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Conceptual Environmental Sustainable Development Through Environmental Management Accounting Practices

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ABSTRACT

Corporations possess subsidiaries globally, forming a corporate network that engages with both human and natural cultural systems. The process of combining ecological and economic viewpoints presents certain difficulties. To achieve strong sustainability, it is necessary to transition from a business-centric strategy to one that integrates ecological principles into strategic decision-making. The objective of this study was to examine the role of Environmental Management Accounting in promoting company sustainability. An extensive examination of existing research, known as a systematic literature review, was conducted from 2015 to 2024. The Environmental Management Accounting paradigm was utilized in several contexts, encompassing corporate governance, supply chain management, and sustainability management accounting. A total of 868 full-text publications were found. EMA is a systematic approach for combining financial and non-financial measures of performance. This study aims to emphasize the importance of Environmental Management Accounting in addressing the challenges posed by the investigation of future opportunities, and how scholars and practitioners can contribute to the path towards corporate sustainable development. The focus is on the interaction between MA alignment and shifts in the structure and external circumstances. In addition, the study identified prospective areas for future research and highlighted their value for both scholars and practitioners.

1. INTRODUCTION

Corporations are dispersed worldwide, forming a network that engages with both human and natural cultural systems. This interdependent system requires a thorough comprehension of the world's workings, limitations, and opportunities. However, combining ecological and economic perspectives is not without difficulties. One example is the industrial world's unsustainable dependency on fossil fuels because of poor oversight and management of waste products, such as carbon dioxide. Future business plans must prioritize sustainability to solve this problem, requiring cooperation between producers, customers, and governments to guarantee long-term profitability [1].

Environmental Sustainable Development (ESD) is becoming more acknowledged as a crucial construct for tackling the intricate interaction among economic development, social fairness, and environmental preservation. At the core of this paradigm lies the function of Environmental Management Accounting (EMA), which incorporates environmental factors into accounting procedures to advance sustainability. Existing literature emphasizes several aspects of Environmental Management Accounting (EMA) and its influence on sustainable development.

The connection between natural systems and the corporate world highlights the importance of studying sustainable company plans. This interaction highlights the importance of incorporating ecological factors into business planning to successfully address environmental challenges and promote sustainable practices. Fostering sustainable operations within firms requires corporate sustainability, which includes economic, social, and environmental components. Businesses can create mutually beneficial partnerships that improve strategic and operational integration and foster more sustainable practices by coordinating company identity with sustainability goals.

A change from a business-centric strategy to one that integrates ecological principles into strategic decision-making is necessary to achieve strong sustainability. Corporate governance plays a critical role in improving business sustainability across economic, environmental, and social aspects. Organizational culture and performance can be shaped by effective sustainability management, highlighting the necessity of governance frameworks that assist in environmental sustainability [2].

Environmental Management Accounting (EMA) refers to a collection of methods and procedures that enable the gathering, examination, and communication of both financial and non-financial data about environmental performance. Integration of environmental and economic performance is crucial for

organizations seeking to improve their operations and support sustainable business practices [3]. The concept of Environmental Management accounting (EMA) is based on the recognition that natural resources are limited, requiring a well-balanced strategy for resource use that adheres to principles of environmental sustainability and social justice [4].

Using sustainable practices, businesses can reduce their impact on natural systems and promote long-term societal well-being and economic development. To ensure a more sustainable future for all parties concerned, it is imperative that corporations and the environment have a harmonious relationship, which can only be achieved via research and strategic planning centered on sustainability.

The research questions to guide this study are as follows:

RQ1: What changes have occurred in EMA in recent decades?

RQ2: What is the possible future agenda for EMA?

The EMA framework and SMA offer potential roles for stakeholders in corporate development. The EMA focuses on improving performance by integrating economic and environmental factors, while SMA emphasizes market-oriented entrepreneurial and innovative opportunities. Future research should explore SMA's application, relationship with management accounting tools, and practitioners' involvement.

