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Environmental Accounting and Circular Economy Adoption: A Systematic Review of Corporate Practices, Innovations, and Governance

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ABSTRACT

This systematic review synthesizes 52 studies from the Scopus database on environmental accounting (EA) and circular economy (CE) adoption. 32 studies (62%) reported a positive direct and strong association between EA and CE adoption. However, 10 studies (19%) found the conditional effects, which were dependent on sector or governance factors. Moreover, 10 studies (19%) found a weak relationship due to multiple constraints. EA, environmental management accounting (EMA), material flow cost accounting (MFCA), life-cycle assessment (LCA), and carbon accounting (CA) were the investigated tools in 40 studies (68%), 9 studies (15%), 2 studies (3%), 3 studies (5%), and 5 studies (8%), respectively. Artificial intelligence-based EA systems were also investigated in 3 studies (5%), which helped improve decision-making and resource optimization. Moreover, eco-innovation (EI) enhanced internal environmental competencies in 8 studies (14%). In addition, managerial competencies and sector-specific features moderated the EA-CE nexus in 9 studies (15%). Among internal success factors, human capital, governance, and technology improved the effectiveness of EA. Among external factors, regulatory pressures, financial incentives, and infrastructure provide consistent policy frameworks to firms in CE adoption. This study recommends that firms should comprehensively apply EA and CE practices to achieve ecological, value, and profitability benefits simultaneously.

1. INTRODUCTION

Climate-related risks motivate firms to internalize ecological externalities in the accounting system. Thus, firms are shifting from traditional financial reporting to environmental accounting (EA). EA counts resource inefficiency and ecological effects in business operations. Thus, EA is an ecological tool to add ecological data to support decision-making. At the same time, the circular economy (CE) principles promote resource efficiency, waste minimization, and closed-loop material flows in production systems. Thus, CE offers firms a strategic tool to reduce ecological footprints in business operations. To support CE adoption, EA can help to measure material flows and ecological costs in production systems.

EA is a strategic instrument for corporations, which assimilates accounting tools for Environmental, Social, and Governance (ESG) activities. CE practices may help to firms to meet ecological responsibility in business operations and reporting. It can optimize resource usage and add ecological cost in reporting. It can also enhance transparency in business operations. Moreover, EA can be considered as a compliance tool in response to external pressures. It can support operational decisions with ecological benefits. Thus, it supports firms in assessing ecological effects in business activities, which can help quantify ecological costs in financial and managerial accounting [1].

Technology is also supporting the EA application, which can facilitate CE adoption. For instance, Artificial Intelligence (AI) helps corporations to enhance transparency, decision-making, and optimal resource utilization [2]. Moreover, AI systems help track emissions in global supply chains [3]. Education, training, and digital knowledge may support firms in adopting cleaner production (CP). Moreover, these factors can also improve reporting quality [4]. Material Flow Cost Accounting (MFCA) would also support CE adoption [5]. Consequently, it might help reduce emissions in business operations. In addition, CE-based accounting supports strategic financial decision-making [6]. Thus, methodological and eco-technologies in EA may help firms to apply CE codes. In the external factors, regulatory and reporting requirements are also important in EA and CE adoption. For instance, EA may follow just disclosure guidelines and avoid actual ecological progress in firms. However, regulations can enhance transparency in firms' reporting [7].

EA, corporate sustainability, and CE practices are interdependent strategies, which may enable firms to align operational decisions with sustainability and financial objectives. However, empirical studies in different sectors, firm sizes, and governance contexts provide fragmented findings in the effectiveness of EA and CE practices [8-13]. Thus, this heterogeneity in findings motivates a need for a systematic synthesis of the literature, which is missing in the review literature. To address this gap, the present review research traces the following research questions:

- What is the evidence in existing literature regarding the effectiveness of different EA tools (i.e., EA, environmental management accounting (EMA), life-cycle assessment (LCA), MFCA, carbon accounting (CA), etc.) to support CE implementation?
- How do internal firm factors (i.e., managerial competencies, human capital, board governance, eco-innovation, etc.) moderate the association between EA and CE adoption?
- What are the most common external factors (i.e., regulatory pressures, policy frameworks, financial incentives, infrastructure), which influence the effectiveness of EA to achieve CE outcomes?

2. METHODOLOGY

2.1 Search strategy

The PRISMA framework is applied to ensure transparency in selecting relevant literature in the field of EA and CE practices. Due to a comprehensive coverage of business, accounting and management journals, the Scopus database is selected and explored with a search string TITLE-ABS-KEY("sustainable accounting" OR "green accounting" OR "EA" OR "corporate sustainability reporting" OR "sustainability accounting" OR "eco-accounting" OR "environmental management accounting" OR "corporate environmental reporting") AND TITLE-ABS-KEY("clean technology" OR "cleantech" OR "CE" OR "circular business model" OR "circularity" OR "closed-loop business" OR "circular production" OR "sustainable production" OR "eco-innovation") AND TITLE-ABS-KEY("corporate" OR "firm" OR "company" OR "organization" OR "enterprise"). Initially, this search string resulted in 112 studies.

2.2 Selection criteria and screening process

In the screening phase, titles and abstracts of 112 articles were examined for relevance, which resulted in the inclusion of 84 studies. 28 articles were excluded at this phase, which were not directly linked to the EA and CE analysis. Thus, the inclusion criteria selected the studies addressing EA, LCA, MFCA, CA, corporate sustainability reporting, or EMA, which have examined CE principles, circular business models, Eco-Innovation (EI), or sustainable production. In the eligibility phase, 84 full-text articles were studied, and 54 articles were selected with strong methodological rigor, clarity, and transparency of data reporting. However, 25 studies were excluded because of insufficient methodological rigor. These criteria excluded the studies based on the absence of a clearly stated research design or methodology section (n = 14), lack of transparency in data collection or analysis procedures (n = 9), and insufficient sample size (n = 2). Thus, 54 studies are finalized with methodological rigor, clarity, and transparency of data reporting for further analysis.

Table 1. QUADAS-2 assessment

Domain	Questions	Risk of Bias Judgment	Applicability Concern
Study design and sample selection	1. Was the study design appropriate for investigating EA and CE practices? 2. Was the sample (firms, industries, cases) and sample size clearly described and representative of the target population?	Low to Medium Risk: Mostly clearly defined study design; representative sample; sample size justified.	Low Concern: Samples/cases match research questions.
EA and CE measurement	1. Were EA tools measured using validated and reliable instruments? 2. Was CE adoption measured using standardized indicators? 3. Were measurement methods clearly described and reproducible?	Low to Medium Risk: Standardized and validated measurement instruments used; clear description of EA tools and CE metrics; multiple dimensions captured in most of the studies.	Low Concern: EA and CE measurements are appropriate for the research context and aligned with established frameworks.
Theoretical framework and model specification	1. Was the study grounded in appropriate theoretical frameworks? 2. Were the relationships between EA, CE, eco-innovation, governance, and performance clearly specified? 3. Were appropriate analytical methods used? 4. Were diagnostic tests and robustness checks performed and reported?	Low to Medium Risk: Clear theoretical framework; explicit hypotheses, or research questions; appropriate analytical methods; appropriate diagnostic reporting in most studies.	Low Concern: Theoretical framework aligns with EA-CE research.

2.3 Quality assessment and risk of bias

Table 1 shows the QUADAS-2 framework for systematic review based on three key domains: study design and sample selection, EA and CE measurement, and theoretical framework and model specification. The methodological quality of all 54 included studies has a low to medium risk of bias and low applicability concern across all investigated domains. Most studies used Partial Least Squares Structural Equation Modeling (PLS-SEM) with clearly defined research designs, including surveys and content analyses of corporate sustainability reporting. Moreover, each study provided a clear description of its sample (firms and industries) with an appropriate sample size, which leads to a low risk of bias in study design and sample selection. In addition, low applicability concerns were found as the most samples matched the research questions regarding EA tools, CE adoption, and governance mechanisms. In the second domain, most studies demonstrated a low to medium risk of bias by using standardized measurement insPtruments and appropriate proxies for EA and CE adoption tools. Moreover, all measurement methods were clearly described as well. In addition, EA and CE measurements were appropriate for the research context and established frameworks, leading to low concern in the generalization of the studies' findings. In the third domain, models of the study were appropriately aligned with theoretical frameworks (e.g., resource-based view, dynamic capabilities theory, legitimacy theory, stakeholder theory, or institutional theory, etc.), which results in low applicability concerns. Moreover, analytical methods were appropriately matched to each study's design, and diagnostic reporting was also appropriately provided, which led to a low risk of bias. However, some studies doing qualitative case studies, semi-structured interviews, and qualitative content analysis were having medium risk of bias, which stems from selection bias (case studies), social desirability and interviewer bias (interviews), and coding subjectivity (content analysis). However, these studies are retained for systematic review as they provide essential contextual and theoretical insights into EA-CE processes, which quantitative methods cannot capture. Thus, findings of these studies are retained for systematic review on the nexus between EA and CE adoption.

