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DIGITAL TRANSFORMATION AND ENVIRONMENTAL MANAGEMENT ACCOUNTING: A SYSTEMATIC LITERATURE REVIEW

Muhammad Raja Siregar[1]*, Sambas Ade Kesuma[2], Iskandar Muda[3]
[1]Doctoral Program in Accounting, Universitas Sumatera Utara
[2]Accounting Study Program Universitas Sumatera Utara
E-mail: muhammadraja009@students.usu.ac.id,sambas@usu.ac.id, Iskandar1@usu.ac.id

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Abstract

This study synthesizes evidence from 11 primary studies on the relationships among digital transformation, environmental management accounting (EMA), the managerial use of information, and environmental performance. A focused systematic literature synthesis draws on Scopus records and compares evidence from surveys, case studies, qualitative research, and system-design studies. The findings distinguish three mechanisms: digital data acquisition and interoperability, the integration of physical and monetary information through EMA, and the use of information in managerial decisions. The available evidence indicates potential benefits but does not establish consistent causal effects; several empirical relationships are statistically nonsignificant. The study contributes a three-layer conceptual framework and testable research propositions that call for longitudinal data and objective environmental indicators. The 11 articles constitute a focused synthesis corpus; the complete search and eligibility decisions still require a PRISMA 2020 audit.

Keywords: environmental management accounting; material flow cost accounting; environmental performance; digital transformation; systematic literature review

INTRODUCTION

Corporate environmental accountability is receiving increasing attention as investors, regulators, and supply-chain partners demand relevant and traceable sustainability information. The International Sustainability Standards Board (ISSB) issued IFRS S1 and IFRS S2 in 2023 as standards for disclosing sustainability- and climate-related risks and opportunities. In Indonesia, the Sustainability Standards Board of the Indonesian Institute of Accountants endorsed PSPK 1 and PSPK 2 on July 1, 2025, with an effective date of January 1, 2027; the entities subject to mandatory implementation and the reporting timetable remain dependent on the relevant regulators (Ikatan Akuntan Indonesia [IAI], 2025). Meanwhile, Internet of Things (IoT) sensors, enterprise software, and automated recording systems have increased the availability of data on energy consumption, water use, material flows, and waste. However, growing disclosure pressure and data-collection capacity do not automatically translate into mature environmental management accounting practices.

Environmental management accounting (EMA) is an internal accounting approach that provides environmental information for planning, cost control, investment appraisal, and decision-making. Unlike environmental financial accounting, which primarily concerns the recognition and presentation of environmental impacts or obligations in financial reporting, EMA emphasizes detailed information at the process, product, and responsibility-center levels. Physical measures—such as kilograms of lost raw materials, cubic meters of water, or kilowatt-hours of energy—therefore need to be linked to monetary values so that resource inefficiencies can be translated into costs, alternative courses of action, and manageable economic consequences.

Several studies report relevant relationships among digital capabilities, EMA integration, and decision quality (Li et al., 2026); blockchain use and EMA (Metwally et al., 2026); the moderating role of digital EMA (Abdelhalim et al., 2023); the integration of material flow cost accounting (MFCA) with IoT (Sodkomkham et al., 2024); and automated links between financial and environmental data (Poppe et al., 2022, 2023). However, these findings come from surveys, case studies, and system-design research that differ in their inferential strength. Some studies report nonsignificant relationships, so the benefits of technology cannot be generalized as uniform causal

effects. The conceptual gap addressed in this review is the inconsistent distinction among (1) the availability and interoperability of digital environmental data, (2) the integration of physical and monetary information within EMA, and (3) the use of EMA information in managerial decision-making. This distinction matters because owning sensors or applications is often treated as a proxy for EMA maturity, even though systems may generate data or reports without changing budgeting, waste-control, or investment decisions. Consequently, the relationship between technology adoption and environmental performance may be portrayed as overly direct, while the underlying accounting mechanisms and managerial actions remain untested.

A systematic literature review (SLR) approach was selected to compare findings, construct definitions, and design limitations across 11 primary studies using explicit extraction procedures rather than narrative selection alone. The selection reporting refers to PRISMA 2020, although the search and eligibility audit has not been completed. Accordingly, this review is expressly limited to a focused systematic synthesis of the 11 available studies and does not claim comprehensive coverage of all research on digital EMA.