This article is structured into multiple sections. The initial section introduces the article by outlining the research gap, research questions, and objectives. Section two delineates the methodology employed, which includes literature search, paper selection, and assessment. The third section presents the research findings. The fourth section presents the research findings and addresses the research questions. In the conclusion section, the current state is assessed, and a roadmap for future research is outlined.

2. METHOD

2.1 Literature search

Empirical evidence suggests that the implementation of EMA can have a substantial impact on organizational practices and decision-making procedures. Empirical evidence has demonstrated that Environmental Management Accounting (EMA) can significantly improve a company's environmental performance, thereby resulting in enhanced productivity [5, 6]. Moreover, the adoption of EMA practices is frequently motivated by external sources of pressure, such as regulatory obligations and community demands, which force enterprises to embrace more environmentally friendly activities. The aforementioned pressures underscore the need to include EMA into wider organizational strategies in order to guarantee adherence and improve involved stakeholders.

Nevertheless, the effective execution of EMA is not devoid of obstacles. Constraints such as limited ecological knowledge, inadequate financial resources, and expensive implementation expenses can impede the successful incorporation of Environmental Management Accounting (EMA) into organizational structures [7]. Moreover, the requirement for dependable environmental data is of utmost importance, as conventional management accounting systems frequently fail to provide the essential information for well-informed environmental decision-making [6]. Effectively overcoming these obstacles is crucial for organizations to effectively exploit EMA as a means for achieving sustainable growth.

Furthermore, empirical data validates the correlation between EMA and corporate sustainability, indicating that firms that embrace EMA methods are more effectively positioned to achieve sustainability objectives [8]. Particularly pertinent in areas like tourism, where Environmental Management Accounting (EMA) has been recognized as a crucial catalyst for sustainable practices in tourist villages, showcasing its relevance in many industries [3, 9]. Incorporating Environmental Management Accounting (EMA) into sustainability reporting frameworks can significantly improve openness and accountability, enabling organizations to disclose their environmental effects more efficiently [10].

The scholarly literature on Environmental Management Accounting emphasizes its crucial function in advancing Environmental Sustainable Development. By incorporating environmental factors into accounting procedures, firms can enhance their economic performance and also support wider sustainability objectives. Nevertheless, it is essential to surmount the current obstacles to the use of EMA in order to optimize its possible advantages.

A systematic literature review (SLR) is essential for unbiased literature analysis. A PRISMA-compliant systematic literature review (SLR) was conducted [11, 12].

The selection of bibliographic databases, keywords, and search algorithms was the first step in the literature review. Another way to ensure information quality and relevance is to search only for journal-ranked publications. Well-known literature databases were searched for research-related publications to complete this study. From 2015 to 2024, Environmental Management Accounting (EMA) scholarly publications and journals were searched. Three hundred and fifty-five Google Scholar, 159 Scopus, 267 Emeral, and 87 ScienceDirect publications were identified. The search strings are listed in Table 1.

Table 1. Search strings used in each database

Database	Keyword with String	Search
Google Scholar	"Environmental Accounting" AND/OR "Environmental Management Accounting" AND/OR "Environmental Management Accounting Practices" AND/OR "Sustainability Accounting"	355
Scopus		159
Emerald		267
Science Direct		87

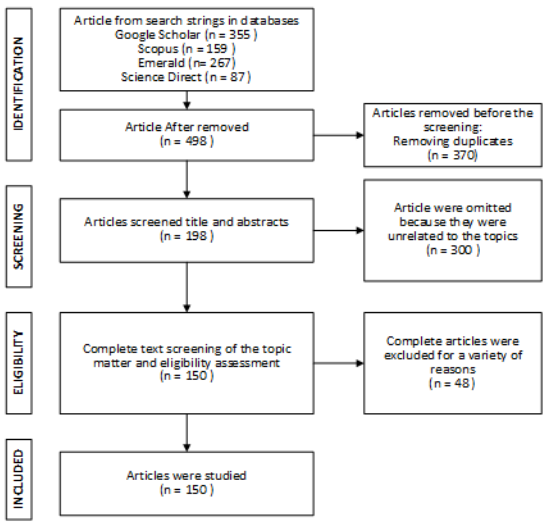

Figure 1. PRISMA data collection and selection [11]

2.2 Paper selection and assessment

The aforementioned search terms were used in four scientific databases, resulting in 868 full-text publications. Publications were systematically screened for evaluation. The procedure for data gathering and subsequent selection is illustrated in Figure 1.

