The Identification and Prioritization of How to Implement Environmental Management Accounting Components in Manufacturing Industries

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This article investigates the identification and prioritization of the components to implement environmental management accounting in manufacturing industries through two parts of qualitative and quantitative. In the qualitative part, the Meta-synthesis method was used to identify the components of environmental management accounting implementation. Hence, various keywords were initially searched in the most popular foreign and domestic databases, and 268 related research works were identified. Then, with the preliminary review of these studies based on certain indicators, 32 scientific and research works directly examining the components of environmental management accounting implementation were selected. Finally, using the coding technique, the related concepts were identified and categorized under the following seven components: Management factors, Resources, Environmental incentives and pressures, Environmental uncertainty, Laws and regulations, Competency of accountants, and Company structural characteristics. The quantitative part of the research included the statistical community, environmental experts, and researchers, 20 of whom were selected by purposive sampling. A paired comparison questionnaire, whose validity was confirmed by experts, was used to collect data. The data were analyzed using the Analytical Hierarchy Process (AHP) to prioritize the components of environmental management accounting implementation and the criteria related to each. The results of the quantitative part of the research demonstrated the component of management factors as the most significant with a relative weight of 0.283

keywords: *Analytical Hierarchy Process (AHP), Environmental Management Accounting, Manufacturing Industries, Meta-synthesis Analysis.*

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1. INTRODUCTION

The most worrying factor for today's economy is climate change, which not only hinders future business growth but also threatens economic and human survival in the long term. Large and small organizations have contributed to widespread ecological degradation by overusing energy and increasing air, land, and water pollution, leading to several adverse effects on the atmosphere in the form of greenhouse gas emissions and ozone depletion. In addition, the continuous reduction of forestry, marine life, and natural resources is among the negative consequences of increasing industrial activities and the growth of companies. Countries and economies seek to ensure environmental sustainability in business methods and processes . due to the importance of increasing environmental pressures in disrupting environmental

conditions. In recent years, industries have considered green strategies as a tool through which environmental performance and competitive advantages can be maintained, and industries can achieve sustainable environmental performance. Thus, is seems necessary to make changes in production systems through the implementation of cleaner production strategies, targeting sustainable development by the elimination and minimization of pollution for economic benefits [1]. By supporting companies' decision-making for clean production measures, organizations seek to support different approaches and tools, one of which is environmental management accounting, receiving more attention from the academic and industrial community [2, 3]. Environmental management accounting plays a vital informing role in the sustainable development of the corporations as a link between management accounting and environmental strategies of companies, including clean production [4]. In particular, environmental management accounting provides a set of accounting tools, along with relevant economic and environmental information for managers to make decisions and evaluate management performance considering clean production strategies [2,3]. In this century, the only criterion for the success of organizations is not limited to their profit-making abilities, but concepts such as environmental and social accounting have created new issues in evaluating and measuring the success of organizations. Considering that such concepts are emerging in Iran, this research seeks to introduce environmental accounting and define the practical indicators of sustainable development based on the internal conditions of Iran and data obtained from the indicators practically viable for agents, helping them preserve and sustain Iran's natural and non-renewable resources and assets. On the other hand, the findings of domestic studies demonstrate that local and comprehensive models for environmental accounting have not been given much attention. However, one of the factors reducing environmental damage is access to a comprehensive and appropriate model of environmental accounting, the institutionalization of which can lead to a change in the organization's environmental behavior and more social and environmental responsibility. Some studies show that most managers in organizations have very little information about the environmental costs associated with their operations (although it may not be credible for some), which can be attributed to deficiencies in accounting systems. Many cost-saving opportunities are lost because of a lack of information about environmental costs. However, since little research has been conducted regarding the environmental management accounting implementation in businesses and how the application of environmental management accounting tools develops over time, such research can guide those seeking to introduce environmental management accounting and move operations toward cleaner and more sustainable production. Hence, this paper examines the paths taken by a set of companies that embark on implementing environmental management accounting tools. This research aimed to show the characteristics and components of environmental management accounting, which were identified and classified by applying the Meta-synthesis approach. Then, the elites in the environmental field prioritized the components of environmental management accounting implementation using the hierarchical analysis process. Therefore, this paper seeks to answer the following two research questions:

- What are the components for implementing environmental management accounting?
- What is the importance and priority of these components to implement environmental management accounting?