3. BIBLIOGRAPHIC ANALYSIS

Figure 1 shows the co-occurrence network of keywords. It shows that "CE" is a central integrating concept in the blue cluster, which links "sustainable reporting", "business model", "supply chain", and "AI" within the same blue cluster. It shows that the technical aspects of sustainable reporting in the business model which are supporting CE concept. In the green cluster, "EA" is a dominant node, which links "innovation", "eco-innovation", "environmental planning", "resource-based view", and "corporate finance" within the same green cluster. In the red cluster, "environmental management" is the largest node, which links "environmental management accounting", "sustainable development goals", "energy utilization", "material flows", "flow cost", "waste management", and "recycling". Thus, this cluster connects environmental management with many sustainability and EA practices, which shows the motivation of firms toward sustainable practices in operation and accounting systems. In the yellow cluster, sustainability is the largest node, which links "CSR", "ESG", "sustainable accounting", and "green economy". Thus, sustainability is achieved and motivated by CSR, ESG, and sustainable accounting concepts. Overall, Figure 1 demonstrates a shift from traditional environmental costing to a more integrated, governance-oriented, and strategically entrenched approach to EA in the CE framework.

Figure 2 presents a bibliographic coupling network of journals. In the red cluster, "Sustainability (Switzerland)" is in a central node, which suggests that it publishes influential work in EA and CE. Moreover, it is strongly linked with "CE and Sustainability Reporting" in the same red cluster. In the orange cluster, the most prominent journal is "Journal of CP", which is linked with "Discover Sustainability" in the same cluster. In the brown cluster, "Business Strategy and the Environment" is found as the most influential journal. In the green cluster, "Revista de Contabilidad" is the most influential journal, which is also linked with "Accounting, Auditing and Accountability" in the same cluster. In the yellow cluster, "Resources, Conservation and Recycling" is in the central place and linking with "European Business Review" in the same cluster. Some other journals are also prominent in blue and purple clusters. Overall, Figure 2 shows the interdisciplinary nature of CE and EA topics, which are linked with environmental science, accounting, and management disciplines.

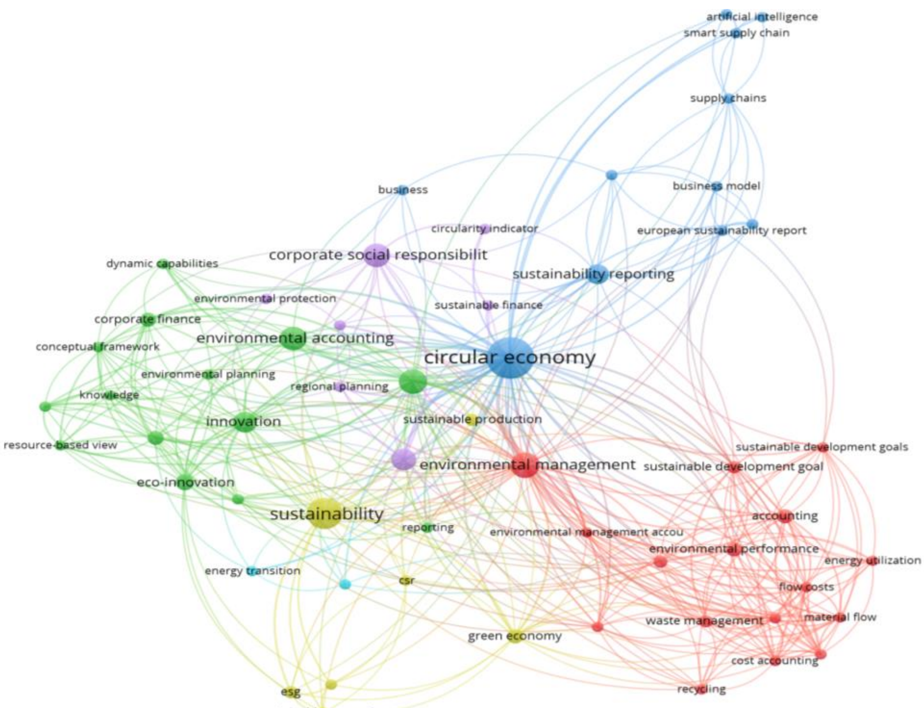

Figure 1. Co-occurrence of keywords

Figure 3 explains a bibliographic coupling network of research organizations. The most central and largest node shows "Department of Accounting and Finance" in an aqua green cluster, which is a key hub of intellectual activity in CE and EA disciplines. It is linking "Department of Accounting" in green and blue clusters, "KU Leuven (Belgium)" in orange cluster, "BML Munjal University" in brown cluster, "Center for Environmental and Sustainability Studies" in purple cluster, and many other institutions in other clusters. Overall, Figure 3 reveals interconnected global research in terms of shared citation practices, which reflects growing institutional collaboration in CE and EA disciplines.

Figure 4 shows the bibliographic coupling network of countries. In the aqua green cluster, "Spain" is in a central hub, which is shaping key ideas in CE and EA domains with publication and citation practices. It is linked with "China" and "United States" in the same cluster, "India" in the blue cluster, "United Kingdom" in the orange cluster, "Belgium" in the purple cluster, "Bangladesh" in the yellow cluster, and "Palestine" in the red cluster. Overall, Figure 4 shows a global distribution of EA and CE literature and its citation practices.

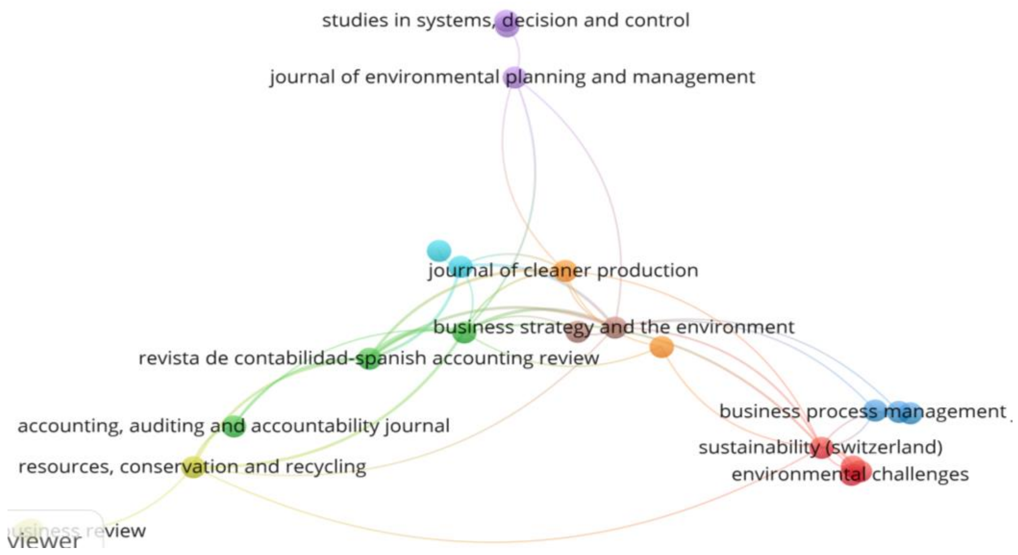

Figure 2. Bibliographic coupling of journals

Figure 3. Bibliographic coupling of organizations

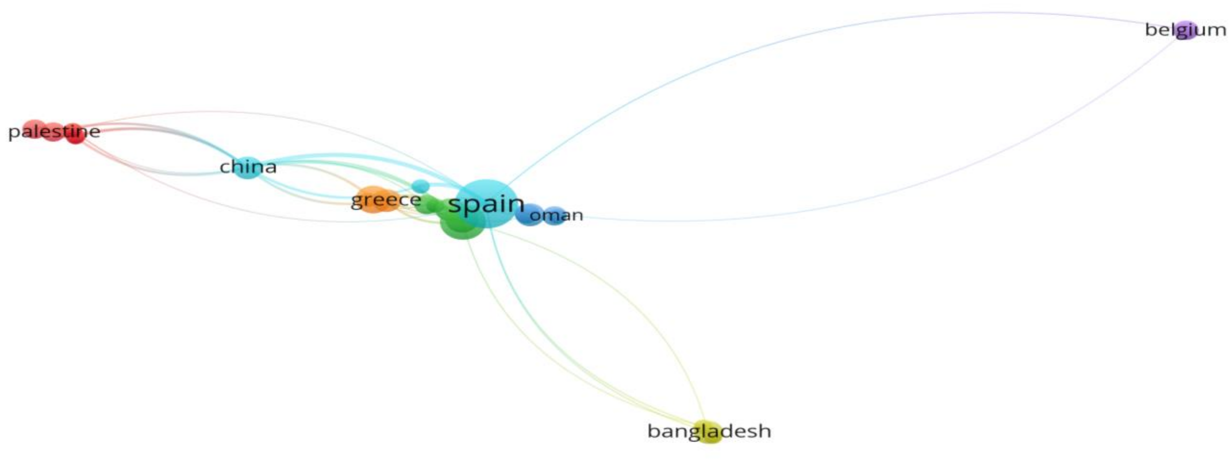

Figure 4. Bibliographic coupling country

4. LITERATURE SURVEY

EA, corporate sustainability, and CE practices are modern business strategies that facilitate firms to assimilate ecological reporting with financial performance. In this regard, LCA, MFCA, and AI-driven systems may optimize resources, internalize ecological costs, and enhance transparency. Due to multiple drivers of CE practices, the literature is divided into four subsections. In the Appendix, Table A1 presents the definitions and conceptual boundaries of the key terms used in this review.