3. RESULT

Owing to the extensive range of topics pertaining to Environmental Management Accounting (EMA), it is imperative to utilize clustering techniques. The debates were classified into four main categories-Management Accounting, Environmental Management, Environmental Accounting, and Sustainability Accounting-based on the findings of the literature review. A visual representation of these groups can be observed in Figure 2, which shows the distribution of the articles by year, and Figure 3 shows the distribution of the articles by journal publisher.

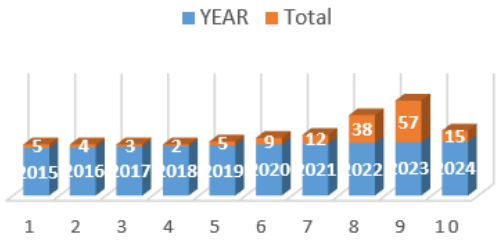

Figure 2. Temporal distribution of the articles

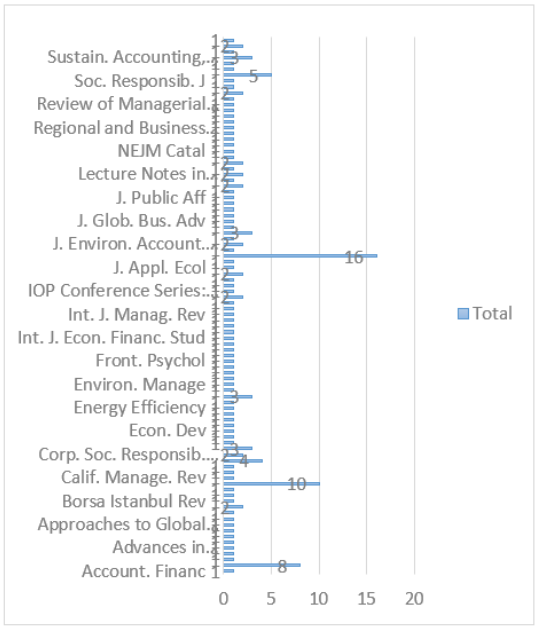

Figure 3. Distribution of researcher article publications in scientific journals within 10 years

3.1 Most Productive Countries in the last 10 years

Table 2 displays the countries that have made the greatest contributions to EMA research over the past decade. The data presented in the table indicate that Germany is the most productive country, producing 22 articles. China followed closely with 21 articles, while Italy, Indonesia, Australia, and the UK produced 10, 9, 6, and 5 articles, respectively. Iran, Japan, South Africa, Sri Lanka, and the United States each contain four articles. The remaining countries had between one and three articles.

Table 2. Most Productive Countries in the last 10 years

Country	Publication	Country	Publication
Germany	22	Ukraine	2
China	21	Bangladesh	1
Italy	10	Egypt	1
Indonesia	9	England	1
Australia	6	Finland	1
United Kingdom	5	France	1
Iran	4	Ghana	1
Japan	4	Hungary	1
South Africa	4	Iraq	1
Sri Lanka	4	Ireland	1
United States	4	Korea	1
Canada	3	Lithuania	1
Greece	3	Norway	1
India	3	Oman	1
Netherland	3	Poland	1
New Zealand	3	Portugues	1
Spain	3	Russia	1
UnitedArab Emirates	3	Singapore	1
Austria	2	Sweden	1
Brazil	2	Switzerland	1
Jordan	2	Turkey	1
Kazakhstan	2	Vietnam	1
Malaysia	2	Yemen	1

Figure 4 demonstrates that a significant number of studies have been conducted by multiple researchers in the field of Environmental Management Accounting. However, additional research is required to investigate these topics.

