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Environmental Management Accounting in Organizational Sustainability Transformation: A Review

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Abstract

This review examines the evolution of environmental management accounting (EMA) research, its role in organizational sustainability transformation, and the factors shaping that role. Bibliometric analyses of 357 Scopus-indexed publications were combined with a focused thematic synthesis of 51 transformation-oriented studies. The findings reveal a marked but non-linear expansion of EMA research and a thematic broadening from environmental costs, production efficiency, and accounting techniques toward performance, innovation, institutional influences, and organizational sustainability. The thematic synthesis shows that EMA supports sustainability transformation by integrating physical and monetary environmental information and making resource consumption, material losses, and environmental costs visible. When adopted and actively used, this information can support operational improvements, innovation, and the integration of environmental considerations into planning and strategic decision-making. However, EMA's contribution depends on strategic and leadership conditions, organizational capabilities and collaboration, technological and information infrastructure, institutional and stakeholder conditions, and resources and implementation conditions. The review therefore conceptualizes EMA as an organizational information infrastructure whose transformational contribution depends on its effective integration into managerial processes. These findings provide an integrated understanding of EMA's organizational role and practical guidance for strengthening its implementation.

Keywords: environmental management accounting, organizational sustainability transformation, bibliometric analysis, thematic synthesis

1. INTRODUCTION

Environmental pressures, resource constraints, and rising expectations of corporate accountability have intensified the need for organizations to explain not only what they disclose about sustainability, but also how environmental considerations influence their everyday managerial decisions. Public sustainability reports communicate commitments, policies, and performance indicators to external stakeholders; however, disclosure alone does not necessarily change operational routines, investment priorities, or resource-allocation practices. Research has identified inconsistencies among corporate reporting channels [1], while other evidence suggests that organizational change becomes more substantive when external disclosure is combined with environmental planning, internal management practices, and sustained implementation [2]. Consequently, organizational sustainability transformation calls for information systems that enable managers to recognize environmental effects, evaluate alternative courses of action, and connect environmental goals with operational and strategic choices. This requirement extends beyond regulatory compliance to the ways in which environmental information becomes part of organizational learning, innovation, and accountability.

Environmental management accounting (EMA) has developed as an approach to meeting this information requirement. EMA integrates physical information on material inputs, energy, water, waste, and emissions with monetary information about environmental costs, savings, revenues, and investment consequences [3]. By revealing costs that conventional accounts may combine with general overheads, EMA can make environmental consequences visible in product design, production processes, budgeting, and investment appraisal. Burritt et al. [4] provide a framework distinguishing physical and monetary information and the time horizons of decisions for which that information is used. These distinctions are important because EMA is not one uniform method, nor does adopting a particular technique establish that an organization has achieved sustainability. Material flow cost accounting, for example, can disclose the financial implications of material losses [5], whereas environmental cost assessment, carbon accounting, and water management accounting address different decision needs and organizational boundaries [3, 6, 7].

A growing body of empirical and conceptual research connects EMA with organizational change, but the nature of this connection requires careful interpretation. Evidence suggests that EMA implementation can help firms translate environmental information into green process and product innovation, with cross-functional cooperation and supplier co-creation operating differently across innovation outcomes [8]. Other studies associate EMA with organizational sustainability and indicate that stakeholder integration can reinforce this relationship [9]. At the same time, evidence of an association does not establish that accounting systems independently cause transformation: managerial commitment, the quality of data, organizational capabilities, and the institutional environment may affect whether environmental information is adopted, trusted, and translated into action. Research on environmental strategy and process innovation also indicates that the performance implications of EMA can differ by organizational context and by the type of outcome measured [10–12].

Previous reviews have clarified important but partly separate aspects of this research field. Bibliometric work describes EMA as an expanding area situated between environmental management, sustainability, and accounting, rather than a fully consolidated mainstream accounting discipline [13]. Reviews of individual methods, including material flow cost accounting, identify opportunities for research on implementation and organizational consequences [14]. Subsequent reviews emphasize strategic decision-making, sustainable development, and barriers involving regulation, management, organizational culture, and technical resources [15, 16]. A more recent synthesis documents the breadth of sustainability-oriented EMA research and the emergence of topics such as the circular economy [17]. Nevertheless, a conceptual and analytical gap remains between mapping the research landscape and explaining how EMA information contributes to operational improvement, innovation, and strategic change, and why that contribution differs among organizations. Without bringing these perspectives together, EMA risks being discussed either as a collection of technical tools or as a presumed direct driver of sustainability outcomes.

