамезов, Любомир Николов

ТЕОРИИ И МОДЕЛИ НА ПРЕДПРИЕМАЧЕСКИЯ УСПЕХ **42**
Любчо Варамезов, Любомир Николов

УПРАВЛЕНИЕ НА ЧОВЕШКИЯ ФАКТОР В ГРАЖДАНСКАТА АВИАЦИЯ **49**
Галина Тодорова

ПРЕДПОСТАВКИ ЗА СЪЗДАВАНЕ НА ПРОИЗВОДСТВЕНИ ПРЕДПРИЯТИЯ КАТО ДОСТАВЧИК НА МАЛКИ ТЪРГОВСКИ ФИРМИ **55**
Даниел Павлов, Виолета Янколова-Али

ОТ ЧОВЕКОЦЕНТРИЗЪМ КЪМ КОГНИТИВНА АВТОНОМИЯ – КОНЦЕПТУАЛИЗИРАНЕ НА ИНДУСТРИЯ 6.0 В ЕРАТА НА ИЗКУСТВЕНИЯ ИНТЕЛЕКТ **60**
Емил Николов

ПРЕДПРИЕМАЧЕСКИ ИНОВАЦИИ ЧРЕЗ КРЪГОВИ МОДЕЛИ – НОВИ БИЗНЕС ВЪЗМОЖНОСТИ В УСЛОВИЯТА НА ГЛОБАЛНИ ТРАНСФОРМАЦИИ **73**
Искра Пантелеева

РОЛЯТА НА ИНТЕЛИГЕНТНИТЕ ЦИФРОВИ ЕКОСИСТЕМИ В ДИГИТАЛНАТА ТРАНСФОРМАЦИЯ НА ИНДУСТРИАЛНИТЕ ПРЕДПРИЯТИЯ **80**
Кремена Маринова-Костова

ТЕХНИЧЕСКИЯТ ПРОГРЕС И ИНОВАЦИИТЕ ВЪВ ФИЛОСОФСКИ КОНТЕКСТ **86**
Пламен Павлов

ДИГИТАЛНИ ИНОВАЦИИ В ОТЧИТАНЕТО НА УСТОЙЧИВОСТТА И УПРАВЛЕНИЕТО НА РИСКА В ИНДУСТРИАЛНИТЕ ПРЕДПРИЯТИЯ **95**
Радосвета Кръстева-Христова

ПРЕКИТЕ ЧУЖДЕСТРАННИ ИНВЕСТИЦИИ -КРИТИЧЕН ПРЕГЛЕД И ПРЕДИЗВИКАТЕЛСТВА В УСЛОВИЯТА НА ПЪЛНОПРАВНО ЧЛЕНСТВО В ЕВРОЗОНАТА **103**
Сергей Найденов, Добрин Ганчев

ВЛИЯНИЕ НА ДИГИТАЛНИТЕ ТЕХНОЛОГИИ В ИЗКУСТВЕН ИНТЕЛЕКТ ВЪРХУ ЕЛЕКТРОННИТЕ ПРОДАЖБИ: ЕВРОПЕЙСКО СРАВНИТЕЛНО ПРОУЧВАНЕ **114**
Симеонка Петрова

СТРУКТУРНИ ПРОМЕНИ НА ВЪГЛЕРОДНИТЕ ЕМИСИИ ПО ИЗТОЧНИЦИ НА ЗАМЪРСЯВАНЕ **123**
Стела Касабова

РАЗВИТИЕ НА ЕЛЕКТРОННАТА ТЪРГОВИЯ В ПРЕДПРИЯТИЯТА ОТ ПРЕРАБОТВАЩАТА ПРОМИШЛЕНОСТ В ЕВРОПЕЙСКИЯ СЪЮЗ ПРЕЗ ПЕРИОДА 2016–2025 г. **131**
Зоя Иванова

