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Review

The Role of Activity-Based Costing in Reducing Environmental Impact: A Systematic Literature Review

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Abstract: Accounting professionals play a pivotal role in reducing environmental impact through systems like activity-based costing (ABC). This study offers a thorough review of research on ABC and environmental impact, providing insights into the current literature and guiding future developments. It systematically reviews 58 articles published in the Web of Science from 1998 to 2023, using Excel and the R package Bibliometrix for data analysis. The findings indicate a steady increase in research on ABC and environmental impact. Key contributions highlight the advantages of ABC in minimizing environmental impact across industries such as sustainable construction, metallurgy, transportation, and manufacturing. Emerging research directions include developing costing systems to reduce environmental impact, optimizing supply chain cost management models, and applying new technologies to tackle environmental challenges in production processes. Two primary research themes, identified as "motor themes," are crucial for advancing this field: life-cycle assessment management models, which integrate environmental factors throughout a product or service's life cycle; and the performance and impact of environmental cost management systems, which evaluate the effectiveness of these systems in reducing ecological footprints while maintaining profitability. These areas are essential for driving future research and innovation at the intersection of cost management and environmental sustainability.

Keywords: activity-based costing; environmental impact; environmental management; life-cycle assessment; environmental cost management systems

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1. Introduction

Global warming, driven by rising emissions and the accumulation of greenhouse gases, has emerged as one of the most critical consequences of climate change [1–3]. Policymakers have recognized that assessing the environmental impact of organizations is essential for identifying and implementing strategies that reduce these effects [4,5]. Consequently, businesses are under increasing pressure to lower their emissions and contribute to the global effort to combat this environmental crisis [6]. In this context, accounting professionals play a pivotal role by supporting initiatives to reduce environmental impacts through tools such as cost projections, budgeting, and carbon reporting [7]. Additionally, scholars like Sánchez-Rebull et al. [8] emphasize the growing convergence of cost management and

environmental sustainability, reflecting the increasing focus on integrating environmental concerns into cost systems.

In this context, the application of systems like activity-based costing (ABC), originally recognized as a key strategic tool for businesses [8–10], could play a significant role in environmental management. ABC provides detailed and precise cost data that can be integrated into existing environmental accounting systems, enabling managers to incorporate environmental costs into their strategic decision-making processes [11]. This approach enhances the ability of organizations to align their financial strategies with sustainability goals, facilitating more informed decisions regarding the environmental impact of their operations [12–14].

The activity-based costing (ABC) system emerged in the 1980s as an improvement over traditional costing methods, offering a more accurate way to allocate resources and identify the costs associated with various activities within an organization [9,15]. Numerous studies have demonstrated the broad applicability of ABC across different fields [16–19]. For instance, Yang et al. [19] explored its use in the land transportation sector, while Chatrrouz [20] examined its effectiveness in estimating the cost of cataract surgery. Similarly, Rocha-dos-Santos et al. [21] applied ABC to solid waste management, and Zhang and Li [22] employed it to calculate costs for a thermal energy company. ABC has also proven useful in education, as shown by Pouragha et al. [23], and in third-party maritime logistics cost management, as detailed by Gui and Na [24]. Additionally, Ouakhzan and Boukhalfa [25] implemented ABC in clinical environments, specifically the maternity unit of the Tiznit Provincial Hospital Center. These studies underscore the versatility and effectiveness of ABC in diverse areas, highlighting its potential as a valuable tool for improving cost management across multiple industries.

Over the past few years, there has been increasing interest in exploring the environmental implications of activity-based costing (ABC) in relation to business sustainability. Akgün et al. [26] conducted a study that adapts ABC for water footprint accounting, presenting new opportunities for sustainable water management across industries. Similarly, Fu et al. [27] examined the use of ABC to assess the environmental impact of air conditioners, demonstrating its potential as a tool for addressing environmental concerns in the design of industrial products and processes. Tsai et al. [28] proposed a model that integrates ABC with life cycle assessment in the electrical and electronics industry, aiming to maximize benefits while minimizing environmental impacts.