This study addresses that gap by combining two complementary levels of review. First, a descriptive bibliometric analysis maps the development, international collaboration patterns, and thematic structure of EMA research represented in a Scopus-indexed corpus. Second, a focused thematic synthesis examines studies explicitly connecting EMA with organizational sustainability transformation, paying attention to the organizational mechanisms involved and the conditions enabling or constraining their operation. The analysis distinguishes the identification and production of environmental information from its managerial use, and differentiates evidence of improved resource efficiency or innovation from stronger claims concerning organization-wide sustainability transformation. It thereby treats transformation as a process of embedding environmental objectives into strategy, management controls, organizational routines, and decision-making, rather than as an automatic consequence of introducing an accounting instrument.

Against this background, the study addresses three research questions: (1) How has the EMA research landscape evolved? (2) What role does EMA play in organizational sustainability transformation? and (3) Which strategic, organizational, technological, institutional, and implementation conditions shape that role? By combining research mapping

with a mechanism-oriented synthesis, the review aims to provide a clearer explanation of how physical and monetary environmental information may support operational, innovative, and strategic changes. Its theoretical contribution is to conceptualize EMA as an organizational information infrastructure whose effects depend on its integration with capabilities and managerial processes. For managers, the analysis identifies practical conditions that may enable useful information to inform decisions; for policymakers and regulators, it clarifies why requirements for external environmental reporting should be considered alongside the development of reliable internal measurement, decision support, and organizational accountability.

2. LITERATURE REVIEW

To establish the conceptual basis for examining the role of EMA in organizational sustainability transformation, this section reviews the literature in three stages. It first clarifies the conceptual foundations of EMA, then examines its principal information dimensions and accounting practices, and finally considers how these features connect EMA with organizational sustainability transformation.

Environmental management accounting developed from efforts to connect environmental management with management accounting, which had traditionally operated through separate organizational functions and information systems. Early research defined EMA as the internal generation, analysis, and use of financial and related non-financial information to integrate environmental and economic considerations into organizational management [18, 19]. This concept was subsequently formalized through a framework combining monetary environmental management accounting with physical environmental management accounting and differentiating information according to its temporal orientation, decision horizon, and frequency of use [4]. The United Nations approach further established EMA as the identification, collection, analysis, and use of physical information on materials, energy, water, and waste together with monetary information on environmental costs, earnings, and savings for internal decision-making [3]. EMA was thus conceived as an integrated decision-support approach rather than another category of environmental reporting.

The conceptual significance of EMA lies in its capacity to change the environmental information included in managerial calculations. Conventional accounting systems tend to record visible expenditures on environmental protection while leaving the costs of wasted materials, energy losses, and non-product output within general overhead accounts or separate production systems. Evidence from early applications showed that tracing these physical flows and their monetary consequences revealed environmental costs that were substantially understated in conventional accounts [20, 21]. This integration enables environmental considerations to enter routine managerial activities, including planning, cost control, investment decisions, pricing, and performance evaluation, rather than remaining the responsibility of a specialized environmental function [22, 23]. EMA therefore complements environmental management systems: the latter establish policies, responsibilities, and operational procedures, while EMA provides the information required to evaluate and control their implementation [24].

Despite its development as a distinct field, the connection between EMA and sustainability should not be assumed. EMA remains positioned at the intersection of accounting, environmental management, and sustainability rather than fully embedded in mainstream management accounting research [13]. Moreover, generating environmental information does not in itself produce sustainability transformation. Improvements in firm-level resource efficiency may leave cumulative ecological impacts and planetary limits unaddressed [25]. In response, recent research has argued for extending EMA beyond organizational boundaries to supply chains and circular systems and for incorporating longer-term environmental and social measures aligned with broader sustainability objectives [26].

Within this broader view, EMA functions as an information architecture rather than a single accounting technique. Its operation depends on the physical and monetary information it combines and on the accounting practices through which that information is generated and used. These dimensions and practices form the focus of the next section.

Building on the preceding conceptual foundations, Burritt et al. [4] conceptualize EMA through two complementary information dimensions: physical environmental management accounting (PEMA) and monetary environmental management accounting (MEMA). Their framework further classifies EMA information according to whether it is past- or future-oriented, short- or long-term, and generated routinely or for a specific decision. PEMA records organizational interactions with the environment in physical units, whereas MEMA expresses environmentally relevant activities in terms of costs, revenues, savings, and investment consequences. The distinction concerns the type of information produced rather than a rigid division between accounting techniques, as several EMA practices combine both dimensions. Table 1 summarizes the information dimensions and representative EMA practices, distinguishing their decision purposes, temporal orientation, and supporting literature.