This review addresses three questions: (1) What technologies and EMA integration mechanisms are reported in the literature? (2) What evidence exists on the relationships among EMA, the use of information in managerial decisions, and environmental performance? and (3) What methodological limitations and research gaps remain? Its principal contribution is a three-layer conceptual framework—data acquisition and interoperability, physical–monetary EMA integration, and information use in decision-making—accompanied by operational propositions concerning the mediating role of information use, organizational readiness, and the need for objective environmental outcome measures. Following the introduction, Section 2 reviews the conceptual foundations and literature; Section 3 explains the methods and selection status; Section 4 presents the results, critical synthesis, and research agenda; and the final section summarizes the conclusions and limitations.

LITERATURE REVIEW

DIGITAL INFRASTRUCTURE, EMA, AND DECISION-MAKING USE

Environmental management accounting (EMA) provides environmental information for internal decisions by linking physical measures—such as raw material, energy, and water consumption and waste generation—to costs and economic value. Unlike environmental reporting primarily directed at external stakeholders, EMA emphasizes the traceability of resource use across processes, products, and responsibility centers. Linking physical and monetary information is necessary so that material losses are recorded not merely as waste volumes but also as purchasing, processing, and handling costs relevant to managerial control. Digital transformation enables the collection, exchange, and processing of environmental information through the Internet of Things (IoT), sensors, blockchain, and interconnected information systems. Nevertheless, the presence of technology is not equivalent to EMA implementation. Operational data become management accounting information only when they can be validated, classified, matched with monetary units, and linked to alternative actions. Studies of agricultural information-system integration by Poppe et al. (2022, 2023) primarily demonstrate the feasibility of linking environmental and financial data; however, the feasibility of a system architecture does not, by itself, demonstrate improved environmental performance.

Material flow cost accounting (MFCA) illustrates this translation function by identifying material flows that become products or material losses and then assigning associated costs. Sodkomkham et al. (2024) integrate MFCA, IoT, and lean practices in the context of water use in the beverage industry. This study provides a concrete example of using process data to identify inefficiencies, but evidence from a single facility cannot be directly generalized into a causal effect across industries. The benefits of digital EMA must therefore be interpreted in light of the implementation context and the research design. On this basis, the review distinguishes three analytical layers: (1) environmental data acquisition and interoperability, (2) the integration of physical and monetary data through EMA procedures, and (3) the use of EMA information in budgeting, operational control, investment appraisal, and performance evaluation. This distinction prevents digitalization, EMA adoption, and managerial decisions from being measured as though they were the same construct. Li et al. (2026) provide empirical grounds for examining the relationships among digital capabilities, EMA integration, and decision quality, although causal direction must still be interpreted within the limits of the study design.

INCONSISTENT FINDINGS AND CONCEPTUAL GAPS

Empirical findings on digital EMA do not follow an entirely consistent pattern. Abdelhalim et al. (2023) report that the direct relationship between eco-efficiency and corporate sustainability is nonsignificant in their model, whereas the interaction involving digital EMA is significant. Li et al. (2026) find that the moderating effect

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of regulatory pressure is nonsignificant in their specification. Similarly, Dratwińska-Kania and Karmańska (2026) report a nonsignificant effect of environmental uncertainty in their model. These results should not be treated as conflicting replications because the constructs, contexts, and statistical relationships examined are not identical.

The evidence also differs by research design. Surveys can identify associations among constructs, but measurements collected at a single point in time limit confidence in causal ordering. MFCA–IoT case studies provide more detailed operational evidence but may be affected by concurrent process changes or other interventions. System-design research demonstrates the technical feasibility of integration, while qualitative research helps identify implementation barriers. Findings from different designs should therefore be synthesized according to their function and evidential strength rather than pooled into a single uniform effect estimate.

A central conceptual gap is the inconsistent separation of digital data availability, the integration of environmental information into EMA, and the managerial use of that information. When these stages are conflated, increased data availability may be mistakenly interpreted as improved decision quality or environmental performance. This review positions EMA integration as a translation mechanism and information use as a distinct stage requiring direct observation. The framework provides the basis for research propositions on the mediating role of information use, organizational readiness, and the need for objective and longitudinal environmental performance measures. These propositions represent an agenda for future testing rather than causal conclusions drawn from the 11 synthesized studies.