2. REVIEW OF LITERATURE

With the increase in global pressures and concerns about environmental issues in the last two decades, environmental management accounting has been proposed as a new technique in the field of accounting to provide various parties with information about environmental issues. Environmental management accounting may significantly help reduce environmental impacts, improve the environmental performance of organizations, and ensure sustainability. However, the implementation of environmental management accounting is still in its infancy in developing countries. Some interesting discussions provided by various industries around the world to address environmental impacts [5] include the identification of several concepts and techniques related to environmental management accounting, such as environmental costs, environmental reports and types of environmental management accounting information, environmental management and environmental performance indicators, monetary and physical information, environmental information in formal management, accounting information system, cost benefit analysis, environmental audit, etc. Many governments in the developed world are currently involved or interested in promoting environmental management accounting practices. However, environmental management accounting has not yet received any support from the governments or professional organizations in developing countries. In fact, research related to environmental management accounting is gradually increasing in various industry sectors and some small and medium-sized companies. In addition, more attention has been paid to the role of accounting information systems in providing various stakeholders with sufficient information about environmental effects and activities, and environmental accounting information disclosure may be viable for decision-makers to manage, audit, and improve environmental performance [6]. Environmental management accounting has performed better, especially for the development of conventional management accounting, in response to the request of accountants to adopt environmental management and accounting practices. Environmental management accounting, as a subset of environmental accounting, helps to identify, classify, allocate, and control environmental costs, leading to better environmental management and decision-making than the traditional systems. Environmental management accounting has been developed to help managers make decisions that improve the company's environmental performance and is recognized as an important base used by companies to achieve various benefits, such as identifying opportunities to save costs, improving product pricing and pricing decisions, enhancing environmental performance, making more informed decisions, increasing innovation, improving company performance, creating better relationships with shareholders, maintaining maximum personnel, minimizing regulatory attention, and increasing competitive advantage [7]. To analyze the applications of environmental management accounting, it is necessary to examine its different functional roles. The functions of planning, decision making, control, and performance evaluation have traditionally been considered to interpret the role of management or environmental management accounting. Researchers have widely divided these functions into responsibility (control or supervision) and decision-making. Table 1 shows environmental management accounting duties.

The components of the implementation of environmen-

Table 1. Environmental management accounting duties.

Decision-making		Supervision and control
Cost and efficiency	Accounting duties	Budget preparation
cost-volume-profit (CVP)		Giving declarations to analyze actual output
Pricing		Variance Analysis
Special one-time orders		Determining goals and performance indicators
Building/Buying		Description of actual results
Long Term Investment		Analysis and review of goals
Replacement		Risk management
Extension		Preparation of sustainability or integrated reports
Discontinuity		

tal management accounting have been studied by several researchers, as briefly stated in Table 2.

Regarding the studies conducted on the subject, environmental management accounting has been the focus of experts and researchers as a basic category. Besides, considering the implementation of environmental management accounting, each expert and researcher has pointed to various elements and components of the implementation of environmental management accounting, leading to different valuable models and suggestions for this research. Thus, an attempt was made to explain the components of the implementation of environmental management accounting by providing a systematic approach, combining different qualitative research and a comprehensive view of the implementation of environmental management accounting.

3. METHOD

The research was conducted using both qualitative and quantitative methods. The qualitative part of the research was initially carried out utilizing the Meta-synthesis method, followed by the quantitative part, in which the Analytical Hierarchy Process (AHP) was applied. The research steps were as follows:

A. Qualitative research

Meta-synthesis is a qualitative method to create knowledge and interpret the results of previous studies. Since the studies related to the concept of environmental management accounting and related patterns are mostly qualitative rather than quantitative and based on the examination of different cases, the Meta-synthesis method was suitable to obtain a comprehensive combination of environmental management accounting patterns. Hence, the main and subfields of environmental management accounting implementation were presented using the seven-step method of Sandelowsky and Barroso (2007), which can be elaborated as follows:

Step 1: Stating the research question(s);
Step 2: Investigating the texts systematically;
Step 3: Searching and selecting suitable articles;
Step 4: Extracting article information;
Step 5: Analyzing and synthesizing qualitative findings;
Step 6: Quality control; and
Step 7: Representing the findings.

A.1. Step 1: Stating the research question(s)

According to the first goal of the research, the research question was set as follows: What are the components of environmental accounting implementation?

A.2. Step 2: The systematic study of the texts

The statistical population of this research consisted of all scientific documents, research reports, databases, and domestic and foreign magazines focusing on the expansion of environmental management accounting for clean production in manufacturing industries. The most frequent keywords used in the reviewed articles included environmental management accounting, environmental accounting, management accounting, green accounting, and social responsibility accounting, all of which were found in non-Iranian databases, including Science Direct, Emerald, Springer, and Research Gate, and three Iranian databases of Civilica, Magiran, and SID. All the reviewed articles were published until April 2023 in reliable national and international databases, including 268 articles, books, dissertations, etc.