PEMA encompasses practices that trace resource flows and measure environmental pressures. Material and energy flow accounting records organizational inputs, outputs, waste, and non-product outputs, making resource inefficiencies visible in physical terms [21]. Environmental performance indicators convert such information into measures that support compliance, continuous improvement, internal decision-making, and environmental reporting [27]. More specialized ap-

plications address particular environmental issues. Carbon accounting quantifies emissions across organizational activities and value chains to support carbon management [6], whereas water management accounting measures water consumption, discharge, and exposure to scarcity-related risks [7].

MEMA translates environmental effects and resource use into financial information for planning, control, and capital allocation. Environmental cost accounting identifies and allocates expenditures associated with environmental protection, waste treatment, and inefficient resource use that may otherwise remain concealed within general overheads [3]. Activity-based environmental and carbon costing further assigns these costs to the processes and products that generate them, improving product costing, pricing, and process decisions [28]. For longer-term decisions, environmental budgeting and investment appraisal estimate future expenditures, savings, and project returns. Life-cycle costing extends this monetary assessment across product stages and can be combined with life-cycle assessment when comparing alternative designs and technologies [29] .

Several widely used practices connect PEMA and MEMA rather than forming a separate information dimension. Material flow cost accounting attaches monetary values to physical material flows and distinguishes product output from material losses, thereby revealing the financial consequences of resource inefficiency [14]. Eco-efficiency measurement similarly relates economic value creation to environmental resource use, although financial efficiency and environmental improvement do not necessarily advance at the same rate [30]. The decision value of these practices ultimately depends on whether the information produced is incorporated into benchmarking, organizational control, and managerial action [31]. The selection and combination of EMA practices vary with the environmental issue, organizational boundary, decision horizon, and managerial responsibility involved. The next section examines how these information and decision-support functions connect EMA with organizational sustainability transformation.

Table 1. *Environmental Management Accounting Information Dimensions and Representative Practices*

EMA information dimension	Representative practice	Information orientation	Primary decision purpose	Illustrative references
Monetary EMA (MEMA)	Environmental cost accounting and environmental cost assessment	Past-oriented; routine or ad hoc; mainly short-term	Identify and allocate environmental protection, waste-treatment, non-product-output, and hidden overhead costs; support cost control and benchmarking.	[3, 20, 21]
Monetary EMA (MEMA)	Activity-based environmental and carbon costing	Past- and future-oriented; routine or ad hoc; mainly short-term	Assign environmental and carbon costs to the activities and products that generate them; improve product costing, pricing, and process decisions.	[23, 28]
Monetary EMA (MEMA)	Environmental budgeting, life-cycle costing, and monetary investment appraisal	Future-oriented; routine or ad hoc; short- and long-term	Plan environmental expenditures and resource costs; assess capital projects, product designs, and life-cycle alternatives.	[3, 4]; [29]
Physical EMA (PEMA)	Material and energy flow accounting and physical environmental budgeting	Past- and future-oriented; mainly routine; short- and long-term	Measure material and energy inputs, non-product outputs, waste, and emissions; set physical targets and identify cleaner-production opportunities.	[21, 23]; [6]
Physical EMA (PEMA)	Environmental performance indicators	Past-oriented; mainly routine; short- and long-term	Monitor compliance and continuous improvement, support internal decisions, and provide information for environmental reporting.	[22, 27]
Physical EMA (PEMA)	Carbon accounting and carbon-performance measurement	Past- and future-oriented; routine or ad hoc; organization and supply-chain levels	Quantify direct and indirect emissions, map carbon flows, and align carbon performance measurement with corporate and supply-chain strategy.	[6]
Physical EMA (PEMA)	Water management accounting	Past- and future-oriented; routine or ad hoc; organization and supply-chain levels	Measure water flows, costs, and scarcity exposure; support operational and strategic water-management decisions.	[7]
Physical EMA (PEMA)	Life-cycle assessment and life-cycle inventories	Future-oriented; mainly ad hoc; long-term	Quantify environmental impacts across the product life cycle and compare product designs, technologies, and end-of-life alternatives.	[29]

The distinction between PEMA and MEMA clarifies the content and orientation of EMA information, but it does not explain how this information becomes consequential for organizational sustainability transformation. In this review, such transformation refers to a movement from episodic compliance and isolated efficiency initiatives toward the integration of environmental objectives into organizational strategies, routines, management controls, and innovation activities. Research on the strategic use of EMA indicates a corresponding progression from legitimacy and operational-efficiency motives toward proactive, long-term decision-making for strategic sustainable development [15]. EMA is thus relevant not simply because it produces environmental information, but because it can translate environmental concerns into organizational

action.