METHODS

Data Sources, Eligibility, And PRISMA Status

This study adopts a systematic literature review (SLR) with focused thematic synthesis to examine the relationships among digital transformation, environmental management accounting (EMA), managerial information use, and environmental performance. The reporting of identification and selection procedures follows the transparency principles of PRISMA 2020. However, because several audit components remain incomplete, the flow presented here documents provisional selection rather than a finalized PRISMA process.

The search source was a Scopus database export containing 313 records. Based on the previously conducted title-and-abstract screening, 253 records were excluded and 60 candidates were retained for further examination. Of these 60 candidates, full texts for 17 documents were available for preliminary review. Eleven primary studies were selected for the focused synthesis because they provided relevant evidence on digital technologies, EMA mechanisms, or the use of environmental information in organizational management. The other six documents were not used as primary evidence in the working corpus; their individual exclusion reasons still need to be recorded in the selection decision log.

The full texts of the remaining 43 candidates could not be adequately obtained because of download difficulties or incomplete files. These documents were not analyzed and were not treated as exclusions based on substantive relevance or study quality. Thus, the 11 studies analyzed constitute an available working corpus rather than the final inclusion count for the entire Scopus search. The deduplication history, search dates and queries, detailed eligibility criteria, and article-level decisions require further verification before the manuscript can be described as a finalized SLR.

The unit of analysis is the primary study, not the number of respondents or individual statistical findings. The synthesis focuses on publications addressing the use of digital technologies to collect or integrate environmental information, EMA practices—including physical and monetary information—or their implications for environmental decisions and control. This restriction is intended to align the research questions with verifiable evidence, not to imply that unavailable candidate studies are irrelevant.

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Table 1. Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Topic	A substantive relationship between digital technology/information systems and EMA practices or environmental information used in organizational management.	Only addresses digitalization or sustainability generally, without a link to EMA or environmental information processes.
Focus	Data acquisition, interoperability, physical–monetary information integration, MFCA, or the use of EMA information in decisions.	Does not examine environmental information processes, EMA practices, or their organizational use.
Unit of evidence	Primary studies with a research design, data sources, or system design that can be examined from the full text.	General conceptual papers or documents that do not provide relevant primary evidence for the focused synthesis.
Full-text availability	Full text is available to verify methods, findings, and limitations.	Full text unavailable: recorded as not retrieved, not as a substantive exclusion.
Outcome relevance	Reports technology/EMA functions, integration processes, managerial decisions, or related environmental outcomes.	Provides no findings that can be mapped onto the digitalization–EMA–decision mechanism.

The eligibility of documents in the focused synthesis corpus was assessed against the operational criteria presented in Table 1. These criteria describe the basis for reviewing the 11 available studies; their retrospective application to all 60 candidates has not been audited and should not be interpreted as a verified selection protocol.

Table 2. PRISMA Selection Summary

Stage	Number	Interpretation
Scopus export	313	Source records; deduplication audit not yet confirmed
Excluded during title/abstract screening	253	Classification from previous screening
Candidates for eligibility assessment	60	17 preliminarily reviewed + 43 full texts not adequately accessible
Full texts available	17	Reviewed for the focused draft
Primary evidence in working synthesis	11	Not the final PRISMA inclusion count
Full texts not adequately retrieved	43	43 candidates: failed downloads or incomplete files; not substantive exclusions