ДИГИТАЛИЗАЦИЯ НА ПРОИЗВОДСТВЕНИТЕ ПРОЦЕСИ В ИНДУСТРИАЛНИТЕ ПРЕДПРИЯТИЯ **141**
Ивайло Костов

ИДЕНТИФИЦИРАНЕ НА СЛАБИТЕ МЕСТА В ИНСПЕКТИРАНИЯ ОБЕКТ **149**
Надежда Цветкова

IMPROVEMENTS IN ENTERPRISE OPERATIONS MANAGEMENT RESULTING FROM THE APPLICATION OF ARTIFICIAL INTELLIGENCE **156**
Stefan Kalpachev

ОПТИМИЗИРАНЕ НА БЪЛГАРСКАТА ПОЛИТИКА В ОБЛАСТТА НА МЕЖДУНАРОДНАТА ТЪРГОВИЯ С БИОЛОГИЧНИ РЕСУРСИ **163**
Цветелина Кабакчиева

ПРЕКИ ЧУЖДЕСТРАННИ ИНВЕСТИЦИИ В БЪЛГАРИЯ - ДИНАМИКА И ЗНАЧЕНИЕ ЗА ИКОНОМИЧЕСКОТО РАЗВИТИЕ **169**
Явор Станев

РАЗВИТИЕ НА ПАМУКОПРОИЗВОДСТВОТО В БЪЛГАРИЯ **176**
Александър Личев

ОСНОВНИ ПОДХОДИ ЗА КЛАСИФИКАЦИЯ НА ТРУДОВАТА МОТИВАЦИЯ В КОНТЕКСТА НА МРЕЖОВОТО ВЗАИМОДЕЙСТВИЕ В ОРГАНИЗАЦИЯТА **185**
Анелия Станева

РАЗВИТИЕ НА ЧОВЕШКИТЕ РЕСУРСИ В СЪВРЕМЕННАТА ИКОНОМИКА – ОБХВАТ И СЪДЪРЖАТЕЛНИ КОМПОНЕНТИ **191**
Деница Гъркова

ОРГАНИЗАЦИОННО УЧЕНЕ И ESG ИНТЕГРАЦИЯ ЧРЕЗ ИГРОВО-БАЗИРАНО ОБУЧЕНИЕ **198**
Десислава Белева-Димитрова

ПРИЕМЪТ НА ЧУЖДЕСТРАННИ СТУДЕНТИ В УСЛОВИЯТА НА ГЛОБАЛНА КОНКУРЕНЦИЯ: ПРЕДИЗВИКАТЕЛСТВА И КОНТРОЛНИ МЕХАНИЗМИ **208**
Диана Маринкова

ИНОВАЦИОННО РАЗВИТИЕ НА ПРЕДПРИЯТИЯТА В УСЛОВИЯ НА ПРЕХОД КЪМ ИНДУСТРИЯ 5.0 ..... **214**
Захари Пенев

ОСОБЕНОСТИ НА ИНДУСТРИАЛНИТЕ ПРЕДПРИЯТИЯ В СЪВРЕМЕННАТА ИКОНОМИКА **222**
Калин Борисов

ТЕОРЕТИЧНИ МОДЕЛИ ЗА ИНОВАЦИОННО РАЗВИТИЕ НА ИНДУСТРИАЛНИТЕ ПРЕДПРИЯТИЯ **230**
Калин Борисов

АНАЛИЗ НА НОРМАТИВНАТА БАЗА И НА КОЛИЧЕСТВАТА ПУСНАТО НА ПАЗАРА ЕЛЕКТРИЧЕСКО И ЕЛЕКТРОННО ОБОРУДВАНЕ **237**
Калин Карев

ПРЕДИЗВИКАТЕЛСТВА И ПЕРСПЕКТИВИ ПРЕД ПРОЕКТНОТО ФИНАНСИРАНЕ НА ТУРИСТИЧЕСКИЯ СЕКТОР В БЪЛГАРИЯ **248**
Мария Иванова Павлова-Кондрова, Любка Минчева Илиева

ПАЗАРНО РАЗВИТИЕ НА БИОБАЗИРАНИТЕ ИНДУСТРИИ В УСЛОВИЯТА НА ГЛОБАЛНИ ТРАНСФОРМАЦИИ **255**
Преслав Георгиев

УПРАВЛЕНИЕ НА ЗНАНИЕТО В БИЗНЕС ОРГАНИЗАЦИИТЕ – ПРОБЛЕМИ И ПРЕДИЗВИКАТЕЛСТВА **262**
Стела Маринова, Любчо Варамезов