Two complementary theoretical perspectives explain this relationship. From a resource- and capability-based perspective, EMA provides knowledge and measurement capabilities through which organizations can recognize environmental constraints, evaluate resource use, and reconfigure operations. Environmental accounting practices have consequently been associated with the development of dynamic capabilities required when firms move from linear production models toward circular business practices [32]. An institutional perspective emphasizes the external origins of organizational change. Coercive, normative, and mimetic pressures may encourage EMA adoption, while EMA can translate these pressures into internal decision processes and environmental accountability [33]. These perspectives jointly position EMA at the interface between external sustainability demands and internally managed change.

Within organizations, this connection becomes more evident when EMA is integrated with strategy, management control, and innovation. Environmental strategy can influence environmental performance through the mediating role of EMA, indicating that accounting information provides a mechanism through which strategic intentions are converted into managerial action [11]. EMA use has also been associated with process innovation, as information about environmental costs and resource inefficiencies can direct attention toward changes in production processes [10]. More recent evidence further identifies green process innovation as a pathway connecting EMA with corporate environmental performance, particularly when accounting practices are supported by environmentally oriented leadership [12]. This literature portrays EMA as part of the organizational infrastructure through which sustainability strategies are operationalized.

EMA adoption should not, however, be treated as equivalent to sustainability transformation. Its implementation may remain focused on compliance, legitimacy, or short-term cost reduction without altering established routines or strategic priorities. Regulatory limitations, organizational resistance, technical constraints, and insufficient managerial commitment can prevent EMA information from becoming embedded in core decisions [16]. Moreover, the environmental and economic information generated by EMA does not, by itself, address the broader social and ecological dimensions of sustainability. EMA is therefore conceptualized in this review as a potential enabling infrastructure whose transformative contribution depends on how its information is mobilized to reshape decisions, capabilities, innovation, and organizational practices. This distinction provides the conceptual basis for subsequently examining the role of EMA in sustainability transformation and the conditions that shape that role.

3. METHODOLOGY

This review combined a descriptive bibliometric analysis of EMA publications with a focused qualitative thematic synthesis, allowing the distribution of research topics to be examined alongside the mechanisms and implementation conditions discussed in the selected studies. Scopus was selected as the database for retrieving publication data because of its broad coverage of peer-reviewed literature and its well-established use in bibliometric research [34, 35].

The primary retrieval used the following query.

TITLE-ABS-KEY ("environmental management accounting"

OR "environmental managerial accounting")

The results were limited to English-language articles and reviews published in journals. No restriction was imposed on the starting year or on the Scopus subject area, so that studies from accounting, environmental management, and adjacent disciplines could be considered within the same search strategy. Citation information, bibliographic information, abstracts, author keywords, affiliations, and cited references were exported in CSV format. After applying these database limits, the main corpus comprised 357 records; the reported deduplication check identified no duplicate titles, DOIs, or Scopus EIDs. The dataset and screening decisions should be archived alongside the final review to permit independent reproduction of these results.

Bibliometric analysis was undertaken using Bibliometrix through its Biblioshiny interface [36] and VOSviewer [37]. Biblioshiny was used to examine annual scientific production and country collaboration. Because 2026 was incomplete at the time of data collection, its 35 records were excluded only from the annual production analysis. This analysis consequently covered 322 publications from the complete calendar years 2000–2025. The full corpus of 357 records was retained for the remaining analyses so that recent developments were not omitted. The country collaboration map was based on authors' institutional affiliations, and only country pairs with at least two joint publications were displayed. Author-keyword co-occurrence was analysed in VOSviewer using full counting, with the minimum occurrence threshold set at five. A thesaurus file was applied to merge abbreviations and equivalent expressions, including EMA with environmental management accounting and MFCA with material flow cost accounting, standardize singular and plural variants, and remove generic or location-specific terms that did not represent substantive research themes. This procedure retained 40 keywords. The overlay visualization was weighted by keyword occurrence and scored by average publication year, with up to up to the 300 strongest links displayed.