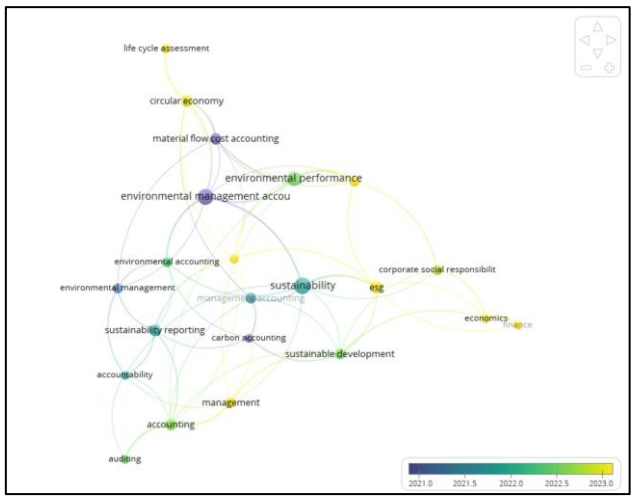

Figure 4. Distribution of articles based on the occurrence of keywords

The mapping process, which relies on the occurrence of keywords, resulted in the identification of six clusters. Cluster 1 is associated with topics such as accountability, accounting, auditing, environmental management, management, sustainability reporting, and sustainable development. Cluster 2 is associated with the fields of environmental accounting, environmental management, ESG (Environmental,

Social, and Governance), and sustainability. Cluster 3 included carbon accounting, management accounting, and sustainable development. Cluster 4 pertains to the areas of corporate social responsibility, economics, and finance. Cluster 5 pertains to the concepts of circular economy, life cycle evaluation, and material flow cost accounting. Cluster 6 focuses on the correlation between environmental performance and financial performance.

Based on EMA articles published between 2015-2024, we can see the distribution of keywords that are often used in describing the problems discussed. Figure 5 shows the keywords used by the authors. EMA researchers have conducted and presented several noteworthy studies over the past 10 years. These studies cover a wide range of topics including "accountability" [13], "accounting" [14], "auditing" [15], "sustainability", [1, 16], "climate change", [17, 18], "environmental management" [19, 20], "management sustainability reporting" [1], "sustainable development" [21, 22], "environmental accounting" [23, 24], "Environmental, Social, and Governance" [25-27], "sustainability carbon accounting" [28, 29], "management accounting" [30], "corporate social responsibility" [31, 32], "economics finance", "circular economy" [33-35], "life cycle evaluation" [36, 37], "material flow cost accounting" [33, 38, 39], "environmental performance" [40, 41], "financial performance" [42-44].

Figure 5. EMA research between 2015 to 2024

4. DISCUSSION

4.1 What are the changes that have occurred in the EMA area in recent decades?

There have been notable shifts in the emphasis and domains of concern within the realm of environmental and sustainability management since then, which has likewise impacted the advancement and examination of the EMA. The forthcoming revisions will be thoroughly examined in the subsequent discussion, accompanied by citations to significant scholarly works and a concise summary of the main topics in Table 3.

Environmental areas of EMA application

The EMA focuses on material flow cost and management accounting to minimize lost and enhance material use. ISO 14051 and ISO 14053 are voluntary standards for MFCA that provide guidance for management decision-making. MFCA tracks and analyzes the costs associated with material flow in a company, addressing environmental expenses that are not typically accounted for in traditional accounting methods.

In addition to its application, academics and practitioners have embraced the EMA concept and use it in several developing environmental possibilities and difficult areas. One area of focus in this field is climate change, which includes topics such as carbon management accounting, water management accounting, cotton production, accounting and management [45-48], and energy management accounting [44].