4.1 Environmental accounting, corporate sustainability, and circular economy practices

EA is the most effective tool in integrating sustainability into corporate strategy. The literature has identified that EA helps firms to internalize ecological costs and enhances profitability. For instance, Fogarassy et al. [1] investigated the cement industry and found that internalizing environmental costs improved the nexus between corporate strategy and sustainable practices. Moreover, Tadic et al. [14] examined firms in the UAE and found that counting ecological footprint and LCA improved the measurement of corporate sustainability. However, methodological gaps were reported in tracking indirect ecological impacts. John and Mishra [15] explored the Indian corporate sector. The authors found that EA and reporting enhanced ecological benefits, which also supported strategic decisions.

The literature has also investigated the effect of technology on EA and CE aspects. For instance, Kumar et al. [2] investigated the manufacturing sector. The authors found that AI improved reporting, decision-making, and resource utilization in production. Thus, AI helped firms to apply CE codes. Similarly, Zhen and Rahman [16] analyzed manufacturing firms. The authors found that EA with green financing tools positively mediated ESG enactment. Thus, it ensured that business activities were associated with ecological benefits. Moreover, EA enhanced financial benefits. Aranda-Usón et al. [5] examined SMEs and found that MFCA supported CE adoption. Thus, EA supported sustainability in small business operations.

In sector-specific studies, Ardini and Fahlevi [8] investigated the healthcare sector. The authors found that CA improved green Supply Chain Management (SCM). Consequently, green SCM helped improve operational productivity. Mondal et al. [9] investigated the textile industry. The authors found that ecological reporting and carbon counting positively mediated the nexus between sustainable production and the financial soundness of firms. Sklavos et al. [10] examined Greek agri-food SMEs. The authors found that digitalization and management competencies improved CE adoption. Badroos [11] investigated Industry 4.0 technologies, which improved EMA and supported strategic targets of Sustainable Development Goals (SDG).

Some studies also focused on the methodological innovation in EA and CE applications. For instance, Nishitani et al. [17] investigated manufacturing firms. The authors showed that MFCA reduced energy usage and CO2 emissions. Moreover, it improved the productivity and profitability of firms. Jesse et al. [3] examined global SCM. The authors found that AI in the EA system tracked emissions in global supply chains. Moreover, AI has also improved transparency and stakeholder collaboration. Marco-Fondevila et al. [6] investigated the banking sector. The authors found that CE-based accounting supported strategic financial decisions. It also enhanced servitization-based sustainability strategies. Caccialanza et al. [12] investigated the Italian food sector. The authors found the pleasant effects of supply-chain ecological disclosure on CE adoption. However, the authors suggested that firms with weak ecological and governance aspects needed emphasis on ESG indicators collectively.

Diaz-Gil [13] conducted a multi-sector analysis and found gaps in CE reporting in different sectors. In some sectors, firms neglected disclosures, standardization, and the adoption of green technologies. However, the author also stated that adopting these practices might enhance the competitiveness and reputation of firms. Aranda-Usón et al. [18] investigated Spanish firms. The authors found that CE was followed without fully closed material loops. However, EMA supported firms to monitor these initiatives. Thus, EMA helped gauge material flows and stakeholders' informed CE progress. Moreover, territorial policies enhanced firms' intentions in adopting CE practices. Barratt [4] conducted a cross-sector study and found that education and training buoyed with digital learning and ecological legislation improved CP processes, which also improved reporting quality. This finding suggested that knowledge management and skill development helped firms enhance ecological performance.

In the cross-sectoral analysis, Hens et al. [19] investigated cross-sector firms and found that CP practices improved ecological efficiency by focusing on human rights, business ethics, and community engagement, which helped achieve CSR responsibilities. Modern accounting techniques also helped adopt CE practices. Tuccio et al. [20] investigated waste and e-waste sectors and found that mass balance analysis in these sectors helped achieve ecological benefits along with economic performance. Thus, it supported adaptive management and recovery of secondary raw materials. In cross-sectoral analysis, Wolters [21] investigated CE and EMA practices in a sustainable value-creation framework. The author advocated transformative strategies to address ecological concerns in business decisions.

Table 2 shows the summary of findings of studies in this subsection. EA, EMA, MFCA, LCA, and CA were the tools applied by 12 studies, 2 studies, 2 studies, 1 study, and 3 studies, respectively. EA tools are predominantly helpful in adopting CE and sustainability practices. However, the strength and direction of this relationship vary across contexts. For instance, 16 studies report a direct positive association between EA tools and CE adoption or sustainability performance. However, 4 studies discussed the role of internal and external factors. For instance, digitalization, human capital, and managerial competencies were internal factors in 3 studies, which moderated the EA-CE nexus. Moreover, Zhen and Rahman [16] reported the role of green financing as an external enabler in this relationship. Some studies reported contradictions or conditional findings, which depend on sectoral or firm-specific factors. In the sectoral differences, the manufacturing sector showed stronger EA-CE linkages compared to the service sector. In firm size analysis, SMEs face greater challenges in implementing EA systems compared to large firms. Regional policy environments also affected the relationship. For instance, EU-based studies showed more positive effects compared to studies in emerging economies.

Some studies also identify persistent gaps or limitations in CE adoption. For instance, Tadic et al. [14] found that methodological gaps persisted in tracking indirect and supply-chain environmental impacts. Moreover, Diaz-Gil [13] mentioned gaps in standardization, monetization, and technology adoption. In tool type mapping, MFCA is consistently associated with reduced energy use, lower emissions, and improved profitability. Moreover, AI-enabled systems enhance transparency, resource optimization, and CE implementation. Besides, CA and sustainability reporting have positive effects on financial performance through sustainable production. Thus, different tools enhance different CE practices.

Table 2. Environmental accounting, corporate sustainability, and circular economy practices

Study	Method	Sample	Relationship Type	Key Findings
Fogarassy et al. [1]	PLS-SEM	Hungary Cement industry	Direct (EA → financial performance)	Internalizing environmental costs strengthens alignment between corporate strategy and sustainability, which improves environmental and financial performance.
Tadic et al. [14]	PLS-SEM	UAE (multi-sector)	Direct (EA → sustainability measurement)	EA tools improve sustainability measurement. However, limitations persist in capturing indirect and supply-chain environmental impacts.
John and Mishra [15]	PLS-SEM	Indian Corporate Sector	Direct (EA → strategic decision-making)	Reliable green accounting and transparent reporting enhance environmental management effectiveness and support strategic decision-making.
Kumar et al. [2]	Fuzzy-DEMATEL	Manufacturing and operations	Direct (AI → CE implementation)	AI-enabled systems enhance transparency, real-time control, and resource efficiency, which facilitate effective CE implementation.
Aranda-Usón et al. [5]	PLS-SEM	Spanish SMEs	Direct (MFCA → CE operationalization)	Simplified MFCA tools enable SMEs to operationalize CE principles.
Zhen and Rahman [16]	PLS-SEM	Bangladeshi Manufacturing Firms	Mediation (green financing → ESG via sustainable production)	Green financing mediates the EA and ESG relationship.
Ardini and Fahlevi [8]	PLS-SEM	Indonesian Healthcare Sector	Moderation (EA → green SCM → firm performance)	EA strengthens green SCM, which improves regulatory compliance and operational efficiency.
Mondal et al. [9]	PLS-SEM, fsQCA, NCA	Bangladeshi Textile Industry	Mediation (EA → financial performance via sustainable production)	Carbon accounting (CA) and sustainability reporting positively affect financial performance through sustainable production practices.
Sklavos et al. [10]	PLS-SEM	Greece Agri-food SMEs	Moderation (digitalization & competencies → EA → CE adoption)	Digitalization and managerial competencies enable CE adoption and the effective usage of EA tools.
Badroos [11]	AHP	Egyptian Industry 4.0 firms	Direct (Industry 4.0 → EMA and SDGs)	Industry 4.0 technologies enhance EMA effectiveness and support SDG-oriented sustainability outcomes.
Nishitani et al. [17]	Two-stage regression	Japanese Manufacturing	Direct (MFCA → environmental performance)	MFCA reduces energy use and emissions, which also improves productivity and profitability.
Jesse et al. [3]	Machine learning design	Global supply chains	Direct (AI → emissions tracking and CE)	AI-driven accounting networks enhance emissions tracking, transparency, and stakeholder coordination in supply chains.
Marco-Fondevila et al. [6]	PLS-SEM	Spanish Financial institutions	Direct (CE accounting → financial decision-making)	CE-oriented accounting metrics support financial decision-making and promote servitization-based sustainability strategies.
Aranda-Usón et al. [18]	PLS-SEM	Spanish firms	Direct (EMA → CE monitoring)	Firms adopt CE practices incrementally. EMA enables monitoring of material flows and communication of progress.
Barratt [4]	PLS-SEM	UK Cross-sector	Direct (education → CP adoption)	Education, training, and digital learning platforms enhance CP adoption and reporting quality.
Caccialanza et al. [12]	PLS-SEM	Italian food sector	Direct (supply-chain disclosure → CE)	Supply-chain disclosure contrasts with weaker environmental and governance reporting.
Diaz-Gil [13]	PICOT	Colombia Multi-sector	Direct (social accounting → business model)	Persistent gaps in standardization, monetization, and technology adoption limit the effectiveness of CE-related disclosures.
Hens et al. [19]	PLS-SEM	Cross-sector	Direct (CP evolution → sustainability framework)	CP has evolved toward an integrated sustainability framework incorporating CSR, ethics, and social responsibility.
Tuccio et al. [20]	PLS-SEM	Italian Waste and e-waste sectors	Direct (mass balance → ecological and economic performance)	Mass balance accounting links ecological outcomes with economic performance, which supports adaptive and circular resource management.
Wolters [21]	PLS-SEM	Cross-sector	Direct (EA & CE → value creation)	EA and CE are core strategic tools for embedding sustainability into value creation and decision-making.