To identify publications explicitly addressing organizational sustainability transformation, a supplementary query combined the two EMA terms with transformation-oriented expressions:

TITLE-ABS-KEY (("environmental management accounting"
OR "environmental managerial accounting")
AND ((sustainab* W/3 transform*)
OR (sustainab* W/3 transition*)
OR (organization* W/3 transform*)
OR (organisation* W/3 transform*)
OR "organizational change"
OR "organisational change"
OR "strategic transformation"
OR "business model innovation"
OR "business model transformation"
OR "green innovation"
OR "eco-innovation"
OR "circular economy"
OR "decarbonization"
OR "decarbonisation"
OR "low-carbon transition"))

The same document-type, source-type, and language limits were applied. This query identified 51 records, all of which were contained in the 357-record corpus. They were therefore treated as a transformation-oriented analytical subset rather than an additional sample. Each publication was examined through its title, abstract, and author keywords, with full texts consulted when the organizational mechanism, context, or direction of the reported relationship required clarification. The coding focused on the role attributed to EMA, the mechanism through which it operated, the associated organizational change or outcome, and the strategic, organizational, technological, institutional, and implementation conditions shaping that role. Codes were compared and consolidated iteratively into the recurring patterns reported in Sections 3.2 and 3.3. Contradictory and non-significant findings were retained to avoid presenting EMA's contribution to sustainability transformation as automatic or uniformly positive.

4. RESULTS AND DISCUSSION

This section presents and discusses the findings in relation to the three research questions by examining the evolution of the EMA research landscape, the role attributed to EMA in organizational sustainability transformation, and the factors shaping that role.

The evolution of EMA research is examined through annual scientific production, country collaboration, and author-keyword co-occurrence. Figure 1 presents annual scientific production in the EMA corpus between 2000 and 2025, providing a visual basis for interpreting the year-by-year publication pattern. Publications assigned to 2026 were excluded from this specific analysis because 2026 was an incomplete publication year at the information cut-off and was therefore not directly comparable with full calendar years. Within the reported corpus, publication activity remained limited and irregular between 2000 and 2014, ranging from zero to 15 publications annually, with temporary peaks in 2006 and 2012. A more sustained increase emerged from 2015, with annual output rising from 12 publications to 35 in 2020. Although production declined to 18 in 2021 and remained relatively low at 19 in 2022, growth subsequently resumed, reaching 32 publications in 2023, 37 in 2024, and a dataset high of 47 in 2025. Notably, 212 of the 322 publications (65.8%) appeared during 2019–2025, compared with 110 during 2000–2018. The distribution indicates a marked, although non-linear, expansion of scholarly interest in EMA in recent years.

Cross-national collaboration in EMA research is geographically uneven and concentrated around a limited number of research hubs. The mapped country-level links are shown in Figure 2, which distinguishes recurrent collaborations from less frequently observed ties. The dataset contains 88 country pairs, of which 19 recurring collaborations met the minimum frequency threshold of two used for the visualization. Australia records the highest overall collaboration strength, followed by Malaysia and the United Kingdom, while the latter two countries engage with the widest range of international partners. The strongest bilateral relationship is between Australia and Germany, with eight joint publications, followed by Malaysia–Pakistan and Saudi Arabia–Egypt, with four publications each. Australia also maintains ongoing ties with Sri Lanka, the United Kingdom, and the United States, whereas Malaysia collaborates regularly with Kazakhstan, Bangladesh, Indonesia, and Oman. China also maintains recurring partnerships with Bangladesh, Japan, and Pakistan. By comparison, collaborative links involving most African and Latin American countries remain sparse. These patterns reveal an increasingly international EMA research field whose collaborative structure nevertheless continues to depend on a relatively small number of countries and recurring partnerships.