ЗЕЛЕНИ ТЕХНОЛОГИЧНИ ИНОВАЦИИ И СТОЙНОСТ НА ФИРМАТА В КИТАЙСКИЯ ИНДУСТРИАЛЕН СЕКТОР: МОДЕРИРАЩАТА РОЛЯ НА ФИНАНСОВИТЕ ОГРАНИЧЕНИЯ **270**
Синюе Ду

РОЛЯТА НА КОНТРОЛА ЗА НАСЪРЧАВАНЕ НА ПРЕДПРИЕМАЧЕСТВОТО В ЗЕМЕДЕЛИЕТО ЧРЕЗ ФИНАНСОВОТО ПОДПОМАГАНЕ ПО ДИРЕКТНИТЕ ПЛАЩАНИЯ В РАМКИТЕ НА ОБЩАТА СЕЛСКОСТОПАНСКА ПОЛИТИКА **283**
Снежана Парушева-Ламбева

ПРЕХОД НА БЪЛГАРИЯ КЪМ ИНДУСТРИЯ 5.0 ..... **296**
Тихомир Георгиев

ПЛАНИРАНЕ НА ЧОВЕШКИТЕ РЕСУРСИ В ИНДУСТРИАЛНИТЕ ПРЕДПРИЯТИЯ – РЕЗУЛТАТИ ОТ ЕМПИРИЧНО ИЗСЛЕДВАНЕ В ОБЛАСТ ВАРНА **303**
Явор Каравелски

ESG ЕФЕКТИВНОСТ И СТОЙНОСТ НА ФИРМАТА ПРИ ПАЗАРНО ПОГРЕШНО ОЦЕНЯВАНЕ: ДАННИ ОТ ИНДУСТРИАЛНИЯ СЕКТОР НА КИТАЙ **310**
Ян Фу

ЕВРОПЕЙСКА СТРАТЕГИЯ ЗА РАЗРАБОТВАНЕ И ВНЕДРЯВАНЕ НА МАЛКИ МОДУЛНИ РЕАКТОРИ В ЕВРОПА - ПРАВНИ, ПОЛИТИЧЕСКИ И СОЦИАЛНО-ИКОНОМИЧЕСКИ ЕФЕКТИ ЗА БЪЛГАРИЯ **323**
Албена Белянова, Борислав Боев

ФОРМИРАНЕ НА ПЪРВОНАЧАЛНА ПРЕДПРИЕМАЧЕСКА ГРАМОТНОСТ У ПЪРВОКЛАСНИЦИТЕ В КОНТЕКСТА НА РЕАЛНА ПАЗАРНА СРЕДА **334**
Милка Венкова

ВЛИЯНИЕТО НА ДИГИТАЛИЗАЦИЯТА ВЪРХУ УПРАВЛЕНИЕТО И РАЗВИТИЕТО НА СЪВРЕМЕННИЯ БИЗНЕС **340**
Даяна Пламенова Лучева

ДИГИТАЛНИТЕ ТЕХНОЛОГИИ КАТО СРЕДСТВО ЗА ОПАЗВАНЕ И ПОПУЛЯРИЗИРАНЕ НА КУЛТУРНОТО НАСЛЕДСТВО……...383
Димитрийка Чакова

ВНЕДРЯВАНЕ НА КРЪГОВА ИКОНОМИКА И ЗЕЛЕНИ ТЕХНОЛОГИИ КАТО ФАКТОР ЗА УСТОЙЧИВ БИЗНЕС **357**
Милена Христова

ДИГИТАЛНИ ИНОВАЦИИ В ОТЧИТАНЕТО НА УСТОЙЧИВОСТТА И УПРАВЛЕНИЕТО НА РИСКА В ИНДУСТРИАЛНИТЕ ПРЕДПРИЯТИЯ

Доц. д-р Радосвета Кръстева-Христова[1]

Резюме: *Докладът предлага интегрирана рамка за дигитално отчитане и управление на риска в индустриалните предприятия. Тя свързва данните за устойчивостта, счетоводния контрол и управлението на риска, като подобрява проследимостта и решенията при запазване на професионалната преценка.*