Note: PICOT = Population, Intervention, Comparison, Outcome, Time

4.2 Circular economy adoption through managerial, technological, and eco-innovation

CE principles can be integrated with corporate strategies to shift from resource-intensive operations toward regenerative systems, which can optimize resource efficiency and sustainability. In this regard, managerial practices and technological capabilities can play a major role in CE adoption. For instance, Aureli et al. [22] analyzed packaging companies and found that managers had adopted informal accounting procedures and life cycle analyses instead of formal management accounting procedures. This approach improved multi-stakeholder engagement, which supported resource optimization. Thus, CE adoption was enhanced by practical learning instead of outdated accounting procedures. Zaid et al. [23] examined Australian firms. The authors found that green innovation improved environmental performance. It also mediated capital structure decisions, which indicated that innovation improved operational efficiency and risk management.

Table 3. Circular economy (CE) adoption through managerial, technological, and eco-innovation (EI)

Study	Method	Sample	Relationship Type	Key Findings
Aureli et al. [22]	PLS-SEM	Italian Packaging firms	Direct (Informal accounting → CE adoption)	CE adoption relies on informal, dialogic accounting and life cycle analysis instead of formal accounting systems, which improved stakeholder engagement and adaptive learning.
Llena-Macarulla et al. [24]	PLS-SEM	Spanish firms	Direct (EMA → CE activity)	CE practices are adopted incrementally. EMA is positively associated with CE activity, but standardized metrics for material-loop closure remain underdeveloped.
Zaid et al. [23]	GMM	Australian firms	Mediation (green innovation → capital structure via environmental performance)	Green innovation improves environmental performance, which mediates its impact on capital structure and financial risk decisions.
Scarpellini et al. [25]	PLS-SEM	Spanish Multi-sector firms	Moderation (circular eco-innovation → dynamic capabilities → CE)	Circular eco-innovation strengthens dynamic capabilities, which improve internal controls, monitoring systems, and systematic CE implementation.
Panori et al. [26]	Scoring system based on GRI	Forest companies	Direct (CE practices → revenue performance)	CE practices are positively associated with revenue performance despite widespread early-stage adoption.
Zaid and Issa [27]	Regression, IV	Australian Corporate firms	Moderation (board committees → eco-innovation → carbon performance)	Board-level governance mechanisms reinforce the eco-innovation and carbon performance linkages.
Holwerda et al. [28]	PLS-SEM	Dutch Infrastructure-intensive industries	Direct (incremental interventions → CE action)	CE implementation requires incremental and context-specific strategies due to technological and infrastructure constraints.
Aranda-Usón et al. [29]	PLS-SEM	Spanish firms	Direct (regional policies → CE adoption)	Regional policy frameworks, financial resources, and local infrastructure facilitate CE adoption.
Opferkuch et al. [30]	Qualitative (content analysis)	European firms	Direct (CE reporting → accountability)	Few firms systematically integrate CE into sustainability reports, which indicates weak accountability and limited transparency.
Ortega-Lapiedra et al. [31]	PLS-SEM	Spanish Multi-sector firms	Direct (human capital → eco-innovation effectiveness)	Human capital and applied knowledge significantly influence eco-innovation effectiveness and sustainability outcomes.
Ivashura et al. [32]	PLS-SEM	Firms in Ukraine	Direct (Clustering → eco-innovation success)	Clustering sustainable production and consumption initiatives accelerates CE adoption through technology diffusion and collaboration.
Llera-Sastresa et al. [33]	PLS-SEM	Spanish Energy Sector	Direct (renewables → CE barriers)	Integrating renewables and carbon utilization into CE frameworks faces socio-economic barriers, which require supportive policies.

Note: GMM = Generalized Method of Moments; IV = Instrumental Variable

Llena-Macarulla et al. [24] investigated Spanish firms and found that CE practices were adopted differently in different companies. Moreover, the correlation between CE activities and EMA was positive with robust Environmental Management Systems (EMS) and transparent reporting. However, the lack of indicators to track material-loop closure reduced the transformation of CE principles into operational processes. Scarpellini et al. [25] investigated multi-sector firms and found that EI with circular business models improved internal environmental capabilities. Moreover, the adoption of circular eco-innovations improved resource management systems, which also improved monitoring mechanisms. Panori et al. [26] examined cross-sector firms by classifying them into pioneers, laggards, innovators, and infants. The authors found that firms applying CE practices improved revenue generation. Thus, CE adoption improved the ecological and financial value of firms.

Zaid and Issa [27] investigated corporate firms and found that active board sub-committees improved the association between EI and carbon performance. Thus, organizational oversight improved the application of CE initiatives. Holwerda et al. [28] explored infrastructure-intensive industries and found the limited role of incremental and context-specific interventions in CE adoption, technological, and infrastructure constraints. Aranda-Usón et al. [29] examined Spanish firms and found that regional policy support, local infrastructure, and financial resources improved CE adoption. Opferkuch et al. [30] analyzed European firms, and few firms integrated CE into sustainability reports, which corroborated weak accountability and limited transparency.

Ortega-Lapiedra et al. [31] examined multi-sector firms. The authors found that the application of knowledge into eco-innovative processes improved ecological performance. Ivashura et al. [32] investigated the firms in Ukraine and found that clustering production and consumption sustainable initiatives improved technology deployment and stakeholder engagement in CE practices. Llera-Sastresa et al. [33] examined energy sector. The authors found that renewable energy and low-carbon technologies faced socio-economic barriers in circular frameworks. This finding suggested a need for supportive policies in the adoption of CE codes.

Table 3 shows a summary of studies in this subsection. EA, EMA, LCA, and CA were the tools applied by 11 studies, 3 studies, 1 study, and 1 study, respectively. CE adoption and corporate eco-innovation are influenced by managerial practices, knowledge, governance, and technological capabilities. 12 studies reported direct positive relationships between managerial/technological factors and CE adoption or EI effectiveness. However, 4 studies found the mediation and moderation effects. For instance, board-level governance mechanisms, human capital, EI, and technology diffusion and collaboration served as internal factors to improve the EA-CE nexus in 4 studies.

The literature has also reported some contradictions and limitations in the use of CE. For instance, Llena-Macarulla et al. [24] found that standardized metrics for material-loop closure remain underdeveloped. Holwerda et al. [28] demonstrated that CE implementation faced technological and infrastructure constraints. Opferkuch et al. [30] reported weak accountability and limited transparency. Llera-Sastresa et al. [33] reported that CE frameworks faced socio-economic barriers. Moreover, the strength of these relationships varies across contexts, firm types, and reporting practices. For instance, older and larger firms demonstrated better reporting quality, and infrastructure-intensive industries faced technological constraints compared to service sectors.

4.3 Regulatory, policy, and reporting frameworks for circular economy transitions

Regulatory, policy, and reporting also influence CE adoption. The literature exposes that regulatory pressure and incentives can encourage CE adoption. For instance, Blum-Kusterer and Hussain [34] investigated manufacturing firms and found that regulatory fears improved eco-adoption. However, stakeholder engagement was a weak factor. The authors showed that EI was influenced by the experience of procedures. Opferkuch et al. [35] examined European firms. The authors found gaps between firms' CE adoption and reporting. For instance, reporting CE without using homogeneous indicators reduced the trustworthiness of disclosures for investors and regulators.

Hahladakis [7] investigated Qatari firms and established that renewable energy usage, waste management, and green procurement improved the ecological benefits. Tsalidis et al. [36] analyzed Greek and Dutch firms and reported that life cycle evaluation with input-output methods identified social risks. This practice supported compliance with regulations with the help of the Corporate Sustainability Reporting Directive (CSRD). Thus, it improved the linkages between government regulations and factual ecological disclosures. Badrous et al. [37] analyzed the banking sector. The authors found that fintech improved green banking, CE adoption, and ecological benefits. Arimany Serrat et al. [38] investigated fashion firms and stated that European Sustainability Reporting Standards (ESRS) and CSRD improved transparency in reporting. However, some firms also faced operational challenges.

Opferkuch et al. [39] explored European firms and reported that CE disclosure improved in these firms. However, its uniformity remained weak in different sectors. Thus, it reduced cross-sector comparisons. Falkenberg et al. [40] re-examined European companies. The authors found that initial adoption of CE reporting resulted in inconsistent disclosures. It reduced standardization in the early phase of CE adoption. Wulansari and Adhariani [41] investigated Indonesian firms and corroborated that waste disclosures improved CSR with reporting quality. However, foreign ownership could not enhance reporting quality. Scarpellini [42] stated that social aspects in CE accounting highlighted the importance of a triple-bottom-line methodology. It integrated environmental, social, and economic aspects. Oliveira et al. [43] analyzed multi-stakeholder systems. The authors found that multi-dimensional evaluation methods helped evaluate CE transitions. Sanches et al. [44] examined Brazilian multinational companies. The authors found that structured process mechanisms with support of regulatory acquiescence, reporting standards, and internal factors of firms supported CE adoption.