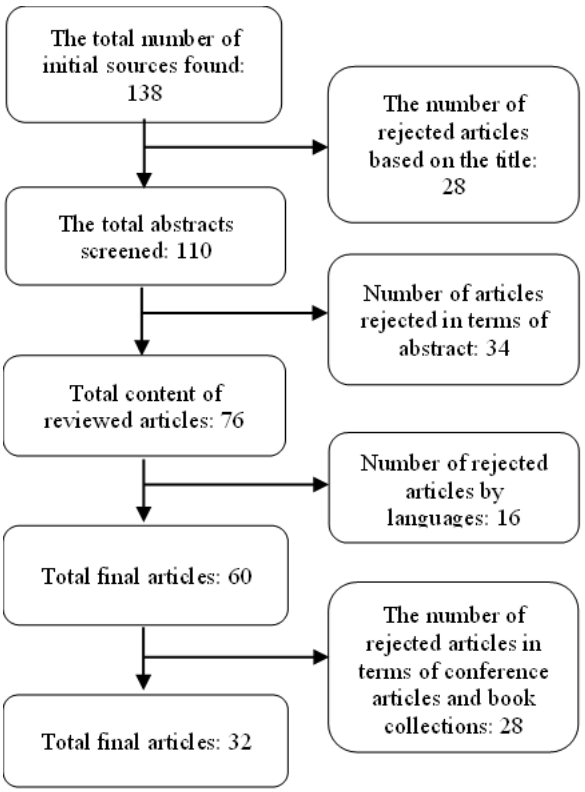

Fig. 1. A summary of the search results and document refinement.

A.3. Step 3: Searching and selecting suitable articles

To search for information in this field, only open access sources were included due to financial constraints. The first search resulted in 130 articles that were not open access and 138 articles that met the conditions of open access, which was a limitation for research. However, 76 studies were excluded due to document type, content, and language. Conference proceedings, books, and other publications were also excluded, totaling 25. Only journal articles were included in the systematic literature review, aiming for high-quality studies guaranteed by the review process conducted by academic journals. In addition, articles that were not in English (n=16) were excluded. Finally, the results of 32 studies were reviewed and analyzed.

The figure below summarizes various stages of refining the obtained documents.(Figure. 1)

A.4. Step 4: Extracting article information

The information of the articles was classified based on the reference of each article, including the author's name and surname, the year of publication, and the coordination components stated

Table 2. Research carried out so far on environmental management accounting implementation components