Table 3. Key literature for various subjects

Subject	Key Literature
Frequency of EMA-applied environments	[45-53]
EMA to SMA framework extension	[38, 48, 54-59]
Accounting scope expansion	[14, 47, 48, 60-65]
Measurements, standards, methodologies, reports	[22, 24, 48, 66-70]
Function of accountants	[47, 48, 71-73]
Overfocus on reporting and new IT breakthroughs drive EMA development	[46, 52, 61, 72, 74, 75]

EMA practices towards Sustainability Management Accounting (SMA) framework

With increasing apprehension regarding sustainability and unsustainability, there has been a broadening of environmental concerns that are now supplemented by the inclusion of management accounting for social sustainability challenges. Recently, there has been a focus on addressing many societal concerns. The topics covered in the literature include health management accounting [38], modern slavery accounting and management [14, 54], ecosystem accounting in relation to pandemics, and management accounting for gender discrepancies and inequalities [57, 58]. By utilizing the concept of sustainability management accounting (SMA), businesses are increasingly incorporating negative externalities into their decision-making processes. In addition, there is an overlap in expanding the field of investigation to include public sector organizations, as these entities have well-established social objectives and are a suitable environment for conducting research on sustainability management accounting (SMA). Clerkin and Quinn [55] and Nolte et al. [59] are two examples of researchers focusing on different aspects of gender disparity and budgeting in the public sector. Nolte et al. [59] are worried about this issue in general, while [55] particularly explored the perspectives of international development NGO finance managers. Clerkin and Quinn, (2021) observed that the financial management accounting role in social settings prioritizes donor compliance over enhancing social impact. This raises the question of how sustainability management accounting (SMA) can be utilized more effectively in such contexts. Conaty and Robbins [56] addressed similar concerns as they investigated the management of performance in non-profit organizations in connection to intellectual disability, specifically focusing on the control of stakeholder salience.

Extension of the scope of accounting

In the past ten years, there has been a stronger focus on expanding the range of EMA information to encompass supply chains, in addition to the organization itself. Supply chain sustainability has a substantial impact on both products and a company's overall sustainability. Therefore, the scope of EMA is being expanded to encompass supply chain management issues related to climate change, raw materials, and labor. Additionally, it is discussed how the EMA can be connected to planetary boundaries. The shift towards relation

EMA and supply chain is a result of globalization and the growing complexity of business networks. This is driven by the understanding that large multinational organizations have substantial economic influence, which can be leveraged to drive positive change. This is especially crucial in developing nations because domestic laws are insufficient, and foreign governments dedicated to the environment lack authority. Nevertheless, the relationship between SMA and potential modifications has been inadequately researched [48].

Measures, benchmarks, methods and accounts

Extra-institutional organizations have collaborated with countries to tackle global environmental and social disasters as part of their efforts to solve the normative challenge of sustainable development. The United Nations implemented 17 Sustainable Development Goals (SDGs) in 2015 to improve the well-being of humanity. These goals come with specific targets, and the corporate sector has been urged to participate in efforts to accomplish these goals [76]. Although there have been attempts to assess advancements in attaining social and environmental objectives, techniques for appraising corporate contributions such as EMA and SMA are still in the process of being refined. However, it is important to note that these aspirations are currently at risk of not being achieved. These significant developments demonstrate that the worldwide scenario has undergone substantial transformation since the publication of the EMA comprehensive framework. The majority of environmental and sustainability issues have become more severe and have deteriorated since 2002. The global community is currently experiencing an unprecedented level of conflict, surpassing any previous instance since the establishment of the United Nations. Furthermore, projections indicate that the original goal of achieving the 17 Sustainable Development Goals (SDGs) by 2030 is unlikely to be accomplished. The importance of EMA and the data it provides, along with the use of EMA and Social Management Accounting (SMA) systems, in enhancing decision-making and aligning with sustainable development goals is increasingly crucial. In addition, the role of businesses in addressing global environmental and social challenges is of utmost importance.

Role of accountants

Practitioners and scholars have questioned the traditional perspective of management accounting in response to these conditions. Skilled management accountants possess the ability to analyze the possible influence of social, political, macroeconomic, and environmental issues on the financial outcomes of the organization. Management accounting has undergone adjustments that have been positively received by the EMA. Gunarathne et al. [46] examined various corporate environmental management methods and their corresponding contingency EMA tools and applications.