Ключови думи: *дигитална трансформация; отчитане на устойчивостта; управленско счетоводство; индустриални предприятия; управление на риска в предприятието; проследимост на данните*

JEL: M41; M15; G32; Q56; O33

DIGITAL INNOVATIONS IN SUSTAINABILITY REPORTING AND RISK MANAGEMENT IN INDUSTRIAL ENTERPRISES

Assoc. Prof. Radosveta Krasteva-Hristova, PhD

Abstract: *The paper proposes an integrated digital reporting-risk framework for industrial enterprises. It links sustainability data, accounting controls and risk management, showing how digital tools can improve traceability and decision-making while preserving professional judgement.*

Keywords*: digital transformation; sustainability reporting; management accounting; industrial enterprises; enterprise risk management; data traceability*

JEL: M41; M15; G32; Q56; O33

1. Introduction

Industrial enterprises operate at the intersection of energy and material consumption, complex supplier relationships, investment commitments and exposure to operational disruptions. Their sustainability performance is therefore not only a disclosure topic but also a management-accounting and risk-management concern. Industrial sensors, enterprise resource planning (ERP) systems, manufacturing execution systems, analytics platforms and artificial intelligence (AI) may increase the timeliness and granularity of relevant

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information. A recent review of Industry 4.0 and ESG strategies describes potential uses of these technologies for resource optimisation and reporting, while also indicating that implementation depends on organisational arrangements (Hammad, Rahamaddulla, & Fauzi, 2025).

The central challenge is the difference between making data available and making information decision-useful. A meter reading may be technically precise but assigned to the wrong production line; a supplier emission factor may be reproducible but unrepresentative; an AI-generated narrative may be fluent but unsupported by evidence. Research on ESG information has documented inconsistent metrics and substantial variation across third-party ratings (Berg, Kölbel, & Rigobon, 2022; Kotsantonis & Serafeim, 2019). These issues make the internal reliability and provenance of sustainability data particularly salient.

This paper asks: How can industrial enterprises connect digital sustainability data to accounting controls and risk decisions without treating automation as a substitute for professional judgement? Its objective is to develop an integrated digital reporting–risk (IDRR) framework that maps data sources to measurements, controls, risks and managerial responses. The contribution is an explicitly conceptual synthesis, supported by an operational traceability matrix and testable propositions. It does not claim to estimate the effects of digitalisation or to evaluate named enterprises.

2. Literature and institutional context

a. Sustainability information and accounting quality

Sustainability measures differ from conventional financial transactions because many depend on physical units, engineering boundaries, estimates and information obtained outside the accounting function. The GHG Protocol provides a structured basis for corporate greenhouse-gas inventories, and its Scope 3 standard extends measurement to relevant upstream and downstream value-chain activities (World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD), 2011; World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD), 2004). The boundary of an emission inventory, the origin of activity data, the emission factor and the method of allocation all matter for interpretation. A reduction in emissions per unit of output, for example, does not necessarily entail a reduction in absolute emissions.

The ESRS adopted under Commission Delegated Regulation (EU) 2023/2772 articulate double materiality, combining impacts on people and the environment with financially material sustainability-related risks and opportunities. EFRAG's implementation guidance discusses materiality assessments, value-chain information and detailed data points (European Commission, 2023; EFRAG, 2024). IFRS S1 focuses on sustainability-related risks and opportunities relevant to an entity's prospects; IFRS S2 specifies climate-related disclosures organised around governance, strategy, risk

management, and metrics and targets (IFRS Foundation, 2023a; IFRS Foundation, 2023b). These frameworks differ in purpose and applicability and should not be presented as interchangeable obligations.

