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Challenges and Opportunities for a Sustainable Development

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**AI in Management
Controlling Systems.
Sustainability Reporting Practices
in European Companies**

Camelia Cojocaru
University of Bucharest

OVERVIEW

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INTRODUCTION

Two Structural Forces Are Converging

Artificial Intelligence

- RPA, ML & NLP are replacing manual consolidation
- Controlling moves from retrospective to predictive & prescriptive
- Real-time ESG data pipelines becoming standard among EU leaders



CSRD — EU Mandatory 2024

- ~50,000 EU companies must report non-financial data under ESRS
- Double materiality: inside-out AND outside-in perspective required
- Third-party assurance - data must be auditable and traceable

The Problem

Traditional controlling - built around financial accounting logic and periodic reporting cycles - is not designed to produce the volume, granularity, and audibility of ESG data that CSRD now requires. Companies need AI. But how many are using it? And how does Romania compare to Western Europe?

What the Literature Has - and Has Not - Addressed

What we know

- AI improves accuracy & speed of financial reporting (Odonkor et al., 2024)
- NLP reaches 80–93% accuracy in automated ESG scoring (Sokolov, 2021; Zhang, 2024)
- CSRD requires a new 'digitainability' capability (Novicka et al., 2024)

What is missing

- AI-controlling & ESG studied separately - never as an integrated system
- No empirical study based on actual corporate report analysis (firm-level evidence)
- No comparison of AI-controlling maturity between EU West and EU East (Romania)

Added Value of This Research

First systematic, post-CSRD empirical comparison of AI-controlling-ESG integration maturity across 40 European companies - introducing a new construct (ESG-in-compensation as maturity proxy) and the first East–West EU maturity gap analysis.

METHODOLOGY

Research Purpose & Methodological Approach

Research Question

To what extent and in what forms are leading European companies integrating AI into their controlling systems to enhance sustainability reporting, and what maturity gap exists between Western European and Romanian-listed companies?

QCA Qualitative Content Analysis

- 40 sustainability & annual reports
- 2022 · 2023 · 2024
- Deductive coding + inter-coder $\kappa \geq 0.70$

40 Sample

- Sub-sample A: 30 Euro Stoxx 50 (EU)
- Sub-sample B: 10 BVB Romania
- Criterion: revenues $>€1B$ + ESG report

☰ Coding Framework

- 3 categories · 10 subcategories
- AI tools · ESG quality · Controller role
- Maturity score 1–4 per company-year

METHODOLOGY

Analytical Framework: 4-Stage Digital Maturity Model

Most RO companies



EU leaders



1 Manual

Spreadsheets
Periodic reports
No automation

2 Automated

ERP integration
RPA for data collection
Reduced cycle time

3 Predictive

Machine learning
Scenario modelling
Risk forecasting

4 Cognitive

NLP & GenAI
Real-time ESG insight
Strategic contribution

→ Increasing AI integration & ESG controlling sophistication

KEY RESULTS

Western Europe: Predictive-Cognitive Controlling

Siemens AG

Stage 4 — Cognitive

- DEGREE framework: ESG KPIs linked to Board LTI compensation (20% weight)
- SiGREEN platform tracks carbon footprint across full supply chain
- CO₂ -46% (2022) → -60% (2024) via AI-driven energy management
- 27 digital learning hours/employee tracked automatically (327k staff)

Schneider Electric

Stage 4 — Cognitive

- #1 Europe sustainability ranking, Corporate Knights 2024 (13th consecutive year)
- Zero Carbon Project: -40% supplier operational emissions through AI data sharing
- Quarterly Sustainability Impact KPIs with external limited assurance

SAP SE

Stage 4 — Cognitive

- SAP Analytics Cloud + Sustainability Control Tower: real-time financial-ESG integration
- First CSRD/ESRS integrated report (2024) with full double materiality assessment
- Provider AND adopter of AI-based ESG controlling solutions

Key pattern: At the cognitive level, AI does not merely automate ESG collection — it enables prescriptive sustainability controlling integrated into governance.

KEY RESULTS

Romanian Companies: Automated Stage, with Two Exceptions

General pattern (8 companies)

- Predominantly Stage 2 - Automated
- Reports: 30–80 pages (vs. 160+ for EU leaders)
- Fewer externally verified indicators
- Limited explicit AI-in-controlling language
- ESG not integrated into executive compensation

OMV Petrom SA — Stage 2–3 Transitional

- GRI 2021 + TCFD + EU Taxonomy + SASB, externally assured by EY Romania (ISAE 3000)
- 2024: First BVB company to publish full CSRD/ESRS Sustainability Statement
- Digitalization as strategic pillar — automation of operational controlling processes

Banca Transilvania — Stage 2–3 Transitional

- First full CSRD/ESRS Sustainability Statement 2024, audited by Deloitte Audit SRL
- ESG Integration & Investor Relations Division created in 2022 — dedicated function
- AI (GPT-powered Intreb BT) explicitly referenced in ESG report as digital leadership evidence

Insight: CSRD obligations and international group standards are stronger maturity accelerators than geography.

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DISCUSSION

Three Cross-Sample Tendencies & Three Contributions

T1

From voluntary to mandatory double materiality

2022: simplified GRI/TCFD assessments
2024: ESRS double materiality — inside-out & outside-in
Evidence: Siemens (2024 DMA), Banca Transilvania (first CSRD statement)

T2

Increasing granularity & auditability of ESG data

Siemens: 21→27 digital learning hrs/person (2022–2024), 327k staff
OMV Petrom: methane –70% vs 2019, verified by EY (ISAE 3000)
AI automation: necessary condition for CSRD-compliant auditable data

T3

ESG integrated into executive compensation

Siemens: ESG Index = 20% of Board long-term variable compensation
Most advanced form of controlling institutionalization identified in sample
Absent in all Romanian companies analyzed

Contributions

C1

Systematic EU East–West comparative framework for AI-controlling-ESG maturity

C2

Empirical post-CSR evidence from corporate report analysis - firm-level, not surveys

C3

New construct: ESG-in-compensation as institutionalization proxy - not previously operationalized

Conclusions

- 1 AI is transforming controlling from a retrospective reporting function into an instrument of prescriptive sustainability governance - at least among EU leaders.
- 2 CSRD is the decisive accelerator of digital maturity, even in emerging EU markets like Romania. Regulatory pressure matters more than geography.
- 3 The EU–Romania maturity gap is significant (~1.3 on a 4-point scale) but is closing. OMV Petrom and Banca Transilvania demonstrate the trajectory is achievable.
- 4 ESG integration into executive compensation is the frontier indicator of fully institutionalized sustainability controlling. Its absence in Romanian companies marks the deepest gap.

Implications

Companies

Integrate ESG metrics into executive compensation · Create dedicated ESG controlling units

Regulators

CSRD phased approach validated · continue extending scope to SMEs & emerging markets

Universities

Update management accounting curricula: AI literacy + ESG expertise are now core controller competencies

Researchers

Future: CFO/controller interviews · Longitudinal maturity tracking · Quantitative ESG quality modelling

Thank you — Questions welcome