Table 4 shows a summary of studies in this subsection. EA and LCA were the tools applied by 13 studies and 1 study, respectively. Regulatory measures, policies, and reporting mechanisms significantly influence CE adoption. 13 studies found a direct link between policy frameworks and CE adoption. However, Badrous et al. [37] found the mediating role of Fintech in improving green accounting practices, which enhanced the environmental performance of the financial sector. Out of 14, 9 studies reported positive direct effects of regulatory pressure or reporting frameworks on CE-related outcomes. Regulatory pressures (e.g., CSRD, ESRS, EU Taxonomy, etc.) as external factors were the most frequently cited driver, which improved transparency and accountability and were a primary enabler of EI and CE disclosure. However, internal financial resources were more prominent in advancing CE implementation in 3 studies.

Some studies also provided contradictions and limitations of regulatory policies. These issues created a gap between policy intent and implementation outcomes, mainly due to challenges in standardization, transparency, and comparability. For instance, Opferkuch et al. [35] found a substantial gap between actual CE adoption and reported information due to generic and non-standardized disclosures. Opferkuch et al. [39] showed that harmonization of CE disclosure remained weak. Moreover, the lack of harmonized metrics across firms and sectors reduced comparability among different sectors. For instance, in sectoral analysis, the financial and manufacturing sectors showed better compliance compared to the agri-food and fashion sectors. Additionally, the literature identified the role of regulatory maturity. For instance, EU-based studies showed stronger positive effects compared to emerging economies. In temporal analysis, Falkenberg et al. [40] identified that early-stage adoption of reporting frameworks resulted in inconsistent CE disclosure. In ownership analysis, Wulansari and Adhariani [41] found that foreign ownership could not enhance reporting quality. Overall, the literature corroborated that regulatory frameworks for CE adoption were constrained due to weak standardization, inconsistent disclosure practices, and varying institutional maturity, which were responsible for a persistent gap between policy objectives and actual CE adoption across sectors and regions.

Table 4. Regulatory, policy, and reporting mechanisms in sustainability circular economy **(**CE) adoption

Study	Method	Sample	Relationship Type	Key Findings
Blum-Kusterer and Hussain [34]	PLS-SEM	German and UK Manufacturing firms	Direct (regulation → eco-innovation)	Regulatory pressure is the primary driver of eco-innovation.
Opferkuch et al. [35]	Qualitative (content analysis)	European firms	Direct (CE reporting → credibility)	A significant gap exists between actual CE adoption and reported information. Disclosures are generic, non-standardized, and limit comparability and credibility.
Hahladakis [7]	Qualitative (case study)	Firms in Qatar	Direct (renewable energy & waste reforms → SDG12)	Renewable energy, waste reforms, and sustainable procurement policies align economic growth with responsible consumption and production.
Tsalidis et al. [36]	S-LCA with PSILCA	Greek and Dutch firms	Direct (social LCA → CSRD compliance)	Integrating social LCA with input-output analysis strengthens compliance with CSRD sustainability directives.
Badrous et al. [37]	PLS-SEM	Middle East Financial Sector	Mediation (fintech → BEP via green accounting practices)	Fintech adoption enhances green banking performance, which supports CE initiatives and improves environmental outcomes.
Arimany Serrat et al. [38]	PLS-SEM	European Fashion Industry	Direct (ESRS/CSRD alignment → transparency)	Alignment with ESRS and CSRD improves transparency and sustainability reporting.
Opferkuch et al. [39]	Qualitative (semi-structured interviews and focus groups)	Italian and Dutch firms	Direct (CE disclosure → comparability)	CE disclosure is improving, but harmonization remains weak. Thus, cross-sector comparability is limited.
Falkenberg et al. [40]	Qualitative (content analysis, semi-structured interviews)	European companies (agri-food sector)	Direct (early-stage reporting → inconsistency)	Early-stage adoption of reporting frameworks results in inconsistent CE disclosure and limited standardization.
Wulansari and Adhariani [41]	Regression analysis	Indonesian firms	Direct (waste disclosure → accountability)	Waste disclosure improves accountability. However, foreign ownership does not significantly enhance reporting quality.
Oliveira et al. [43]	PLS-SEM	Multi-stakeholder systems	Direct (multi-dimensional evaluation → CE transition assessment)	Multi-dimensional and stakeholder-based evaluation methods are essential for assessing CE transitions effectively.
Sanches et al. [44]	Qualitative (content analysis)	Brazilian multinational firms	Direct (structured frameworks → CE implementation)	Structured process frameworks combining regulatory compliance, reporting standards, and internal alignment support CE implementation.

Note: S-LCA = Social Life Cycle Assessment; PSILCA = Product Social Impact Life Cycle Assessment; BEP = Banks' Environmental Performance.

4.4 Strategic and financial implications of sustainability integration

The literature also works on strategic aspects of sustainability initiatives, which help in achieving financial, ecological, and operational benefits. Oh [45] investigated public firms. The authors found that firms' CSR practices, by adopting environmental standards, helped improve firm valuation. Thus, ethical and sustainable practices improved market performance and investor confidence. Weston and Nnadi [46] examined Principles for Responsible Investment (PRI)-signatory firms. The authors found that PRI procedures improved financial indicators. It corroborated that firms' ESG indicators enhanced financial returns. Divyam et al. [47] analyzed the retail sector. The authors explored the strategic role of technology, stakeholders, and SDGs in CSR and corroborated that ecological assessments in operations and SCM improved the competitive advantage of firms.

Rodrigues et al. [48] examined poultry value chains and proved that EMA facilitated ecological control in vertical value chains, which helped in decision-making by using ecological, managerial, and financial information. Appannan et al. [49] explored manufacturing firms. The authors found that EMA positively mediated the effect of clean technologies on ecological benefits. It corroborated that structured accounting helps to transform innovation into ecological and financial gains. Monteiro and Ribeiro [50] analyzed multi-industry firms. The authors found that EMA and CE adoption enhanced ecological benefits. However, inconsistent application in different departments reduced the effectiveness of CE practices. Fernández-Miguel et al. [51] investigated industrial supply chains and found that AI and cognitive automation improved predictive maintenance, supply chain optimization, and regulatory compliance in CE adoption. Huy and Phuc [52] investigated SMEs and found that leadership with technology was mediated by digital environment management accounting, which improved sustainable operations in SMEs.

Table 5. Strategic and financial implications of sustainability integration

Study	Method	Sample	Relationship Type	Key Findings
Oh [45]	PLS-SEM	Public firms	Direct (CSR alignment → firm valuation)	Alignment of CSR with environmental standards increases firm valuation, which indicates positive market and investor responses to sustainability.
Weston and Nnadi [46]	PLS-SEM	PRI-signatory firms	Direct (PRI adoption → financial metrics)	PRI is associated with superior financial metrics and long-term value creation.
Divyam et al. [47]	Bibliometric analysis using R)	Retail sector	Direct (technology & stakeholder collaboration → competitive advantage)	Technology adoption, stakeholder collaboration, and alignment with SDG and CSRD enable sustainability-driven competitive advantage.
Rodrigues et al. [48]	Qualitative (case study)	Brazilian Poultry value chains	Direct (EMA → ecological control & decision-making)	EMA integrates environmental, managerial, and financial data, which strengthens ecological control and decision-making efficiency.
Appannan et al. [49]	PLS-SEM	Malaysian Manufacturing firms	Mediation (clean technologies → environmental performance via EMA)	EMA mediates the impact of clean technologies on environmental performance, which translates innovation into measurable outcomes.
Monteiro and Ribeiro [50]	Qualitative (case study)	Portugal Multi-industry firms	Direct (EMA & CE consistency → environmental performance)	Consistent application of EMA and CE practices improves environmental performance. Fragmented adoption reduces effectiveness.
Fernández-Miguel et al. [51]	PLS-SEM	Spanish Industrial supply chains (ceramic industry)	Direct (AI-driven systems → CE implementation)	AI-driven systems enhance predictive maintenance, supply chain optimization, regulatory compliance, and CE implementation.
Huy and Phuc [52]	CB-SEM and PLS-SEM	Vietnam SMEs	Mediation (technologically vigilant leadership → sustainable performance via digital EMA)	Technologically vigilant leadership is mediated by digital EMA, which strengthens sustainable operational performance.

Note: CB-SEM = Covariance-Based Structural Equation Modeling

Table 5 summarizes the findings of studies in this subsection. EA, EMA, and CA were the tools applied by 3 studies, 4 studies, and 1 study, respectively. Combining sustainability and CE principles generated positive strategic and financial outcomes for firms. 7 studies reported a positive association between sustainability integration (EMA, CE, CSR, ESG) and financial or strategic performance. Moreover, 6 studies reported that the direct effect of CSR alignment, PRI adoption, technology-stakeholder collaboration, EMA integration, and AI-driven systems is consistent with EMA-CE application on firm valuation, financial metrics, competitive advantage, ecological control, or environmental performance. In testing the indirect effects, Appannan et al. [49] demonstrated that EMA mediated the impact of clean technologies on environmental performance. Moreover, Huy and Phuc [52] showed that digital EMA mediated technologically vigilant leadership to strengthen sustainable operational performance.