Carnegie et al. [71] defined modern accounting as a multifaceted activity that encompasses technical, social, and moral aspects. It is primarily focused on the responsible and sustainable utilization of resources, as well as ensuring proper accountability to stakeholders. The ultimate goal is to foster the growth and well-being of organizations, individuals, and the environment. This reflects academic preoccupation with the fundamental essence of accounting. EMA is undergoing a transformation into SMA, as it is evident that the definitions of accounting and SMA are becoming more aligned. However, the incorporation of social issues into SMA is still in its early stages, both in theory and practice [72].

To summarise, the shift in focus during the past decade can be characterised by the following changes when considering the past. Research efforts under the EMA framework have mostly focused on expanding the application areas in the environmental field. These areas include waste management, material flow, carbon emissions, water resources, energy consumption, and biodiversity conservation.

- Subjects: Expanding the range of topics covered by the EMA to include social issues such as modern slavery and diversity, in addition to environmental concerns. This has led to the need for a wider range of tools for managers to promote sustainability. This has led to research focusing on EMA framework can encompass.
- Scope: This involves adhering to legislative changes that require an assessment of environmental and sustainability data in supplier chains.

Consequently, the EMA framework has been extended to encompass more than just a company's framework.

- Measurements, standards, methodologies, and reports: Accounting has been recognized to have a broader scope, including environmental and social sustainability challenges. This has led to renewed emphasis on considering decision-making scenarios within the EMA framework, which also considers sustainable development contexts.

4.2 The possible future agendas for EMA

The developmental trends observed in EMA during the past decade serve as a foundation for contemplating potential adaptations of the EMA framework in the future. Each theme was systematically examined by the co-authors, taking into account their collective experience.

4.2.1 Area application

Two trends define the distinctive features of future application fields. These pertain to additional specializations within certain environmental fields and the incorporation of environmental concerns. In the context of biodiversity, the existing literature is still in its early stages of development [48]. To establish protection, conservation, and restoration policies for companies, it is necessary to have EMA information that reveals potential harm to various ecosystems and species [77]. Furthermore, the inclusion of EMA research in the contentious field of biodiversity offsetting and the exploration of management opportunities to achieve and surpass zero biodiversity loss would be highly [45]. Implementing biodiversity management accounting in various developing countries, utilizing diverse methodologies, and theoretical frameworks at the organizational level, would enable the effective utilization of different EMA tools.

4.2.2 Extension of EMA framework

The social dimensions of SMA have been rather slow to develop. However, they encompass several aspects, such as the focus on the management control in supply chains and environment. Additionally, efforts to promote decent labor and combat modern slavery are also considered part of the social aspects of SMA, as highlighted by Christ et al. [78]. This approach aims to tackle problems such as modern slavery in businesses involved in deforestation. However, this approach has not yet been implemented in SMA.

Environmental impacts play a crucial role in sustainability. As new ideas and methods have been developed, the application of EMA has been integrated into efforts to establish a circular economy. The goal is to eliminate harmful side effects of industrial processes, such as those highlighted in the study [33]. Additionally, there is growing recognition of the social and health consequences associated with product design, including the toxic aspects of packaging and production processes, as discussed by Kennedy and Linnenluecke [35]. In the future, there is likely to be a focus on SMA and on providing information to encourage the adoption of positive externalities.

4.2.3 Role of accountants

In addition to the proposed expanded responsibilities of management accountants, there is a growing presence of new management which utilize SMA information. Thus, the concept that managers require information that is distinct from the accounting system remains valid. However, the emergence of novel categories of managers has evolved and is expected to persist. The framework has the capacity to adapt to such possibilities; however, it is crucial to maintain ongoing vigilance for SMA to remain pertinent. Currently, the existing EMA literature does not adequately address many types of managers and their specific needs. It is crucial that this issue be addressed in the future.