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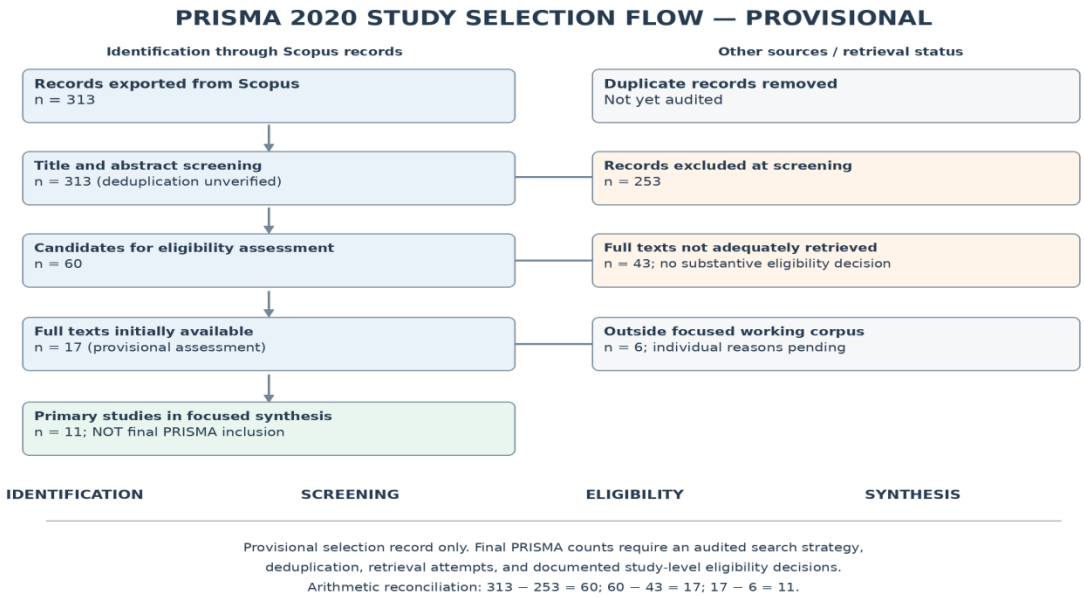

Figure 1. PRISMA 2020 flow diagram: Identification, screening, eligibility, and provisional synthesis of EMA research in the digital transformation era.

Figure 1 illustrates the initial selection process from 313 Scopus records to a working corpus of 11 primary studies. The figure of 43 refers to reports that could not be adequately retrieved, not articles rejected after content appraisal. The diagram is used as a provisional transparency record; a final PRISMA inclusion count can be established only after the selection audit is completed. Arithmetic reconciliation gives 313 − 253 = 60 candidates; 60 − 43 = 17 available full texts; and 17 − 6 = 11 studies in the synthesis. The six documents not used as primary evidence require individual decision reasons in the selection log. The deduplication history, Scopus search string and export date, and retrieval attempts for the 43 reports are not yet available as a complete audit trail; the diagram is therefore labeled provisional.

DATA EXTRACTION, SYNTHESIS, AND QUALITY APPRAISAL

Data were extracted from the 11 primary studies in the working corpus, including publication details, country and sector, research design, data-source characteristics, digital technology, EMA function, performance or decision measures, main findings, and reported limitations. The information was organized into an evidence matrix to facilitate cross-study comparison. The thematic synthesis grouped evidence into three analytical mechanisms: (1) environmental data acquisition and interoperability, (2) integration of physical and monetary information through EMA, and (3) information use in managerial decisions and environmental control.

Studies were compared with attention to differences among surveys, case studies, qualitative research, and system-design studies. Nonsignificant findings were retained to avoid selective emphasis on positive results. No meta-analysis was conducted because differences in design, construct definitions, outcome indicators, and implementation contexts precluded the pooling of comparable effect sizes. Interpretation was therefore limited to patterns and mechanisms supported by the available studies, without asserting uniform causal relationships.

Quality appraisal was structured around six domains: alignment between design and research question, clarity of sample or case selection, operationalization of EMA and digitalization constructs, appropriateness of analytical methods, validity of outcome measurement and risk of bias, and transparency regarding limitations. Each domain served as a design-sensitive guide to critical appraisal rather than a numerical score directly comparable across research designs. Because full-text, page-level verification remains incomplete for some domains, this manuscript does not present final article-level quality scores. This is explicitly acknowledged as a methodological limitation A source audit of the 11 available full-text files compared their principal claims, contexts, designs, and identifiable limitations. Quality appraisal was differentiated by design: observational surveys were examined for potential common-method bias, sample representativeness, and temporal ordering; qualitative studies for case selection, coding transparency, and transferability; implementation studies for the presence of a comparator; and system-design studies for the distinction between technical feasibility and

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environmental effectiveness. This was a domain-based narrative audit, not a formal risk-of-bias score or an independent appraisal by two reviewers.