In a contradictory finding, Monteiro and Ribeiro [50] reported that fragmented adoption reduced effectiveness. Thus, fragmented adoption failed to create the synergies for environmental performance improvements, which corroborated that the benefits of sustainability integration could only be achieved with organization-wide commitment.

5. DISCUSSIONS

The literature shows that firms improve sustainability through EA, CE adoption, corporate EI, regulatory frameworks, and the strategic and financial efforts for sustainability and firm value. In different industries and sectors, EA is a compliance tool and also a strategic enabler, which combines sustainability and financial goals in corporate decision-making. Adopting EA practices internalizes environmental costs, which optimizes resource usage, reduces costs, and helps in revenue generation. Thus, it helps improve both ecological and economic performance. Particularly, LCA and CA to MFCA, and AI systems are important tools to quantify ecological impacts and resource utilization as per sustainability initiatives.

Technological innovation also helps improve the operational effectiveness of EA and CE practices. Thus, AI, digital monitoring systems, and Industry 4.0 technologies support firms in collecting and analyzing ecological and operational data. This data improves decision-making and optimizes resource flows. Thus, digitalization supports environmental management, which helps firms operationalize CE activities of waste reduction, resource recovery, and sustainable SCM. Moreover, methodological innovations of AI-based circularity accounting networks also improve transparency, which helps in tracking emissions. It also supports operational execution, strategic planning, and financial performance. Corporate EI is an effective driver of CE adoption. It combines eco-innovative processes and operational and strategic frameworks, which support internal ecological control, monitoring systems, and a feedback loop among innovation, ecological performance, and financial outcomes. Moreover, firms' experience and knowledge improve the effectiveness of sustainability initiatives. Active board oversight and cross-functional coordination also align ecological objectives with strategic decision-making.

The adoption of CE practices is also influenced by sector-specific conditions and firm capabilities. In the early stages of

CE, Firms mostly could not achieve full material-loop closure. It is because of the difficulty in transitioning from linear production systems to regenerative business models. However, human capital helps overcome these challenges. Thus, knowledge, skills, and managerial competencies support CP practices and CE initiatives. In this regard, learning, training, and knowledge management improve sustainability in operational activities and EI benefits. Regulatory and policy frameworks are external factors of sustainability and CE adoption, which can help uniform reporting standards and structured measurement frameworks to support transparency, stakeholder trust, and investment decisions.

The institutional, social, and economic infrastructures can support regional policies for waste management systems and renewable energy usage. Moreover, the financial sector can provide monetary resources to firms for applying modern CE practices. Moreover, CSR, ESG, and CE goals combined with business strategies support value, revenue, and financial risk management of firms. Moreover, EMA can mediate this process by linking EI and financial and operational performance. EA can provide reliable information to optimize resource allocation, supply chain efficiency, and strategic planning. Moreover, AI systems and operational monitoring can improve these benefits.

The literature also identifies some gaps and challenges in CE adoption. For instance, some firms face difficulties in closing material loops and standardizing CE metrics. Moreover, sector- and firm-specific incapability also results in unequal adoption of CE. Thus, firms remain in their early stages of implementation, and such reporting gaps reduce the ability of stakeholders to estimate the effect of sustainability initiatives. Furthermore, the effectiveness of EI and CE practices depends on human capital, managerial expertise, and financial capacity of firms. Thus, the internal capacity of firms is necessary to translate CE adoption into ecological benefits. However, firms' lower capacity to implement CE practices could result in a delay in ecological outcomes.

5.1 Integrated conceptual framework

Figure 5 shows an integrated conceptual framework, which synthesizes the key pathways and moderating relationships as per the findings of the reviewed studies. In the first stage, EA tools (CA, EMA, MFCA, and LCA) flow into two primary governance mechanisms (Internal Control Systems and Strategic Alignment). Among these, EMA demonstrates the strongest connection to governance. Thus, EMA is the most established EA tool. On the other hand, EMA shows a weak connection, which corroborates that the EMA system for EA is not fully integrated into governance frameworks.

In the second stage of the framework, governance mechanisms (Internal Control Systems and Strategic Alignment) flow into two CE adoption dimensions (Resource Optimization and Material Flow Tracking). Comparatively, Internal Control Systems show a slightly stronger influence on CE adoption compared to strategic alignment. Thus, formal control mechanisms (EMS, internal audits, and compliance protocols) play a more direct role in enabling CE practices compared to high-level strategic alignment alone.

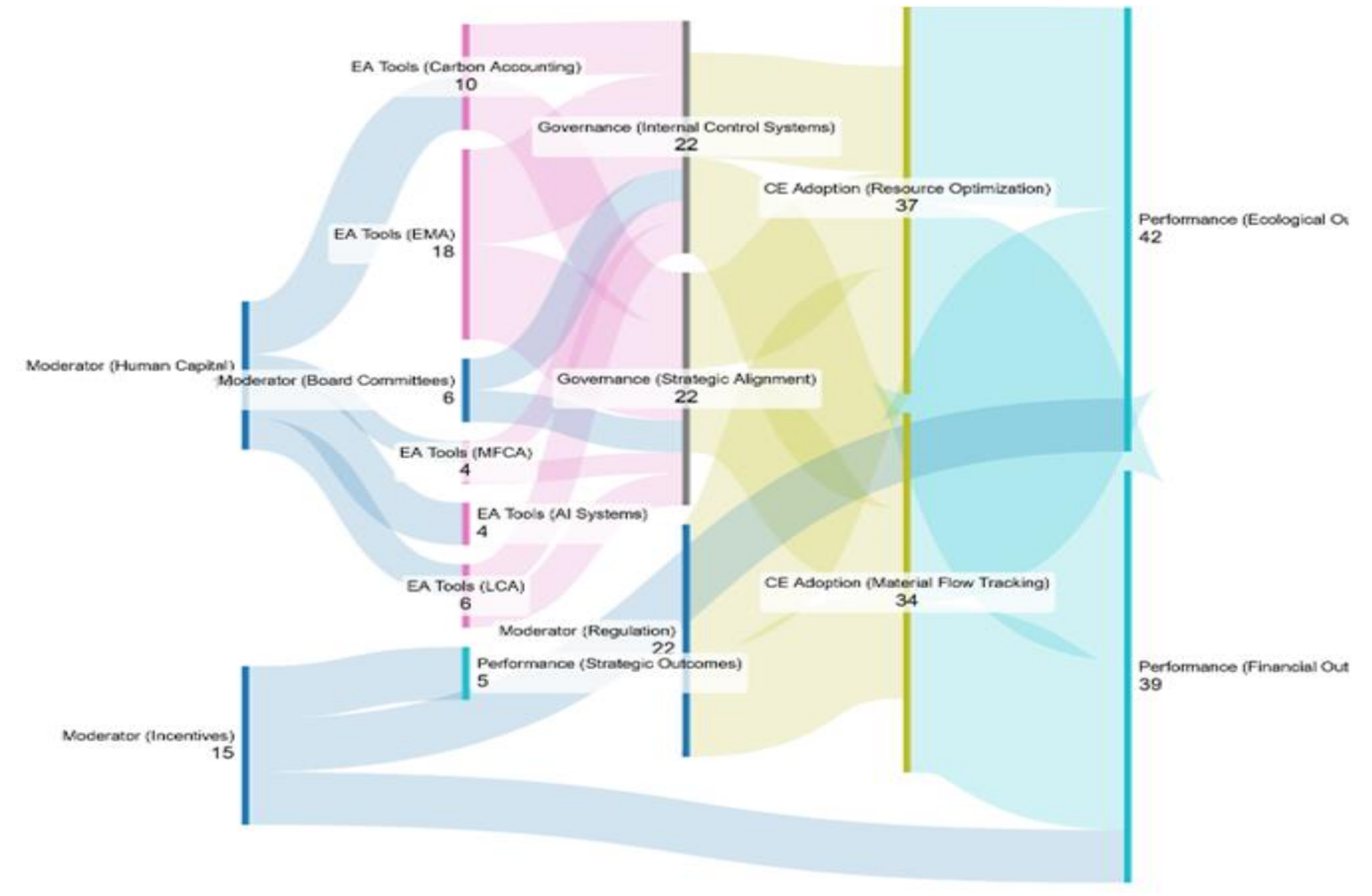

Figure 5. Integrated EA-CE conceptual model

The third stage shows the role of CE adoption in determining organizational performance outcomes. CE adoptions (Resource Optimization and Material Flow Tracking) flow into two performance dimensions (Ecological Outcomes and Financial Outcomes). Thus, CE adoption significantly determines the real ecological and financial.

Figure 5 also shows the role of four moderators in each stage of the model. Human capital (workforce skills, knowledge, and expertise) moderates the first stage by strengthening the adoption and effective use of all EA tools. Moreover, board committees moderate the two indicators of governance, which corroborates an important role of board-level oversight and sustainability committees to enhance the effectiveness of internal control systems and strategic alignment. In addition, regulatory pressure moderates the CE adoption, which shows a strong accelerating effect of environmental regulations, reporting mandates, and compliance requirements on CE implementation. Finally, incentives (subsidies and tax benefits, incentives, and non-financial incentives) moderate the ecological and financial performance. However, their effectiveness is relatively lower than that of regulatory pressure.

Collectively, this integrated conceptual framework confirms that EA tools alone are not sufficient for achieving CE performance. Rather, they must be embedded within robust governance structures and should be supported by regulatory pressure and human capital, which can improve successful CE adoption and may also improve ecological and financial performance.