4.2.4 Scope

To be successful in the future, it is necessary to transform macro-level SDGs and planetary boundary targets into specific objectives that companies may strive to attain. Traditionally, management accounting has been the primary foundation for making decisions on how to achieve desired goals. It is therefore crucial for companies to prioritize and engage with various aspects of performance to work towards the SDGs and stay within environmental limits. Additional financial and physical benchmarks from the EMA are required in situations where various natural capital boundaries become strained or to effectively address the reduction of pressure on limits that are already overstressed. This is particularly important as the achievement of SDGs approaches a critical condition.

4.2.5 Measurements, standards, methodologies, reports

Tracking non-monetary/non-financial environmental and social data is becoming crucial. Both internal decision-maker reports and external reports should contain this information. Creation of strategies to assist decision-makers and personnel in effectively executing corporate operations. This encompasses sustainability management control systems that aid and exerting management influence over staff behavior to advance sustainability changes both within and beyond the organization.

4.2.6 Driver of EMA development

SMA information is intended for various managers who act as catalysts for sustainability, such as those in procurement, production, marketing, human resources, and other related areas. The use of SMA can aid in this process. As the focus on eradicating modern slavery in operations and supply chains intensifies, managers need information pertaining to identification, training, education, and policies for prevention and reduction. Furthermore, it is essential for them to take proactive measures [48] by strategically implementing technologies, such as integrating blockchain information and implementing transportation systems that are resistant to modern slavery.

Environmental Management Accounting (EMA) techniques and their function in supporting ecologically sustainable development have various constraints that should be considered. Geographic, methodological, and contextual constraints may restrict findings' generalizability and applicability. EMA research often focuses on specific regions, particularly developed countries, which may not accurately reflect the challenges and opportunities faced by developing nations, especially low-income countries with less developed environmental management practices. Qualitative approaches to EMA investigations may be limited by their depth and bias. These research' small sample sizes and specific industries may not provide a complete picture of EMA practices across sectors, fragmenting knowledge. External factors including regulatory demands and market dynamics affect EMA practices. Comprehensive frameworks to combine these factors are needed. Leadership styles, managerial dedication, and stakeholder participation are typically disregarded, limiting how EMA may transform society.

The difficulty lies in the fact that these bots acquire knowledge from an extensive database and essentially surpass the necessity for professional technical education in EMA. However, the presence of these bots may lead to redundant processing. This provides environmental management accountants with the opportunity to focus on strategic inquiries regarding sustainable growth.

The EMA framework was established to be universally applicable to businesses of all sizes. However, the full potential of this concept has not yet been realized owing to the delayed progress in developing comprehensive theories, such as in the case of a circular economy, and the lack of systematic evidence demonstrating widespread successful implementation in real-world scenarios [33]. There is potential for future investigations into scenarios in which the advantages of widespread use can be further proven.

5. CONCLUSION

Managers and management accountants must analyze historical data to forecast future sustainability challenges. Assessing a company's performance over time is essential for achieving long-term sustainability. Despite improvements in IT systems and the availability of real-time information, performance assessments still require the use of both historical and future data. Studies on the combination of real-time sustainability topics and traditional time-based performance monitoring are lacking. Further examination and analysis are necessary to comprehend the connections between immediate operational actions and long-term consequences and effects on sustainability.

Business practitioners can use EMA to increase efficiency and reduce environmental responsibilities. Life cycle analysis and pollution avoidance help firms satisfy regulations and acquire a sustainable edge. EMA can improve communication with stakeholders including customers and investors, who are prioritizing sustainability in their decisions. Due to stakeholder expectations, firms must develop transparent and responsible environmental practices, which EMA frameworks can help with.

Policymakers must prioritize environmental education at all levels to ensure future generations have the skills for

sustainability. This educational focus will promote sustainability and encourage people and communities to manage the environment, enhancing the social side of sustainable development.

For ecologically sustainable development, policymaking and commercial operations must incorporate Environmental Management Accounting. Policymakers and practitioners may create a framework for sustainable economic growth and environmental protection through education, stakeholder involvement, and creative practices.