RESULTS AND DISCUSSION

Study characteristics and strength of evidence

The 11 primary studies synthesized include surveys, an MFCA–IoT implementation case study, qualitative research in hospitality, and the design of agricultural accounting information systems. Variation in sectors, countries, units of analysis, and research designs allows comparison of digital EMA implementation mechanisms but does not support pooling results into a single effect estimate. Table 3 summarizes the contribution and limitations of each study; associative findings, process implementation outcomes, and system-design feasibility are interpreted according to their evidential strength.

Table 3. Evidence Matrix of the 11 Primary Studies

Study	Evidence type	Main finding / limitation
Li et al. (2026)	Survey; managers	Digital capability → EMA integration → decision quality; causal limitations
Metwally et al. (2026)	Survey; one Egyptian firm	Blockchain × EMA moderation; single-firm sample
Abdelhalim et al. (2023)	Survey; Saudi Arabia	Digital EMA moderation; nonsignificant direct eco-efficiency effect
Huy & Phuc (2025)	Quantitative supply-chain study	Digital EMA mediation; uncertain transferability of constructs
Simanjuntak et al. (2025)	Indonesian manufacturing	Smart accounting and environmental service quality; observational evidence
Sodkomkham et al. (2024)	Single-factory case study	MFCA–IoT–lean; observable resource/cost changes, no counterfactual
Nyide (2025)	Qualitative; hotels	Digital tools, barriers, and contextual insights; limited transferability
Dratwińska-Kania & Karmańska (2026)	Multicountry survey	Technological sophistication and EMA; nonsignificant uncertainty relationship
Huynh & Nguyen (2025)	Vietnamese survey	Stakeholder engagement and digital context; self-report limitations
Poppe et al. (2022)	System design; farms	Robotic accounting architecture; no verified causal performance effect
Poppe et al. (2023)	System integration design; farms	Financial–farm-system integration; design feasibility

Three-layer mechanism: Digital data, EMA integration, and decisions

The synthesis identifies three interconnected but conceptually distinct layers. The first is the acquisition and interoperability of environmental data through sensors, the Internet of Things (IoT), blockchain, or integrated

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information systems. The second is EMA integration, which links physical quantities of materials, energy, water, and waste to costs, processes, and responsibility centers. The third is the use of information for budgeting, process control, investment appraisal, and environmental improvement decisions. Li et al. (2026) provide evidence of associations among digital capabilities, EMA integration, and decision quality, while Poppe et al. (2022, 2023) highlight opportunities to integrate accounting and operational data. These findings support the importance of linking mechanisms, not the claim that technology ownership automatically improves environmental performance.
In production settings, Sodkomkham et al. (2024) illustrate how MFCA combined with IoT and lean practices can identify resource losses and related costs. This case study provides more concrete operational evidence than perceptual measures, but observations from one facility cannot be generalized as an average effect across industries. The benefits of digital EMA should therefore be assessed through actual information use and measurable changes in process indicators.

Comparison of empirical findings and inconsistent results

Findings across studies do not point uniformly in the same direction. Abdelhalim et al. (2023) report a nonsignificant direct relationship between eco-efficiency and sustainability in their tested model, whereas the digital EMA interaction is significant. Li et al. (2026) report a role for EMA integration in their model linking digital capabilities and performance, but the moderating effect of regulatory pressure is nonsignificant. Dratwińska-Kania and Karmańska (2026) likewise report a nonsignificant environmental uncertainty relationship in their model specification. These findings are not replications because the constructs, samples, and tests differ. Rather, the comparison underscores the need to specify context and EMA operationalization explicitly.

Table 4. Quality Appraisal Framework and Verification Status

Domain	Verification rule	Current status
Q1: Design suitability	Research question and design are aligned	Provisional; check source pages
Q2: Sampling	Sample, recruitment, context, and exclusions are reported	Provisional; heterogeneous designs
Q3: Construct clarity	EMA and digital constructs are operationally distinguished	Important issue across studies
Q4: Analysis	Measures, estimation, assumptions, and uncertainty are reported	Source-level verification pending
Q5: Bias	Confounding, common-method effects, and case selection are considered	Potential risk; not consistently addressed
Q6: Claim support	Conclusions are calibrated to observed outcomes	Design-specific caution required

Table 5 provides brief appraisal notes for each study. The risk categories identify methodological concerns, not eligibility decisions or standardized scores.