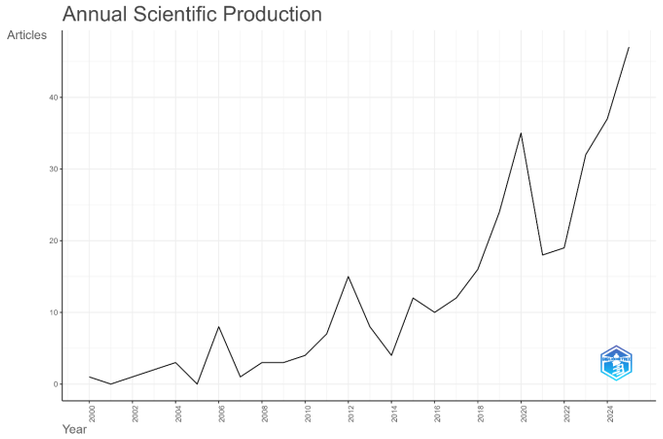

Figure 1. *Annual scientific production*

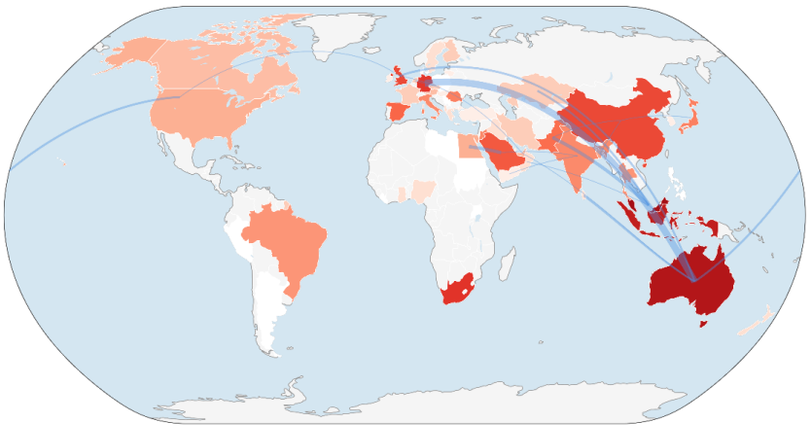

Figure 2. *Country collaboration map*

The author-keyword co-occurrence analysis reveals a research field anchored in EMA and increasingly connected to performance, sustainability, and strategic themes, as illustrated by the author-keyword overlay network in Figure 3. Following thesaurus-based standardization, 40 keywords occurring at least five times were retained. Environmental management accounting is by far the most prominent term, with 237 occurrences and a total link strength of 298. It is followed by environmental performance (48 occurrences; total link strength = 94), sustainability (29; 53), environmental management (28; 41), and material flow cost accounting (26; 30). EMA has its strongest direct association with environmental performance (link strength = 30), followed by environmental strategy (18), sustainability (17), institutional pressure and material flow cost accounting (15 each), and contingency theory (14). These connections position EMA at the centre of a network linking accounting techniques with organizational and sustainability-related concerns.

The colours represent the average publication year associated with each keyword rather than the year in which the keyword first appeared. Dark blue and purple indicate comparatively earlier research, while green and yellow represent progressively more recent attention. Cleaner production and environmental costs are among the earliest themes, with average publication years of 2012.1 and 2013.0. Environmental management and material flow cost accounting follow, with average publication years of 2016.4 and 2017.9. During 2020 and 2021, the field expanded towards environmental accounting, contingency theory, environmental strategy, sustainable development, and sustainability. Their average publication years range from 2020.0 to 2021.8. More recent themes include institutional pressure in 2022.0, circular economy and EMA practices in 2022.4, financial performance in 2022.7, regulatory pressure in 2023.4, green innovation in 2023.5, stakeholder theory in 2023.6, sustainability performance in 2024.0, and green intellectual capital in 2024.1. The temporal pattern indicates that EMA research has broadened from its earlier emphasis on environmental costs, production efficiency, and accounting techniques towards performance, innovation, institutional influences, and organization-level sustainability.

The thematic synthesis identifies several mechanisms through which EMA may connect environmental information with operational improvement, innovation, and strategic change; the evidence does not imply that these outcomes occur automatically or uniformly across firms. By combining physical and monetary information, EMA makes resource consumption, material losses, and environmental costs visible. Material flow cost accounting links this information

to environmental and economic performance [38]. Environmental accounting practices have also been linked to the scope of circular-economy adoption [32], while other research reports associations between EMA-related practices, energy efficiency, and environmental performance [39].