Researcher's name (year of publication)	Environmental accounting implementation Elements
Mukwarami et al [8]	Government rules and regulations, technological capabilities, skills and training, strategic leadership, management attitude and culture, environmental cost management
Hoan [9]	Stakeholder pressure, manager's perception, relationship between costs and benefits, accountants' competence
Nzama et al [10]	Activities related to the environment, the company's environmental strategy, control of plastic pollution
Duong et al [11]	Technology level, organizational characteristics, performance pressure, qualification of accounting staff, knowledge of managers
Karmozi et al [12]	Internal environmental management, senior managers' commitment to green supply chain management, middle managers' support for green supply chain management, mutual functional cooperation to improve the environment, comprehensive management of environmental quality, environmental compliance and audit activities, establishment of environmental management system , green purchasing, customer environmental cooperation, reversible logistics, reduction of air pollution emissions, reduction of sewage pollution, reduction of solid waste disposal, promotion of reuse and recycling of raw materials, development of green skills, green motivation, performance of environmental management accounting system, Market share in industries compared to competitors, brands of industries compared to competitors
Dinh et al [13]	Company size, stakeholder pressure, understanding the benefits of implementing environmental accounting, legal regulations, financial resources, staff qualifications
Thu Hang & Thanh Loan, et al [14]	stakeholder pressure; Company managers' understanding of social responsibility; characteristics of plastic companies; Qualification of accountants
Arizona et al [15]	Company size, statement of accounting standards and environmental management
Nguyen [16]	Stakeholder pressure, company characteristics, mandatory pressure from government agencies, environmental awareness of senior managers, environmental accounting accountant qualification
Sayyadi, Tooranloo & Askari [17]	accounting requirements, environmental justice, environmental responsibility, legal requirements, organizational factors, pollution control and business issues
Lee et al [6]	The nature and prospects of the company, the business strategy towards sustainable development, determining the disclosure of environmental activities by the company, the willingness to accept costs for the application of environmental management accounting, the pressure of the government and shareholders, the pressure of environmental standards for product features. and the company's production process, the pressure of waste management regulations for the company's production, the pressure of local regulations on environmental pollution, the pressure of regulations on environmental fines/fees, the pressure of investors' expectations for the company's adherence to environmental regulations, the pressure of customers' expectations for the company's adherence to environmental regulations, the pressure caused by suppliers' expectations for the company's adherence to environmental regulations, the relationship between the accounting department and the company's environmental department, the competence of accountants in environmental management accounting, the application of information technology in accounting work, the use of financial and physical information, including environmental information in the official management accounting information system, reporting environmental information to external stakeholders, using software to track environmental information, developing environmental performance indicators.
Sopia et al [18]	Stakeholder pressure, organization size, top management commitment, environmental uncertainty
Hung et al [19]	Business characteristics, business area, organization goals, technology level, manager's perspective, business strategy perspective, knowledge and ability to skillfully use accounting software, training programs for employees specializing in accounting, business operations, business age, development plan, the company's ability to provide information to related institutions, legal framework, accounting standards and principles of social responsibility, organizational responsibility, economic-political-social situation
Ji et al [20]	Firm size, external pressure, firm performance, corporate governance, government regulation, media pressure, profitability and sales ability
Giang et al [21]	The legal regulatory system related to green accounting, the timeliness and appropriateness of the legal document system related to green accounting, the completeness of legal documents related to green accounting, the characteristics of the supply chain, pressure from the supplier, pressure from customers, pressure from competitors, strategies to use effectiveness of resources, clean production strategy, ensuring the interests of stakeholders, business characteristics, up-to-date production technology, competence of managers, information system
Burritt et al [21]	Costs and liabilities, hierarchy of authority, control and communication, openness of existing social adaptation system, existence of management systems related to sustainability, individual ability to handle complexity, personal involvement in issues, partnership with industry associations, external bodies or consultants
Zandi & Lee [22]	Customer influence, regulatory pressure, ethical and social responsibility
Lee et al [23]	Positive environmental strategy, environmental uncertainty, financial conditions, government implementation, training and professional development, peer pressure, network of professional associations.
Astawa et al [24]	Risk identification and management, promoting policies to determine, developing a framework for generating reliable financial and non-financial information, managing independent review and audit processes, preparing and implementing sustainability conceptual plans, local culture, government regulations, stakeholders
Huyen-Tram & Toan [25]	Government support, company size, manager understanding, business strategy, company culture, environmental management accounting system organization cost, construction industry and qualified internal accountant.
Shahzadi et al [26]	Environmental uncertainty, the existence of a competitive market, the type of company's competitive strategy, organizational structure, production technology
Alkisher [27]	Environmental law, government initiatives, stakeholder pressures, the importance of environmental costs and challenges to current accounting practices
Albaddad & Nassar [28]	Competition Level, age of the company, type of sector, quality of ownership and size of the company
Parihastiwi and Sholihin [29]	Competence of accounting staff, involvement of managers and owners, company size, environmental uncertainty, competitive market
Darabi & Akbari [30]	Environmental threats, risk caused by environmental threats, accountability of companies, accountability of companies regarding their type of activity for environmental sustainability, giving legitimacy to companies from society, new relationship between companies and environmental sustainability
Ehsani [31]	Reporting environmental costs and disclosing information related to environmental costs, increasing the awareness of managers about the issues and priorities of optimal management of environmental accounting costs, reviewing the relationship between industries and the environment and the amount of use of natural resources.
Sheikhi Setoude et al [32]	Environmental sensitivity, implementation of environmental reporting, indicators of regulatory, structural and functional variables
Ghanbari et al [33]	Value accounting mechanisms, development accounting mechanisms, financial accounting mechanisms, legal mechanisms, cultural mechanisms
Azizi [34]	Senior management commitment, strategy, uncertainty, social legitimacy, environmental monitoring, accounting information system
Namazi & MosallahneZhad [35]	efficiency, sales, costs, equipment effectiveness, training, compliance with standards in the organization, information capital, suppliers, creditors and investors, governmental, social and environmental organizations
Shahrestani et al [36]	Management factors, technology, financial resources, human resources, organizational and industrial, environmental and extra-organizational factors
Nazarian et al [37]	Environmental measures and management, characteristics of corporate governance, financial and economic performance of the company, environmental reporting strategies of the company, the structure of company reports, structural characteristics of the company, laws and regulations and environmental pressures, environmental incentives and punishments (government, industry, society)

in each article. After selecting the articles and sources using the open, selective, and central coding procedures, the codes of the texts were extracted, as separately shown in Table 4.

A.5. Step 5: Analyzing and synthesizing qualitative findings

At this stage of the research, all the factors extracted from previous studies were initially regarded as codes. Then the concept of each of these codes was categorized in a similar concept to determine the research concepts. Consequently, an interpretation beyond each of the studies included in the Meta-synthesis of the desired phenomenon was presented, simultaneously including all of them and ensuring that the effect of each of the primary studies would be searched in this whole. This step, which is possibly the most sensitive in Meta-synthesis, requires special care. The findings of this step provide the basis for the final model of the research and should be carefully combined.