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Table 5. Narrative Appraisal and Limits of Inference for the 11 Primary Studies

Study	Evidence type	Quality note / inference limit
Li et al. (2026)	PLS-SEM survey	Sequential mediation is associational; consider temporal ordering and common-method bias.
Metwally et al. (2026)	Single-firm survey	Single-organization coverage limits generalizability.
Abdelhalim et al. (2023)	Survey of 77 respondents	Limited sample; distinguish main and interaction effects.
Huy & Phuc (2025)	Survey/relational model	Supply-chain outcomes are not equivalent to measured environmental impacts.
Simanjuntak et al. (2025)	Manufacturing supply-chain study	Service and logistics outcomes do not automatically represent emissions.
Sodkomkham et al. (2024)	MFCA–IoT–lean implementation	Context-specific process evidence; no general effect demonstrated without a comparator.
Nyide (2025)	Qualitative multiple-case study	Explains context and barriers; limited transferability.
Dratwińska-Kania & Karmańska (2026)	Cross-country survey	Observational relationships; 2026 is the journal volume year.
Huynh & Nguyen (2025)	Firm survey	Potential respondent-perception bias and confounding.
Poppe et al. (2022)	System design	Technical integration is not evidence of environmental performance.
Poppe et al. (2023)	System integration design	Sustainability reporting does not automatically establish internal EMA use.

Methodological Quality And Risk Of Bias

By design, the surveys by Li et al. (2026), Metwally et al. (2026), Abdelhalim et al. (2023), Huy and Phuc (2025), Simanjuntak et al. (2025), Dratwińska-Kania and Karmańska (2026), and Huynh and Nguyen (2025) primarily support associational inference. Major concerns include reliance on the same respondents for predictors and outcomes, limited sample generalizability, and uncertain temporal ordering. Nyide (2025) provides contextual explanations from interviews but does not estimate effect sizes. Sodkomkham et al. (2024) demonstrate process mechanisms in an MFCA–IoT–lean implementation, while Poppe et al. (2022, 2023) demonstrate the potential for system-architecture integration; none of these three studies should be treated as a cross-organizational causal test.

Quality appraisal uses the six domains in Table 4: design suitability, sample selection, construct clarity, analytical appropriateness, outcome validity, and the evidential support for conclusions. As verification of each domain against full texts remains incomplete, the table is an audit framework rather than a final scoring result. Surveys may be subject to common-method bias and uncertain temporal ordering; case studies to concurrent interventions and limited transferability; and system-design research may not demonstrate routine adoption or changes in performance. Findings in this synthesis are interpreted within the constraints of each design.

Sectoral Differences And Transferability Of Findings

Manufacturing and process-industry studies focus on material losses, energy and water use, and process efficiency; hospitality research identifies barriers to using digital tools in environmental practices (Nyide, 2025); and agricultural studies emphasize links between farm-management systems and accounting records (Poppe et al., 2022, 2023). These differences suggest that digital EMA indicators should reflect the process boundaries and decision objectives of each sector. A single technology-adoption measure is insufficient to represent EMA maturity. The transferability of findings is also affected by sample coverage. Metwally et al. (2026) examine respondents from one organization, while Abdelhalim et al. (2023) use a relatively small sample. Accordingly,

observed associations should be retested across organizations and sectors before broad generalizations are made. Cross-context evidence would be stronger if EMA integration and environmental performance were operationalized using comparable measures.

Environmental Performance Measurement And Alternative Explanations

Several studies rely on perceptual measures of environmental performance or sustainability. Such measures capture managerial assessments but are not equivalent to objective measurements such as energy intensity, water volume per unit of output, material losses, emissions, or negative-product costs. Future studies should therefore combine operational and accounting data and document baseline conditions before digital interventions. Reductions in costs or resource use may also reflect changes in production volume, raw materials, or other efficiency initiatives. Nonsignificant moderation results in several models caution that regulatory pressure and environmental uncertainty do not necessarily strengthen the relationship between EMA and performance. Differences in construct measurement, institutional context, and statistical power may play a role; however, these are possible explanations rather than causal findings established by this synthesis.