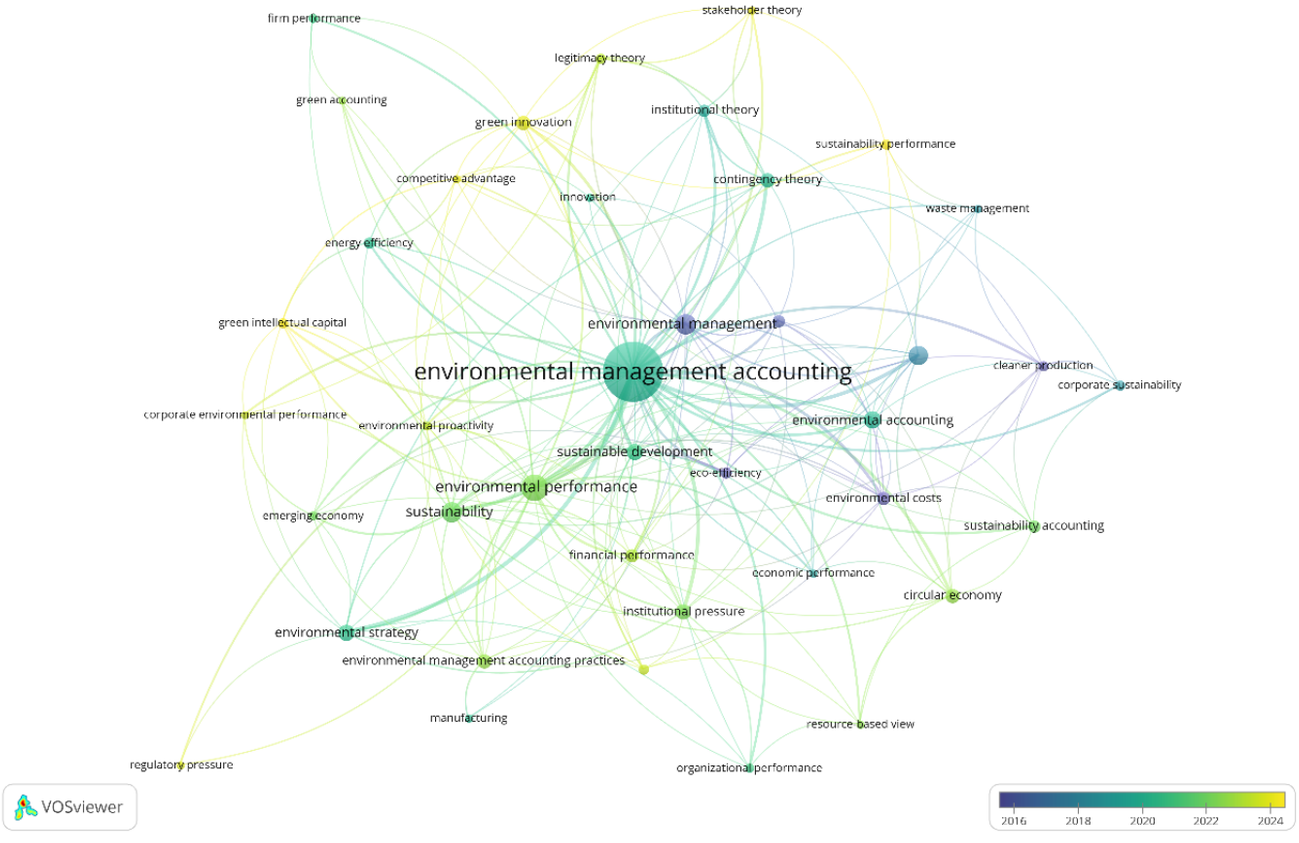

Figure 3. *Overlay visualization of author keyword co-occurrence*

EMA also supports knowledge transfer and green innovation. Evidence from Indonesian SMEs shows that EMA was reported to be associated with knowledge transfer and green innovation, which were in turn linked to environmental performance [40]. Evidence from manufacturing SMEs in Yemen identifies top-management support as a partial mediator of the relationship between EMA and environmental performance and institutional pressures as a positive moderator; it does not test green innovation as the mediating mechanism [41]. In a study of Vietnamese small and medium-sized enterprises, the relationships among EMA, green innovation, and financial performance were examined using structural equation modelling; conclusions should be restricted to the pathways supported by the reported model [42].

Other studies examine the contribution of EMA information to strategic integration and accountability. In circular eco-innovation projects, accounting information supports project measurement, budgeting, and reporting, although disclosure may decline over time [43]. Eco-efficiency measurement, environmental cost tracking, life-cycle assessment, and reporting transparency strengthen ESG performance [44]. EMA has also been examined alongside green ambidexterity as a possible means of translating green knowledge assets into competitive advantage [45].

The performance contribution of EMA is not uniform. EMA mediates the relationship between green innovation and firm value [46], but other evidence finds no significant direct effect on firm performance [47]. EMA is best understood as an enabling mechanism that improves environmental visibility, supports innovation, and connects sustainability activities with organizational decisions. Its outcomes depend on the capabilities and implementation conditions examined in the next section.

The roles identified above are not realized uniformly, as their strength depends on the context in which EMA is adopted and used. Table 2 organizes the conditions identified in the thematic synthesis into five categories and connects each category with illustrative literature. At the organizational level, environmental strategy and leadership commitment determine whether EMA is incorporated into planning and decision-making. Digital capability and environmental strategy strengthen EMA integration and improve the use of environmental information in managerial decisions [48]. Research on technologically vigilant leadership examines how a digital environmental management accounting system mediates its

relationship with smart sustainable circular supply-chain management, placing the technological and leadership context of accounting information at the centre of the model [49]. The effective use of this information also depends on organizational capabilities. Green absorptive capacity strengthens the relationship between EMA and green innovation [50], while cross-functional cooperation and supplier co-creation translate EMA implementation into process and product innovation [8].