A.6. Step 6: Quality control

To control the extracted concepts, the researcher's opinions were compared with those of an expert who coded the same text separately and blindly. If the codes of these two researchers were close to each other, it indicated a high agreement and confirmed the reliability. The index value calculated by SPSS software was 0.733 at the significant level of 0.000, rejecting the assumption of independence of extracted codes due to the significance value of <0.05. Also, code extraction had good reliability.

A.7. Step 7: Representing the findings

In this step, the extracted codes and concepts were presented based on the previous steps. The focus group method was utilized to complete the results obtained from Meta-synthesis and validate the presented conceptual model. In this part of the qualitative research, the analyses and findings obtained from Meta-synthesis were further studied and edited by forming a focus group, which included experts in the environmental field, and modifying all the analyses and the presented model. The focus group method is used to find out people's understanding of a certain issue. In the current research, after completing the previous steps, the classified findings were presented in a focus group meeting with the participation of nine experts to control the extracted concepts. Table 2 presents the demographic characteristics of the focus group members.

B. Quantitative Research

The hierarchical analysis method was used to analyze the data and prioritize the factors. This technique is a decision-making method that enables the decision-maker to specify the desired problem and make comparisons based on the resulting structure to determine the priority of the options raised in decision-making. Hierarchical analysis process is one of the most comprehensive procedures designed for decision-making with multiple criteria, making it possible to formulate the problem in a hierarchical way. The most significant characteristic of the hierarchical analysis method is the ability to transform the hierarchical structure of a complex multi-criteria problem into an expanded structure, providing deeper insights into the decision-making problem. A group hierarchy analysis is created through several steps as follows.

Step 1: that the first step is to form pair-wise comparison matrices for each sub-criterion, provide a criteria matrix whose elements are numbers in a certain distance, and express the relative superiority of one over the other. In this phase, the elements of each level are compared to other related elements at a higher level in a pair-wise manner, forming pair-wise comparison matrices.

Step 2: After determining the pair-wise comparison matrix, it is time to calculate the weight of the elements.

Step 3: The final weight of each option in a hierarchical process is obtained as the sum of the product of each criterion in the score of the desired option.

Step 4: This step is specific to calculating the inconsistency rate.

One of the advantages of the hierarchical analysis process is to control the decision consistency. In other words, it is always possible to calculate the degree of decision inconsistency, and as long as it is less than 0.1, there is no need to revise judgments and preferences. The inconsistency rate was 0.01 in the current study, which is less than 0.1 and indicates the consistency of the pair-wise comparison matrix. The statistical population in this research included the experts and researchers in the field of environmental management accounting, 20 of whom were selected through purposeful sampling. The sampling criterion was their scientific works, including articles, books, and research projects in the environmental field. Table 3 presents the demographic characteristics of the sample.

Table 3. Demographic characteristics of the statistical sample in the quantitative and qualitative sections.

Demographic variable	selection	Qualitative	Quantitative
Gender	Male	0.100	0.75
	Female	0.0	0.25
Education	Master's degree	0.33	0.35
	PhD	0.67	0.65
Service Record	Under 10 years	0.22	0.30
	Between 10 and 20 years	0.56	0.45
	over 20 years old	0.22	0.25

4. RESULTS

A. What are the components of environmental accounting implementation?

As mentioned earlier, the qualitative part of this research included two stages. The first stage utilized Meta-synthesis method to identify the components and sub-components of environmental management accounting, followed by determining the related concepts (codes), categorizing the coding of the identified concepts, and providing the main categories. Then, the initial conceptual framework of the research was presented according to the identified categories (components) and the background of the research. Finally, preparations were made to hold the focus group meeting. In the second stage, a focus group discussion was formed with nine specialists and experts to ensure the analysis results of the data obtained from Meta-synthesis methods and modify and adjust the analyses carried out and the identified components. In this meeting, lasting for more than 120 minutes, the experts confirmed the general analysis of the qualitative part of the research while proposing constructive points regarding various aspects of the subject, which were applied. The final concepts and categories are presented in Table 4.

The analytical results of this research indicated 17 concepts, and at a higher level, 7 categories, whose quality tests were confirmed and categorized into three Main, Contextual, and