The European reporting environment has also changed. Directive (EU) 2026/470 narrowed the scope of mandatory corporate sustainability reporting and amended related requirements. Consequently, the reporting obligations of a specific industrial enterprise must be assessed against applicable law, company characteristics, reporting period and national implementation, rather than inferred from its industry alone (European Parliament & Council of the European Union, 2026). The Commission's voluntary sustainability reporting recommendation offers a proportionate reference for smaller undertakings and their value-chain information requests (European Commission, 2025). In this article, reporting frameworks are analysed as design resources; no universal legal duty to apply every cited standard is asserted.

b. Digitalisation as an opportunity and a risk source

Digital tools can link physical production to sustainability accounting: IoT meters can capture energy and water use, ERP records can provide purchased-material quantities, and analytics can flag abnormal process values. A review of environmental and governance strategies in Industry 4.0 considers both opportunities from connected technologies and the organisational conditions for their application (Hammad, Rahamaddulla, & Fauzi, 2025). Digital traceability is therefore a conditional capability: its contribution depends on data definitions, coverage and controls.

AI can support anomaly detection, estimation and narrative drafting, but may introduce model drift, biased training data, undocumented transformations and misleading outputs. The voluntary NIST AI Risk Management Framework groups risk practices into govern, map, measure and manage functions (Tabassi, 2023). ISO 31000:2018 offers broader principles and processes for risk identification, analysis, evaluation, treatment and monitoring (International Organization for Standardization (ISO), 2018). The two sources complement one another at different levels: the former addresses AI-related risks; the latter informs enterprise-wide risk processes.

3. Research design and analytical method

The study uses a qualitative, framework-development design based on a purposively selected set of sources. The documentary corpus comprises: (i) peer-reviewed work on ESG measurement and industrial digital technologies; (ii) primary standard-setting texts on sustainability reporting and greenhouse-gas accounting; and (iii) authoritative risk-management guidance. Sources were selected for their direct relevance to data generation, reporting qualities, traceability, risk translation and industrial applicability, not through an

exhaustive database search. Accordingly, this is neither a systematic literature review nor a meta-analysis, and it does not support prevalence estimates.

The analytical procedure has four steps. First, the sources are read for recurring informational challenges (measurement boundaries, data provenance, comparability and uncertainty). Second, the roles of available digital technologies are associated with specific data-generation and processing activities. Third, potential failure modes are linked to accounting controls and risk responses. Fourth, these relationships are organised into an integrated five-layer framework and a traceability matrix. A proposed control or performance indicator is the author's analytical recommendation, not a verbatim requirement of every cited standard.

4. Results: the integrated digital reporting–risk framework

a. Five connected layers

The IDRR framework treats a sustainability disclosure as the end product of a documented information chain, rather than as a dashboard output. Its five connected layers are: (1) source data from meters, machinery, purchasing and supplier systems; (2) measurement and accounting rules for units, organisational boundaries, factors and allocations; (3) controls and assurance readiness through reconciliations, access rights, approvals and evidence retention; (4) risk translation into exposure, time horizon, probability or scenario, potential financial implications and response ownership; and (5) management decisions and external disclosure. Changes in definitions, methods or estimated values should travel through the chain with a versioned audit trail.

Table 1. Proposed IDRR layers and accountability

Layer	Primary task	Illustrative accountability
1. Source data	Capture machine, meter, purchasing and supplier records with timestamps and identifiers.	Operations / procurement; IT safeguards capture.
2. Measurement	Define boundaries, denominators, allocation rules, factors and estimation methods.	Sustainability specialist and accounting jointly approve methods.
3. Controls	Validate completeness, reconcile records, document overrides and retain evidence.	Accounting / internal control; independent review as appropriate.
4. Risk translation	Identify exposure, uncertainty, scenarios, thresholds and response owners.	Risk function and production / finance management.
5. Decision / disclosure	Link validated indicators to investment, mitigation and proportionate reporting.	Management authorises actions and external statements.

Source: Author's conceptual synthesis of European Commission (2023), IFRS Foundation (2023a, 2023b), ISO (2018) and Tabassi (2023).

The framework separates three questions that are frequently conflated. Data availability asks whether a record exists. Measurement validity asks whether a record represents the intended phenomenon according to an appropriate boundary and method. Decision usefulness asks whether the resulting information supports a specified management choice. More frequent readings cannot compensate for an inappropriate emission factor; conversely, a well-documented estimate may be useful when direct measurement is impracticable, provided uncertainty is disclosed and governed.

b. An industrial traceability matrix

Table 2 operationalises the framework for four illustrative data domains. Entries are proposed control designs, not observations from actual firms. No numerical KPI values or risk frequencies are imputed. The table also makes the link between the underlying physical process, reporting metric and accountable risk response explicit.