Table 2. *Strategic, Organizational, and Institutional Factors Shaping the Role of EMA*

Factor category	Conditions influencing EMA use and outcomes	Illustrative references
Strategic and leadership conditions	Environmental strategy, managerial commitment, and technologically vigilant leadership determine whether EMA is integrated into planning and decision-making.	[48, 49]
Organizational capabilities and collaboration	Absorptive and dynamic capabilities, knowledge sharing, cross-functional cooperation, and supplier co-creation help translate EMA information into innovation and organizational learning.	[50, 51]; [8]
Technological and information infrastructure	Digital capability, environmental information systems, data quality, and system integration influence the availability and usability of EMA information.	[52]; [48, 49]
Institutional and stakeholder conditions	Regulatory pressure, stakeholder expectations, legitimacy requirements, disclosure, and green-growth policies encourage EMA adoption and external accountability.	[2, 52, 53]
Resources and implementation conditions	Financial resources, skills, implementation costs, process complexity, market conditions, and implementation maturity shape the scope and continuity of EMA use.	[51, 54]; [55, 56]

Technological and institutional conditions affect both the availability of EMA information and the motivation to use it. Environmental information systems and knowledge management strengthen its informational basis, while stakeholder and institutional pressures encourage its implementation and reinforce its contribution to environmental and financial performance [52]. When EMA is combined with environmental planning and disclosure, sustainability becomes more deeply integrated into organizational practices and values [2]. Policy support can further strengthen the relationships among leadership, accounting information systems, and sustainable operations [53].

Resources and implementation conditions place practical limits on these effects. EMA may begin as a selective cost-saving response and develop into integrated environmental control when its benefits are recognized and supported by stakeholders [55]. Its implementation can nevertheless be restricted by limited skills, process complexity, and the difficulty of adapting accounting tools to circular operations [51]. Market conditions, processing capacity, and implementation maturity also influence whether EMA tools remain fragmented or become part of strategic monitoring and control [54, 56]. The contribution of EMA consequently depends on the alignment of strategic commitment, organizational capabilities, information infrastructure, external pressures, and implementation resources.

5. CONCLUSION

This review examined the evolution of EMA research and its role in organizational sustainability transformation by combining a descriptive bibliometric analysis of 357 publications with a focused thematic synthesis of 51 transformation-oriented studies. The bibliometric findings indicate that EMA research has developed from an initial emphasis on environmental cost identification, resource control, and regulatory compliance towards broader concerns involving environmental performance, green innovation, circular resource use, and sustainability-oriented decision-making. This development reflects EMA's evolution from a specialized accounting approach into a multidisciplinary field that links accounting information to environmental management and organizational change.

Across this evolving literature, the central contribution of EMA lies in integrating physical and monetary environmental information and making resource consumption, material losses, environmental impacts, and related costs visible to decision-makers. When effectively implemented, EMA can consequently inform operational improvements, support green process and product innovation, and bring sustainability considerations into planning, control, and strategic decision-making. EMA's contribution, however, is not automatic but is shaped by strategic and leadership conditions, organizational capabilities and collaboration, technological and information infrastructure, institutional and stakeholder conditions, and resources and implementation conditions. These factors determine whether EMA is adopted, effectively used, and translated into sustainability-related organizational change. Its potential contribution to sustainability transformation therefore rests on the existence of complementary conditions that enable effective and sustained use. By connecting the development of the research field with the organizational roles and contextual conditions of EMA, this review moves beyond treating EMA as either a collection of accounting techniques or a direct determinant of organizational performance. It instead positions EMA as an organizational information infrastructure through which environmental knowledge can be translated

into operational, innovative, and strategic change.

Several limitations should nevertheless be acknowledged. The exclusive reliance on Scopus may have excluded relevant studies indexed in other databases. Bibliometric patterns are also sensitive to keyword standardization and network thresholds, while the focused synthesis may overlook contextual nuances and transformation mechanisms that are not explicitly articulated in the selected studies. Moreover, the identified co-occurrence structures and thematic relationships indicate associations within the literature rather than causal effects of EMA on sustainability outcomes. Future research could draw on multiple bibliographic databases, conduct longitudinal studies to trace how EMA contributes to sustainability transformation over time, and compare these processes across organizational, industrial, and institutional contexts.

Author Contributions

Both authors contributed to the preparation of this review and approved the manuscript for submission.

Conflict of Interest

The authors declare that they have no conflicts of interest relevant to the present review.

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Data Availability

The bibliometric analyses described in this manuscript were based on Scopus publication metadata, and the thematic synthesis used a subset of records identified through the reported search queries.

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