Table 4. Codes, concepts, and categories extracted from sources

Factors	Categories	Key concepts	Codes	Sources of code extraction
Key Factors	Management factors	Senior management commitment	Senior managers' commitment to green supply chain management; Commitment and responsibility of managers; moral culture; corporate social responsibility; Financial transparency; proper organization; constant monitoring; organizational flexibility; planning; use of consultants; comprehensive environmental quality management; financial justice; Financial support; Protection of managers from the financial management team	[8, 9,10, 11, 12, 13, 14,16, 18, 25, 29, 31, 34, 36]
		Corporation management expertise and knowledge	Expertise and knowledge of company management, empiricism, innovation	
		The way company managers look at the environment	environmental awareness of senior managers; manager's imagination; The requirement of environmental accounting for the organization from the manager's point of view; Increasing the awareness of managers about the issues and priorities of optimal management of environmental accounting costs	
	Sources	Funds	financing; available financial resources; The cost of organizing the environmental management accounting system; Attracting foreign resources to develop environmental projects; credibility for the development of environmental strategies	[6, 8, 9,11, 13,22, 24, 25, 37]
		Technology	technological capabilities; organization's access to technology; Investment costs in equipment, software; Development of a stable, up-to-date and reliable information technology infrastructure; technical expertise and alternative design for products in accordance with environmental requirements; Recycling of used products; design complexity to reduce resource consumption; The existence of environmentally friendly means and equipment for transporting materials; application of communication and information technologies; advanced production technology; comprehensive corporate information system; Flexibility and adaptability of the information system	
Environmental Factors	Environmental incentives and pressures	Stakeholders' Persistence	the pressure of environmental standards for product characteristics and the company's production process; The pressure of waste management regulations for company production; the pressure of local regulations on environmental pollution; Regulatory pressure on environmental fines/fees; Pressure from investors' expectations for the company's adherence to environmental regulations; pressure from customers' expectations for the company's adherence to environmental regulations; pressure from suppliers' expectations for the company's adherence to environmental regulations; Stakeholders' attention to sustainable development	[6, 8, 9, 13, 14, 16, 18,20, 22, 24, 25, 27, 37]
		Governments' Persistence	the pressure of environmental standards for product characteristics and the company's production process; Forced pressure of the government agencies	
		Environmental encouragement and punishments	financial and non-financial encouragement of the government; receiving tax benefits and incentives; valid government certificates; valid industrial certificates; Valid international certificates; Fines	
	Environmental Uncertainty	Environmental Uncertainty	Economic cycles (boom and recession), tax laws, environmental laws, environmental crises, stability of laws	[6,18, 26, 28, 29, 36]
	Regulations	Organizational and National Regulations	Having regulatory regulations in the sustainable development of environmental processes; Social responsibility accounting standards and principles; Industry specific requirements and standards; regulations at the organization level; government regulations to accept environmentally friendly policies; Support and guidance of regulatory authorities to preserve the environment	[8, 13, 17, 20, 21,27, 32, 33, 34, 37]
Background factors	Accountants' Competency	Professional and moral competence	environmental accounting competency of accountant; higher professional education; having ability to skillfully use accounting software; being of familiarity with information technology, working with accounting software; High ability to monitor, analyze information and accurately calculate the company's profits and losses; meeting the highest standards of professional competence; qualification of accounting staff; training programs for staff specializing in accounting; moral competence; complete confidentiality regarding financial information of the company and shareholders; Credibility and honesty; Domestic and international work experience	[6, 9, 11,13,14,16,17, 23, 25, 29,34, 37]
	Company's configuration	size	property value; the market value of the company; market value of shares and liabilities; the amount of company sales; Number of Employees	[2, 8, 10,11, 12, 13, 14, 15, 16, 18,19, 20, 24, 25,28,29,32, 33, 34, 37]
		norm	Founding a norm of respect for the environment; Effective development of supply chain networks; promoting the effectiveness of environmental functions in reducing costs; culture and landscape; motivating and supporting new ideas received from employees and managers; Shared decision making	
		Business	organizational characteristics of performance pressure; age of the company; type of industry; company's performance	
		supply chain	Cutting losses along the supply chain; planning and managing time; continuous monitoring of environmental changes; supply chain risk management; communicating with multiple suppliers; warehousing and supply storage management; Logistics and supply support	
		Corporation governance	type of corporate ownership; Financial accounting knowledge of the board of directors; Obligations of shareholders and stakeholders, committee auditing	

Environmental factors. The research model for the implementation of environmental management accounting, which is the output of Meta-synthesis analysis is presented in Table 5. The model presented in this research is actually the consensus of the ideas presented in the form of a single collection, supplying a comprehensive and general view of the production industry.

B. Valuing the components of environmental management accounting implementation

To calculate the value of each component of the environmental management accounting implementation and determine the weight of each component based on the Analytical Hierarchy Process (AHP), the geometric mean of the pair-wise comparison scores of the components was obtained based on the experts' opinions (Table 6). As shown in the table, the inconsistency rate obtained is 0.01, and the diameter of the matrix is 1, indicating equal priority of a component over itself. Since the acceptable inconsistency rate in Analytical Hierarchy Process (AHP) method is < 0.1, the validity of the respondents' answers is confirmed.

After the opinions of the experts were examined to calculate the geometric mean, the Expert Choice software was used for their integration and the calculation of the final weights of the criteria (Table 7). The final prioritization results of the desired components showed that management factors had the greatest contribution to determining the environmental management accounting components with a relative weight of 0.283. The components of company configuration (0.194), resources (0.140), environmental uncertainty (0.139), competence of accountants (0.095), rules and regulations (0.093), and incentive and environmental pressures (0.056) were ranked second to seventh, respectively.