Table 2. Illustrative data-to-risk traceability matrix for industrial enterprises

Information domain	Digital input and metric	Control / evidence	Risk response
Energy	Meter readings matched to production volumes; kWh and kWh per unit.	Meter calibration; reconcile invoices; test plant/line boundaries and downtime.	Investigate abnormal intensity; assess price volatility and efficiency investment.
GHG emissions	Fuel and electricity activity data; tCO_2e by relevant scope.	Document emission factors, organisational boundary, methods and revisions.	Assess transition exposure; evaluate abatement options and sensitivity.
Materials / waste	ERP purchases, production logs and waste-transfer records; tonnes and yield.	Reconcile input–output balances; verify waste classification and contractor documents.	Address supplier disruption, material loss and circularity investment.
Occupational safety	Incident logs and exposure records; incident frequency with defined denominator.	Confirm incident completeness, definitions, privacy and authorisation.	Review process hazards and prevention measures; protect sensitive data.

Source: Author's proposed applications, informed by WRI & WBCSD (2004, 2011), European Commission (2023) and ISO (2018).

Consider an illustrative electricity-consumption anomaly. The system detects a rise in kWh per unit at one production line, but accounting first verifies the denominator and meter-to-line mapping, and operations checks whether a product-mix change explains the deviation. Only after validation is the anomaly

escalated for a risk decision on maintenance, process redesign or energy procurement. This is a hypothetical process walkthrough, not a company case study or measured improvement. It shows how professional judgement remains indispensable even with real-time monitoring.

4.3. Digital control points and failure modes

Four control points are especially important. First, master-data governance defines each asset, facility, product and unit consistently across ERP, meter and reporting systems. Second, source-to-report lineage records where inputs originated and which transformations were applied. Third, exception handling requires a human owner, documented correction and, where necessary, retrospective recalculation. Fourth, disclosure review distinguishes verified measurements, estimates, forward-looking scenarios and AI-assisted text. These practices can make information more inspectable but cannot eliminate model uncertainty, supplier omissions or deliberate misstatement.

An enterprise adopting AI-generated descriptions or emission estimates should separately register the system purpose, permitted inputs, performance tests, override authority and review frequency. Under NIST's framework, such measures are examples of governance and monitoring; they do not constitute a claim that an AI system is certified by NIST (Tabassi, 2023). Where external suppliers contribute data, a proportionate hierarchy—supplier-specific data when reliable, documented secondary factors where justified, and transparent uncertainty flags—may be preferable to demanding an artificial precision that SMEs cannot provide.

5. Discussion and implications

The principal theoretical implication is that digital innovation is not an independent determinant of disclosure quality: its potential effect is mediated by measurement choices, governance and risk integration. This reasoning is consistent with findings that ESG metrics can vary in definition and ratings can diverge even when they concern the same company (Berg, Kölbel, & Rigobon, 2022; Kotsantonis & Serafeim, 2019). Accordingly, more datapoints and more sophisticated dashboards should not be treated as sufficient proxies for stronger sustainability performance or more reliable reporting.

For management accounting, the IDRR framework suggests linking operational physical measures with financial exposures—such as energy cost sensitivity, downtime, capital-expenditure decisions and financing needs—while keeping impact measures distinct from financial effects. For risk management, it suggests recording both the event and uncertainty in the evidence used to assess it. For governance, it clarifies that IT owns system security, operations owns physical process knowledge, accounting owns measurement controls and management owns decisions; exact allocations must be adapted to organisational structures.

Proportionality is critical. A large industrial group may need automated interfaces and consolidated, entity-level controls, whereas a small manufacturer may obtain an adequate traceable process from calibrated meters, structured spreadsheets, documented assumptions and periodic review. The Commission's 2025 voluntary SME recommendation provides a possible disclosure reference without implying that smaller suppliers automatically fall within the amended mandatory CSRD scope (European Commission, 2025; European Parliament & Council of the European Union, 2026). Investment decisions should compare expected benefits with deployment, maintenance, cybersecurity and staff-training costs rather than assume digitalisation is costless or environmentally neutral.