6. CONCLUSION

To meet SDG and other global environmental goals, firms are extensively adopting CE practices, and the literature has investigated CE adoption with different dimensions of EA, corporate EI, regulatory frameworks, and strategic alignment. This review study explores such literature by following PRISMA guidelines and selecting 54 articles. The findings expose that EA provides the tools to measure, monitor, and internalize ecological impacts to achieve ecological and financial performance. EA, EMA, LCA, MFCA, and CA facilitate resource optimization, decision-making, and transparency of firms to apply CE principles. Moreover, EI helps in CE adoption, which can support internal ecological capabilities, monitoring and control systems, and the application of CE practices in organizational frameworks. Managerial skills and organizational learning support the effectiveness of this transition. However, sectoral differences, limited standardization of CE metrics, and inconsistent reporting are challenges in this transition. However, regulatory, policy, and reporting frameworks are external factors, which can help in consistent reporting standards. Moreover, financial incentives and regional infrastructure can further enhance CE adoption. Furthermore, human capital, technology, and governance are firms' internal factors, which help improve firms' CE adoption. Adopting ESG and CE activities can increase the ecological and financial value of firms. These also help achieve competitive advantage and revenue gains.

Based on the synthesis of 54 studies, the present study recommends that regulatory bodies should establish mandatory and standardized reporting frameworks for CE indicators, as the lack of harmonized indicators is the most frequent problem in CE adoption. Second, firms should adopt EMA, CA, LCA, and MFCA as foundational EA tools, as the literature corroborates that these are the most effective tools to link environmental performance with financial returns. Third, governments should provide financial incentives to firms adopting EA technology, as the literature showed that financial incentives are a significant enabling factor of CE adoption. Fourth, firms should invest in EI capabilities and managerial training as human capital and EI together appear to be the significant moderators. Fifth, governments should develop regional infrastructure for waste management, renewable energy, and digital monitoring systems to support CE adoption, as the literature showed that resource constraints reduced CE adoption.

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REFERENCES

[1] Fogarassy, C., Neubauer, É., Mansur, H., Tangl, A., Oláh, J., Popp, J. (2018). The main transition management issues and the effects of environmental accounting on financial performance–with focus on cement industry. Administratie si Management Public, 2018(31): 52-66. https://doi.org/10.24818/amp/2018.31-04

[2] Kumar, A., Kumar, R., Jha, A., Oberoi, S.S., Kumar, V. (2025). Harnessing artificial intelligence for operational excellence: Pathways to a circular economy. Business Process Management Journal. https://doi.org/10.1108/BPMJ-10-2024-0944

[3] Jesse, F.F., Antonin, C., Luque-Vilchez, M. (2023). A circularity accounting network: CO2 measurement along supply chains using machine learning. Revista de Contabilidad, 26: 21-33. https://doi.org/10.6018/RCSAR.564901

[4] Barratt, R.S. (2006). Meeting lifelong learning needs by distance teaching–Clean technology. Journal of Cleaner Production, 14(9-11): 906-915. https://doi.org/10.1016/j.jclepro.2005.11.050

[5] Aranda-Usón, A., Scarpellini, S., Moneva, J.M. (2024). Dynamic capabilities for a "circular accounting" and material flows in a circular economy. Resources, Conservation and Recycling, 209: 107756. https://doi.org/10.1016/j.resconrec.2024.107756

[6] Marco-Fondevila, M., Benito-Bentué, D., Scarpellini, S. (2023). "Old" financial instruments in "new" circular models: Applied environmental accounting in the banking sector for reporting in a circular economy. Revista de Contabilidad, 26: 34-45. https://doi.org/10.6018/rcsar.576251

[7] Hahladakis, J.N. (2025). From local actions to global impact: Overcoming hurdles and showcasing sustainability achievements in the implementation of SDG12. Sustainability, 17(15): 7106. https://doi.org/10.3390/su17157106

[8] Ardini, L., Fahlevi, M. (2024). Circular economy from an environmental accounting perspective: Strengthening firm performance through green supply chain management and import regulation in Indonesia's plastic

recycling industry. Uncertain Supply Chain Management, 12(3): 1633-1646. https://doi.org/10.5267/j.uscm.2024.3.017
[9] Mondal, M.S.A., Akter, N., Ibrahim, A.M. (2024). Nexus of environmental accounting, sustainable production and financial performance: An integrated analysis using PLS-SEM, fsQCA, and NCA. Environmental Challenges, 15: 100878. https://doi.org/10.1016/j.envc.2024.100878
[10] Sklavos, G., Theodossiou, G., Papanikolaou, Z., Karelakis, C., Lazarides, T. (2024). Investing the impact and the challenges of digital transformation and green entrepreneurship in Greek food industry. Intellectual Economics, 18(2): 360-383. https://doi.org/10.13165/IE-24-18-2-06
[11] Badroos, Y.M.L. (2024). A proposed hierarchical framework for prioritizing industry 4.0 technologies to improve environmental performance of manufacturing companies and environmental SDGs. Cogent Business & Management, 11(1): 2422561. https://doi.org/10.1080/23311975.2024.2422561
[12] Caccialanza, A., Sartori, A., Gubelli, S., Giannini, F.R., Capri, E. (2023). The sustainability of meat and cured meat supply chain: Where are we now? Sustainable Transition of Meat and Cured Meat Supply Chain: A Transdisciplinary Approach, pp. 223-242. https://doi.org/10.1007/978-3-031-34977-5_15
[13] Diaz-Gil, N.D. (2024). Social accounting and its effect on the corporate business model. Aibi. Revista de Investigacion Administracion e Ingenierias, 12(2): 166-179. https://doi.org/10.15649/2346030X.3224
[14] Tadic, M.D., Mathur, S., Mathur, D. (2025). Opportunities and challenges in applying environmental accounting techniques to monitor sustainability progress in UAE economy. The Paradigm Shift from a Linear Economy to a Smart Circular Economy: The Role of Artificial Intelligence-Enabled Systems, Solutions and Legislations, 586: 33-41. https://doi.org/10.1007/978-3-031-87550-2_3
[15] John, J., Mishra, R. (2025). A comprehensive analysis of environmental accounting practices in Indian companies: A key approach to ensuring environmental sustainability. The Paradigm Shift from a Linear Economy to a Smart Circular Economy: The Role of Artificial Intelligence-Enabled Systems, Solutions and Legislations, 586: 1781-1795. https://doi.org/10.1007/978-3-031-87550-2_124
[16] Zhen, T., Rahman, M.M. (2024). Greening emerging economies: Enhancing environmental, social, and governance performance through environmental management accounting and green financing. Sustainability, 16(11): 4753. https://doi.org/10.3390/su16114753
[17] Nishitani, K., Kokubu, K., Wu, Q., Kitada, H., Guenther, E., Guenther, T. (2022). Material flow cost accounting (MFCA) for the circular economy: An empirical study of the triadic relationship between MFCA, environmental performance, and the economic performance of Japanese companies. Journal of Environmental Management, 303: 114219. https://doi.org/10.1016/j.jenvman.2021.114219
[18] Aranda-Usón, A., Portillo-Tarragona, P., Scarpellini, S., Llena-Macarulla, F. (2020). The progressive adoption of a circular economy by businesses for cleaner production: An approach from a regional study in Spain. Journal of Cleaner Production, 247: 119648. https://doi.org/10.1016/j.jclepro.2019.119648
[19] Hens, L., Block, C., Cabello-Eras, J.J., Sagastume-Gutierez, A., et al. (2018). On the evolution of "cleaner production" as a concept and a practice. Journal of Cleaner Production, 172: 3323-3333. https://doi.org/10.1016/j.jclepro.2017.11.082
[20] Tuccio, G., Bua, P., Teodoro, G., Failla, F., Giuffrida, V.A. (2017). Mass balance as economic and sustainable strategy in WEEE sector. Procedia Environmental Science, Engineering and Management, 4(3): 191-197.
[21] Wolters, T. (2023). Sustainable Value Creation: An Inevitable Challenge to Business and Society. Springer. https://doi.org/10.1007/978-3-031-35351-2
[22] Aureli, S., Foschi, E., Paletta, A. (2025). Management accounting for a circular economy: Current limits and avenue for a dialogic approach. Accounting, Auditing & Accountability Journal, 38(9): 291-319. https://doi.org/10.1108/AAAJ-04-2022-5766
[23] Zaid, M.A., Issa, A., Deari, F., Kijkasiwat, P., Kumar, V. (2025). Does corporate green innovation unlock financial doors? The mediating role of environmental performance. European Business Review, 37(3): 437-468. https://doi.org/10.1108/EBR-01-2024-0048
[24] Llena-Macarulla, F., Moneva, J.M., Aranda-Usón, A., Scarpellini, S. (2023). Reporting measurements or measuring for reporting? Internal measurement of the circular economy from an environmental accounting approach and its relationship. Revista de Contabilidad–Spanish Accounting Review, 26(2): 200-212. https://doi.org/10.6018/RCSAR.467751
[25] Scarpellini, S., Valero-Gil, J., Moneva, J.M., Andreaus, M. (2020). Environmental management capabilities for a "circular eco-innovation". Business Strategy and the Environment, 29(5): 1850-1864. https://doi.org/10.1002/bse.2472
[26] Panori, D., Papaspyropoulos, K.G., Nikolaou, I.E. (2024). A forest companies typology regarding their contribution to circular economy: A sustainability reporting-based analysis. Discover Sustainability, 5(1): 120. https://doi.org/10.1007/s43621-024-00304-4
[27] Zaid, M.A., Issa, A. (2024). Board committees as catalysts: Divulging the impact of nomination and risk management on corporate eco-innovation and carbon performance. Business Strategy and the Environment, 33(7): 6187-6206. https://doi.org/10.1002/bse.3803
[28] Holwerda, H., Haanstra, W., Braaksma, J. (2024). Operationalizing the circular economy—A longitudinal study on sustained circular action. Sustainability, 16(14): 5874. https://doi.org/10.3390/su16145874
[29] Aranda-Usón, A., Moneva, J.M., Portillo-Tarragona, P., Llena-Macarulla, F. (2018). Measurement of the circular economy in businesses: Impact and implications for regional policies. Economics and Policy of Energy and the Environment, 60(2): 187-205. https://doi.org/10.3280/EFE2018-002010
[30] Opferkuch, K., Caeiro, S., Salomone, R., Ramos, T.B. (2022). Circular economy disclosure in corporate sustainability reports: The case of European companies in sustainability rankings. Sustainable Production and Consumption, 32: 436-456. https://doi.org/10.1016/j.spc.2022.05.003
[31] Ortega-Lapiedra, R., Marco-Fondevila, M., Scarpellini, S., Llena-Macarulla, F. (2019). Measurement of the human capital applied to the business eco-innovation. Sustainability, 11(12): 3263.