C. Valuation of each sub-component of environmental management accounting implementation

The geometric means of the scores of the criteria pair-wise comparisons were obtained to calculate the importance of the sub-components of each environmental management accounting component and determine their weights based on the hierarchical analysis process. Measures were then taken to combine the geometric means of the experts' opinions and calculate the final weights of the criteria using the Choice Expert software (Table 8). The matrix of pair-wise comparisons and diagrams related to the sub-components of environmental management accounting were not provided for brevity.

The results of the above table showed that senior management commitment and the government's persistence ranked first and last with respective weights of 0.154 and 0.015.

The components of management factors showed that the senior management commitment, the company managers' understanding of the environment, and the company's management expertise were in the first to the third place, respectively. Financial resources and technology were also in the first and second ranks, respectively. The components of incentives and environmental pressures showed that the stakeholders' persistence, environmental incentives and punishments, and the government's persistence were in the first to the third place, respectively. The components of the company's configuration proved that company size, supply chain, corporation governance, business, and company norm were in the first to the fifth rank, respectively.

5. CONCLUSION

The current research seeks to identify and prioritize the components of the implementation of environmental management accounting, providing new insights into the incentives of the environmental management accounting implementation and increasing the stakeholders' awareness of the incentives and factors that effectively promotes this type of accounting. The literature review showed that several factors significantly contributed to the implementation of environmental management accounting in different countries worldwide. However, the implementation of environmental management accounting is still

Table 5. The Meta-synthesis based conceptual model of the environmental management accounting implementation

Implementation of environmental management accounting	Management factors	Senior management commitment
		Corporation management expertise and knowledge
		The way company managers look at the environment
	Sources	Funds
		Technology
	Regulations	Organizational Regulations
	Environmental Uncertainty	Environmental Uncertainty
	Environmental incentives and pressures	Stakeholders' Persistence
		Governments' Persistence
		Environmental encouragement and punishments
	Company's configuration	size
		norm
		Business
		supply chain
		Corporate governance
	Accountants' Competence	Professional Competence
		Moral Competence

Table 6. Matrix of pair-wise comparisons of the determinants of environmental management accounting implementation.

components	Management factors	Sources	Environmental incentives and pressures	Environmental Uncertainty	Regulations	Accountant's Competence	Company's configuration
Management factors	1	2.88	3.91	2.0	3.63	2.62	1.21
Sources		1	3.03	0.79	1.44	1.81	0.87
Environmental incentives and pressures			1	0.39	0.62	0.43	0.34
Environmental Uncertainty				1	1.25	1.44	0.69
Regulations					1	0.94	0.55
Accountant's Competence						1	0.36
Company's configuration	Income: : 0.01						1

Table 7. Basic components of environmental management accounting and their relative importance

Components	Relative importance	priority
Management factors	0.283	First
Sources	0.140	Third
Environmental incentives and pressures	0.056	Seventh
Environmental Uncertainty	0.139	Forth
Regulations	0.093	Sixth
Accountants' Competence	0.095	Fifth
Company's configuration	0.194	Second

Table 8. Sub-components of each environmental management accounting component and their relative importance.

Sub-components	Relative importance	Priority
Senior management commitment	0.154	First
Manager's expertise	0.031	Fourteenth
The way company managers look at the environment	0.036	Twelve
Funds	0.076	Fifth
Technology	0.033	Thirteenth
Stakeholders' Persistence	0.030	Fifteenth
Governments' Persistence	0.015	Seventeenth
Environmental incentives and pressures	0.021	Sixteenth
Environmental Uncertainty	0.076	Sixth
Organizational & national regulations	0.051	Fifteenth
Professional competence	0.052	Ninth
Moral competence	0.052	Tenth
Size	0.105	Second
Norm	0.065	Seventh
Business	0.065	Eighth
Supply Chain	0.105	Third
Corporation governance	0.085	Forth

in its infancy in developing countries. Major incentives include increasing environmental legislation, government initiatives, environmental pressure groups, companies, managers' perspectives, and the failure of conventional accounting systems to address environmental issues. Over many years, experts have investigated and studied various aspects of this accounting and identified the elements, characteristics, and components that affect it. The current study sought to identify the components of environmental management accounting implementation in industries with a dynamic and comprehensive approach. Thus, the implementation of environmental management accounting components was initially identified and then analyzed using the Meta-synthesis and hierarchical analysis methods, respectively. The results of the qualitative and quantitative parts were also analyzed further. The analytical results of the 32 selected articles indicated 109 codes, 17 concepts, and at a higher level, 7 categories under three Main, Contextual, and Environmental factors. The results of this Meta-synthesis and the consensus of the experts in the literature review showed that the necessary grounds and conditions for cleaner production would be provided if the factors affecting environmental management accounting gained due attention. The factors identified in this research included management factors, resources, environmental incentives and pressures, environmental uncertainty, regulations, accountants' competence, and company's configuration. The final results of the prioritization of the desired components showed that the component of management factors was the most important in determining the environmental management accounting components with a relative weight of 0.283. The components of company configuration (0.194), resources (0.140), environmental uncertainty (0.139), competence of accountants (0.095), rules and regulations (0.093), and incentive and environmental pressures (0.056) were ranked second to seventh, respectively.