Three empirically testable propositions follow. P1: stronger data lineage is associated with fewer unresolved source-to-report discrepancies, controlling for enterprise size and disclosure complexity. P2: the relationship between monitoring frequency and risk-response timeliness is moderated by the presence of defined escalation ownership. P3: the integration of sustainability and management-accounting data is associated with more explicit treatment of sustainability-related assumptions in investment appraisal. These propositions have not been tested in this paper; possible evidence includes process logs, control-exception records, interviews and investment files.

6. Conclusion

Digital innovation can support industrial sustainability reporting and risk management only when source data are translated through coherent accounting methods, documented controls and accountable decisions. The IDRR framework makes that chain explicit and provides an illustrative matrix covering energy, emissions, materials and occupational safety. Its main contribution is to specify where digital tools can assist and where professional judgement, measurement discipline and risk ownership remain necessary. The paper is limited by its purposive documentary scope and absence of organisational fieldwork. Future research should apply and revise the framework through multi-case studies, examine implementation costs and test whether traceability and escalation mechanisms improve the timeliness and verifiability of information. The framework should be adapted to each enterprise's material topics, reporting obligations and risk profile.

References

Berg, F., Kölbel, J., & Rigobon, R. (2022). Aggregate confusion: The divergence of ESG ratings. *Review of Finance, 26*(6), 1315–1344. doi:10.1093/rof/rfac033

EFRAG. (2024). *ESRS implementation guidance documents: IG 1 materiality assessment, IG 2 value chain and IG 3 detailed ESRS datapoints.* Retrieved from https://www.efrag.org/en/projects/esrs-implementation-guidance-documents

European Commission. (2023). Commission Delegated Regulation (EU) 2023/2772 of 31 July 2023 as regards sustainability reporting standards. *Official Journal of the European Union*. Retrieved from https://eur-lex.europa.eu/eli/reg_del/2023/2772/oj

European Commission. (2025). Commission Recommendation (EU) 2025/1710 of 30 July 2025 on a voluntary sustainability reporting standard for small and medium-sized undertakings. *Official Journal of the European Union*. Retrieved from https://eur-lex.europa.eu/eli/reco/2025/1710/oj

European Parliament & Council of the European Union. (2026). Directive (EU) 2026/470 of 24 February 2026 amending certain corporate sustainability reporting and due diligence requirements. *Official Journal of the European Union*. Retrieved from https://eur-lex.europa.eu/eli/dir/2026/470/oj

Hammad, M., Rahamaddulla, S., & Fauzi, M. (2025). Environmental and governance strategies in ESG for industry 4.0: A systematic review. *AIMS Environmental Science, 12*(4), 557–575. doi:10.3934/environsci.2025025

IFRS Foundation. (2023a). *IFRS S1: General requirements for disclosure of sustainability-related financial information.* Retrieved from https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/ifrs-s1-general-requirements/

IFRS Foundation. (2023b). *IFRS S2: Climate-related disclosures.* Retrieved from https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/ifrs-s2-climate-related-disclosures/

International Organization for Standardization (ISO). (2018). *ISO 31000:2018: Riskmanagement—Guidelines.* Retrieved from https://www.iso.org/standard/65694.html

Kotsantonis, S., & Serafeim, G. (2019). Four things no one will tell you about ESG data. *Journal of Applied Corporate Finance, 31*(2), 50–58. doi:10.1111/jacf.12346

Tabassi, E. (2023). *Artificial intelligence risk management framework (AI RMF 1.0) (NIST AI 100-1).* National Institute of Standards and Technology. doi:10.6028/NIST.AI.100-1

World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD). (2004). *The greenhouse gas protocol: A corporate accounting and reporting standard (rev. ed.).* Retrieved from https://ghgprotocol.org/standards

World Resources Institute (WRI) & World Business Council for Sustainable Development (WBCSD). (2011). *Corporate value chain (Scope 3) accounting and reporting standard.* Retrieved from https://ghgprotocol.org/corporate-value-chain-scope-3-standard