Managers give greater importance to internal information on physical flows, such as carbon emissions, rather than monetary information when making decisions. Furthermore, it is crucial to consider social factors, such as the prevention of labor exploitation. Factors such as the number of migrants and specific working conditions are of utmost importance. Creating supply chain management accounting systems is crucial for enhancing labor conditions and mitigating abuse. Figure 6 provides a brief overview of the current state and possibility of future research.

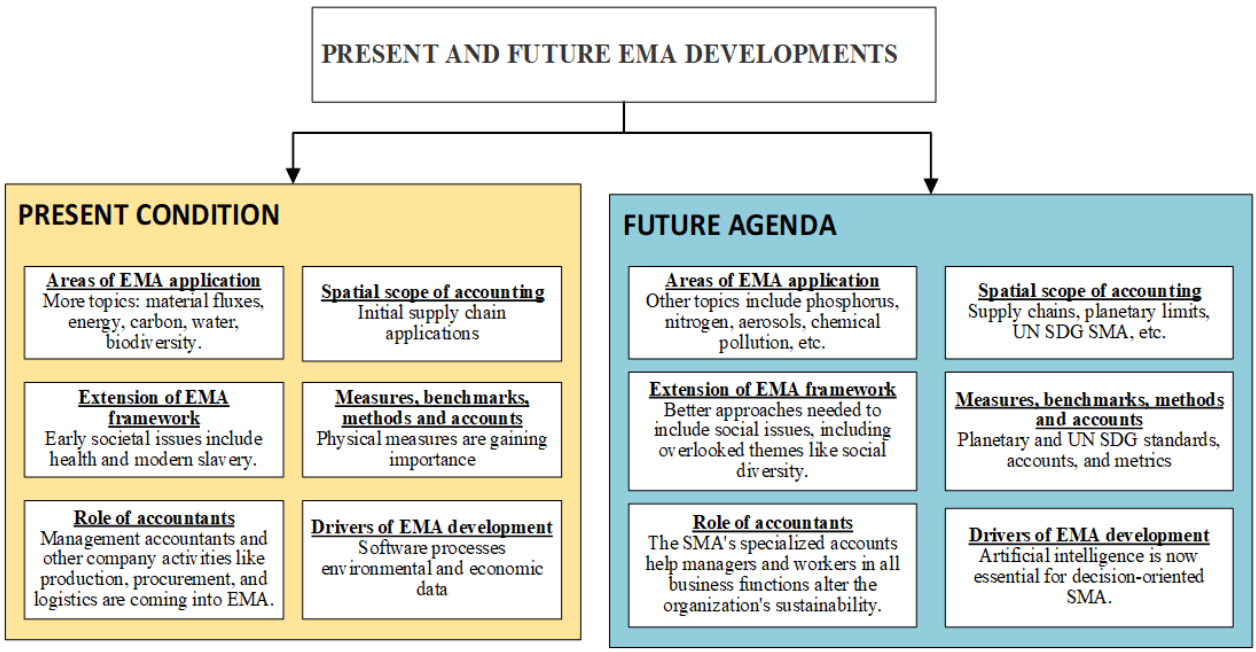

Figure 6. Summary of present and future EMA developments

Future studies on the EMA framework and SMA are crucial for understanding the potential involvement and benefits of stakeholders in their development. The EMA framework aims to enhance corporate performance by incorporating economic and environmental aspects, whereas the SMA focuses on promoting change through market-driven entrepreneurial and inventive prospects.

However, challenges persist in promoting the internalization of negative externalities, and regulation remains crucial. The shift towards SMA now focuses on integrating positive external factors through market-driven entrepreneurial and inventive prospects rather than relying on government regulations.

Future research should explore the use of SMA, its connection to traditional management accounting tools, and the role of practitioners. By addressing the challenges posed by the exploration of future possibilities, researchers and practitioners can contribute to the journey towards corporate sustainability.

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