The central factors identified in this research were the same management factors and resources presented in most environmental management accounting models, indicating their importance at the managerial level and in the clean production of manufacturing industries. The Meta-synthesis results showed the contribution of certain elements to expanding environmental management accounting, while some elements played a more central role in the implementation of environmental management accounting. Thus, domestic participants, including managers and academics, play a critical role in the realization of technology transfer in this field, and successful managers focus on such changes for the benefit of their organizations as technology grows. Through their vital role, managers can optimize the use of available resources, contributing to the growth and promotion of technology in a dynamic environment beyond other departments, practically highlighting their technology and commitments. The research results also emphasize the influence of management factors and resources in previous research and its effect on the implementation of environmental management accounting to the extent that Karmozi et al [12], Sopia et al [18], and Duong et al [11] regard it as a key element of environmental management accounting. Many experts and researchers have used the terms financial resources and technological resources as the main factors in environmental management accounting. The prominent role of environmental management accounting has also been considered by evaluating the impact of policies, procedures, and cleaner production methods in the activities of manufacturing industries. In addition, the research indicates that senior management commitment, company management expertise, the way company managers look at the environment,

financial resources, and technology are important to support environmental management accounting developments. The realization of environmental management accounting requires extensive management changes in manufacturing industries to provide an environment for companies' clean production activities. From a domestic perspective, environmental management accounting helps managers in proper tracking and strong management of financial and physical resources, identifying cost reduction opportunities, and making better decisions. In such a context, environmental management accounting is an important tool in the decision-making process of management, specifically emphasizing the management of environmental costs by reducing and controlling the consumption of natural resources and preventing the wastage of the country's national capital.

Background factors include the configuration qualities of the company and the accountants' competence, which provide the necessary infrastructure and context for the implementation of environmental management accounting. Such cases are recognized as the factors increasing or decreasing the implementation of environmental management accounting in manufacturing industries and provide the grounds for reducing industrial pollution. The articles on the environmental management accounting analysis have also widely discussed the role of creating social responsibility in addition to the economic and environmental contribution of industries. hence, industries should be aligned with company norms, size, business characteristics, supply chain, and corporation governance, affording to found the necessary infrastructure through cleaner activities. The findings show that the structural characteristics of the company and accountants' competence (professional/moral) significantly affect the promotion of environmental management accounting, leading to the approval and encouragement of the use of environmental management accounting and strengthening the necessary motivation for the company development.

Environmental factors include environmental incentives and pressures, environmental uncertainty, and regulations, indicating the industry's attention to stakeholders' persistence, government persistence, environmental incentives and punishments, environmental uncertainty, and organizational and national regulations. The results of the research prove that the industries should comply with the laws and adjust their programs according to them, seeking to implement environmental management accounting for cleaner production with environmental incentives and pressures. Although the results of this Meta-synthesis show that categories such as environmental incentives and pressures, environmental uncertainty, and regulations are among those contributing significantly to the development of environmental management accounting, on which experts have high consensus, the results confirm the comprehensiveness of the proposed model and the potential effect of all aspects on the development of environmental management accounting. This model shows the output and consequences of industries using environmental management accounting in four areas, including sustainable development accounting standards, compliance with environmental regulations, improving the level of social responsibility culture, and optimal use of resources and cleaner production. Accordingly, the realization of environmental management accounting depends on the adherence to the factors mentioned in the presented model, and cleaner production in manufacturing industries will not reach the ideal level because of failure to consider all factors stated in the comprehensive framework of the implementation of environmental management accounting. Thus, environmental legislators and relevant institutions are supposed to use the results of this research and the final model provided for legislation.

Although the current research had a suitable research method and was conducted correctly, it suffered from some limitations. First, the data analysis was based on the study of a set of 32 articles selected purposefully, while other articles were not used in this research.

This research can provide valuable insights for future research in this field. Further investigations, practically conducted in similar industries, would highlight the possibility of classifying industries in the current field. Future researchers may explore more knowledge about the practice of expanding environmental management accounting, enabling them to better identify the factors influencing the implementation of environmental management accounting and recognize the depth of the problem that prevents companies from its implementation.

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