Conceptual Framework And Research Propositions

Based on the synthesis, this review proposes four propositions for empirical testing. P1: Digital capabilities are associated with EMA integration when systems enable the combination of physical and monetary data. P2: The use of EMA information in managerial decisions is a potential linking mechanism between EMA integration and improvements in objective environmental performance. P3: Environmental accounting competencies and organizational readiness may influence the translation of integrated data into action. P4: Assessments of digital EMA effects should account for baseline conditions, production volume, and concurrent efficiency interventions. These propositions constitute a research agenda, not causal relationships established by the 11 studies.

Theoretical And Managerial Implications

The conceptual contribution of this review is the distinction among data availability, EMA integration, and information use. This distinction helps explain why the digitalization of environmental reporting does not necessarily produce environmental cost information useful for internal control. EMA is positioned as a mechanism for translating operational data into information relevant to managerial action, rather than as a synonym for digital technology.

Implementation implications and research agenda

Organizations may begin implementation with one material or energy flow of substantial importance. Records of input quantities, products, and losses can be reconciled with purchasing, processing, and disposal costs and then used to prioritize actions and assign process responsibility. A phased approach allows organizations to evaluate the usefulness of information before expanding investment in digital systems. For researchers, longitudinal designs across organizations are better suited to testing the sequence linking data collection, EMA integration, decisions, and changes in environmental outcomes. Indicators should include evidence of actual decision use and auditable objective measures, with controls for production characteristics, firm size, and other environmental interventions.

Synthesis limitations and reporting transparency

All substantive discussion is limited to the 11 available primary studies. The PRISMA 2020 diagram in the methods section records a provisional search status; because deduplication, access to other candidates, and individual exclusion reasons have not been fully verified, the figure of 11 must not be presented as the final PRISMA inclusion count. This limitation reduces the completeness of literature coverage and must be considered when interpreting the novelty and consistency of findings. The audit reinforces the need for cautious interpretation: evidence of technical implementation is not the same as evidence that EMA information informs decisions, and perceptual performance measures cannot be equated directly with measured reductions in emissions, water use, or waste. With only 11 articles available for appraisal, generalization to the entire Scopus literature remains limited.
Before submission, further work should document the search strategy and dates, individual selection decisions, and quality appraisal of each study against full-text evidence. Completing this audit is important to substantiate the claim that the review is systematic and reproducible.

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CONCLUSION

This review synthesizes evidence from 11 primary studies examining the relationship between digital transformation and environmental management accounting (EMA). The findings suggest that digital technologies can support EMA through three interconnected yet conceptually distinct mechanisms: (1) the acquisition and interoperability of environmental data, (2) the integration of physical and monetary environmental information into management accounting processes, and (3) the utilization of EMA information in managerial decision-making. However, the availability of digital technologies does not necessarily translate into effective EMA implementation or measurable improvements in environmental performance. The principal theoretical contribution of this review is the development of a three-layer conceptual framework that distinguishes digital infrastructure, EMA integration, and managerial information utilization. This framework provides a basis for explaining why technological adoption alone may be insufficient to improve environmental outcomes. From a practical perspective, organizations should prioritize the reliability of environmental data, the integration of resource-flow information with relevant costs, and the systematic use of EMA information in operational control, budgeting, and investment decisions.

Nevertheless, the findings should be interpreted cautiously because the reviewed studies differ in research design, organizational context, measurement approaches, and analytical methods. The evidence remains insufficient to establish consistent causal relationships between digital transformation, EMA implementation, and environmental performance. Future research should therefore employ longitudinal and comparative designs, incorporate objective environmental performance indicators, and examine the organizational conditions that enable digital environmental information to influence managerial decisions and sustainability outcomes. Finally, this review is limited to 11 accessible primary studies and does not claim comprehensive coverage of the literature. The study selection process and associated PRISMA 2020 documentation require further verification before the review can be regarded as a fully completed systematic literature review.

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