https://doi.org/10.3390/su11123263
[32] Ivashura, A., Protasenko, O., Mykhailova, E., Severinov, O. (2022). Study of strategies for sustainable production and consumption in the economic conditions of Ukraine. Economics of Development, 21(1): 8-16. https://doi.org/10.57111/econ.21(1).2022.8-16
[33] Llera-Sastresa, E., Romeo, L.M., Scarpellini, S., Portillo-Tarragona, P. (2020). Methodology for dimensioning the socio-economic impact of power-to-gas technologies in a circular economy scenario. Applied Sciences, 10(21): 7907. https://doi.org/10.3390/app10217907
[34] Blum-Kusterer, M., Hussain, S.S. (2001). Innovation and corporate sustainability: An investigation into the process of change in the pharmaceuticals industry. Business Strategy and the Environment, 10(5): 300-316. https://doi.org/10.1002/bse.300
[35] Opferkuch, K., Caeiro, S., Salomone, R., Ramos, T.B. (2021). Circular economy in corporate sustainability reporting: A review of organisational approaches. Business Strategy and the Environment, 30(8): 4015-4036. https://doi.org/10.1002/bse.2854
[36] Tsalidis, G.A., Shahvi, S., Renfrew, D., Katsou, E. (2025). Assessing social risks in Greek and Dutch economies: A product social impact life cycle assessment approach. The International Journal of Life Cycle Assessment, 30(6): 1451-1463. https://doi.org/10.1007/s11367-024-02396-6
[37] Badrous, Y.M.L., Tawfik, O.I., Elmaasrawy, H.E., Srour, M.I., Sharaf, M.A.A. (2025). Fintech adoption and commercial banks' environmental performance: Do green accounting practices matter? International Journal of Financial Studies, 13(2): 90. https://doi.org/10.3390/ijfs13020090
[38] Arimany Serrat, N., Arribas-Ibar, M., Erdoğan, G. (2025). Fast fashion sector: Business models, supply chains, and European sustainability standards. Systems, 13(6): 405. https://doi.org/10.3390/systems13060405
[39] Opferkuch, K., Walker, A.M., Roos Lindgreen, E., Caeiro, S., Salomone, R., Ramos, T.B. (2023). Towards a framework for corporate disclosure of circular economy: Company perspectives and recommendations. Corporate Social Responsibility and Environmental Management, 30(5): 2457-2474. https://doi.org/10.1002/csr.2497
[40] Falkenberg, C., Schneeberger, C., Pöchtrager, S. (2023). Is sustainability reporting promoting a circular economy? Analysis of companies' sustainability reports in the agri-food sector in the scope of corporate sustainability reporting directive and EU taxonomy regulation. Sustainability, 15(9): 7498. https://doi.org/10.3390/su15097498
[41] Wulansari, W., Adhariani, D. (2023). Corporate waste disclosure, risk-taking and foreign ownership: Evidence from Indonesia. Business Strategy & Development, 6(2): 205-225. https://doi.org/10.1002/bsd2.234
[42] Scarpellini, S. (2022). Social impacts of a circular business model: An approach from a sustainability accounting and reporting perspective. Corporate Social Responsibility and Environmental Management, 29(3): 646-656. https://doi.org/10.1002/csr.2226
[43] Oliveira, M., Miguel, M., Van Langen, S.K., Ncube, A., et al. (2021). Circular economy and the transition to a sustainable society: Integrated assessment methods for a new paradigm. Circular Economy and Sustainability, 1(1): 99-113. https://doi.org/10.1007/s43615-021-00019-y
[44] Sanches, J.R., Trevisan, A.H., Seles, B.M.R.P., Castro, C.G., Piao, R.S., Rozenfeld, H., Mascarenhas, J. (2022). Sustainable circular economy strategies: An analysis of Brazilian corporate sustainability reporting. Sustainability, 14(10): 5808. https://doi.org/10.3390/su14105808
[45] Oh, Y. (2019). Corporate social responsibility and the value of a firm. In International Dimensions of Sustainable Management: Latest Perspectives from Corporate Governance, Responsible Finance and CSR, pp. 107-111. https://doi.org/10.1007/978-3-030-04819-8_7
[46] Weston, P., Nnadi, M. (2023). Evaluation of strategic and financial variables of corporate sustainability and ESG policies on corporate finance performance. Journal of Sustainable Finance & Investment, 13(2): 1058-1074. https://doi.org/10.1080/20430795.2021.1883984
[47] Divyam, A.K., Jasrai, L., Gupta, V. (2025). Corporate social responsibility influencing sustainability within the retail industry: A bibliometric analysis using R. International Review on Public and Nonprofit Marketing, 22(4): 995-1022. https://doi.org/10.1007/s12208-025-00450-z
[48] Rodrigues, V.D.V., Wander, A.E., Da Rosa, F.S. (2023). Diagnosis of the sustainability of a poultry value chain from the perspective of environmental management accounting. Revista de Gestao Social e Ambiental, 17(1): e03174. https://doi.org/10.24857/RGSA.V17N1-021
[49] Appannan, J.S., Mohd Said, R., Ong, T.S., Senik, R. (2023). Promoting sustainable development through strategies, environmental management accounting and environmental performance. Business Strategy and the Environment, 32(4): 1914-1930. https://doi.org/10.1002/bse.3227
[50] Monteiro, S., Ribeiro, V. (2023). Environmental strategy & management and accounting information system's relationship: A Portuguese case study. Corporate Social Responsibility in Difficult Times, pp. 197-223. https://doi.org/10.1007/978-981-99-2591-9_10
[51] Fernández-Miguel, A., García-Muiña, F.E., Ortíz-Marcos, S., Jiménez-Calzado, M., Fernández del Hoyo, A.P., Settembre-Blundo, D. (2025). AI-driven transformations in manufacturing: Bridging industry 4.0, 5.0, and 6.0 in sustainable value chains. Future Internet, 17(9): 430. https://doi.org/10.3390/fi17090430
[52] Huy, P.Q., Phuc, V.K. (2025). Impact of technologically vigilant leadership on smart sustainable circular supply chain management. Emerging Science Journal, 9(4): 1868-1885. https://doi.org/10.28991/ESJ-2025-09-04-07

APPENDIX

Table A1. Definitions of key terms

Term	Acronym	Definition (as Used in This Review)	Boundary
Environmental	EA	The identification, measurement, and reporting of	It is general and broader category, which

Accounting		environmental costs, impacts, and performance.	includes all types of environmental reporting and is used by most reported literature.
Environmental Management Accounting	EMA	A category of EA that is focused on providing internal decision-makers with financial and non-financial information about environmental costs, material flows, and resource efficiency.	It is for management decisions and not for external disclosure. It includes tools such as MFCA and LCA.
Sustainability Accounting	SA	It is a broader concept than EA, which includes environmental, social, and governance dimensions into accounting and reporting frameworks.	It extends beyond environmental accounting to include social and governance factors.
Corporate Social Responsibility	CSR	A voluntary corporate commitment to manage social, environmental, and economic impacts, which is operationalized through reporting and stakeholder engagement.	It is broader than EA and includes community relations, labor practices, and ethics.
Environmental, Social, and Governance	ESG	It includes corporate performance on environmental, social, and governance criteria, which is useful information for investors and other stakeholders.	ESG is externally focused. However, EA can be internal or external.
Carbon Accounting	CA	A specialized form of EA that particularly focuses on measuring, reporting, and verifying greenhouse gas emissions.	It is a category of EA that focuses exclusively on carbon and greenhouse gas emissions.
Circular Economy	CE	It is an economic model, which is designed to eliminate waste, keep resources in use, and regenerate natural systems.	It includes practices of material flow tracking, resource optimization, waste reduction, and circular business models.