While many analyses of ABC have been conducted over the years, few have focused on its environmental applications. For instance, Bjørnenak and Mitchell [29] published a comprehensive literature review of ABC in accounting journals from the UK and the US over a 14-year period. Lueg and Storgaard [30] analyzed the literature on the adoption and implementation of ABC, highlighting a lack of consensus on the factors influencing its success. Stefano and Filho [31] explored ABC's application in the service sector, providing insights into its broader usage in various business contexts. Hofmann and Bosshard [32] examined ABC's role in supply chain management, emphasizing its significance in inter-organizational settings.

The most recent systematic review, by Sánchez-Rebull et al. [8], covered 30 years of ABC research, offering a comprehensive overview and suggesting future research directions. They noted the expansion of ABC research into emerging areas such as environmental costs, eco-efficiency, carbon emission reduction, and sustainability, a shift driven by increasing awareness of the importance of environmental management and the need to integrate sustainability into accounting and management practices [7].

Given the context, the objective of this study is to conduct a comprehensive review of the research on environmental impact and activity-based costing (ABC). The aim is

to provide a clear understanding of the current state of the literature on ABC's role in environmental management and to guide future research in this area. As Bryman [33] emphasizes, research questions are crucial because they shape the methods used to address them. Accordingly, this study poses four research questions, which form the core contributions of the paper to the field of ABC and environmental impact research: RQ1: Who are the most influential authors in the field of ABC and environmental impact based on citation metrics?; RQ2: Which are the leading journals that have published articles on this topic?; RQ3: What are the key contributions made in this area of research?, and; RQ4: What research avenues can be suggested for further development in this field?

By addressing these questions, this study aims to clarify the academic landscape surrounding ABC and environmental sustainability and offer guidance for future investigations into this critical intersection of cost management and environmental stewardship.

2. Materials and Methods

2.1. Data

The selected literature for this study includes articles published in the Web of Science database from 1998 to 2023. Web of Science (WoS) is the database most widely used for research publications and citations [34]. The search equation used in this study specifically targeted articles related to "activity-based costing" and "environmental impact", ensuring a comprehensive exploration of the topic in the title, abstract, and keywords.

2.2. Inclusion and Exclusion Criteria

The search yielded 70 results, from which three were removed, because one corresponded to a review, and the other two did not approach the subject of this work. This allowed us to obtain 67 articles that were reviewed individually to confirm the presence of the keywords, whether in the title, abstract, keywords, or body of the document. After this, nine articles were excluded, since they did not address the ecological environment, but the organizational environment. Finally, it was possible to obtain a database with 58 articles published in the selected period (Figure 1).

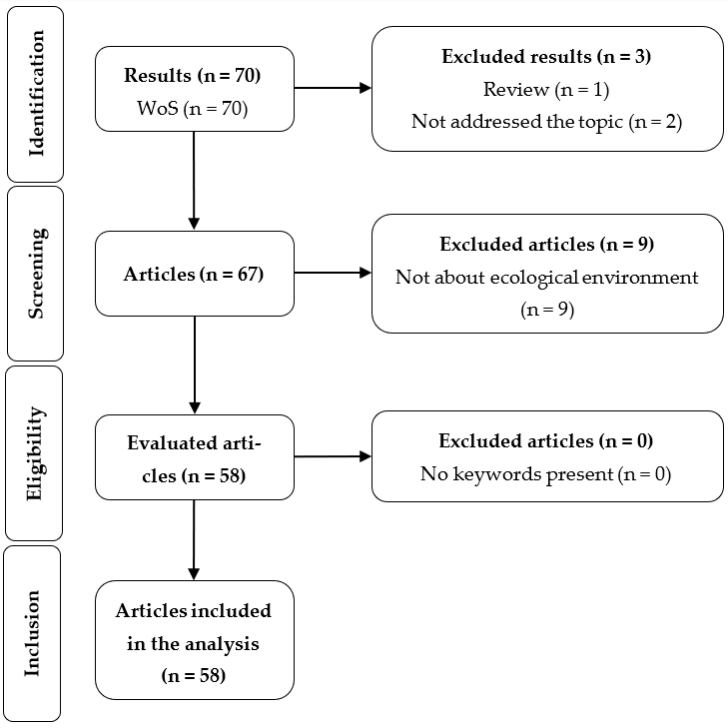

Figure 1. Inclusion and exclusion criteria of results using the PRISMA method [35].

2.3. Data Analysis

The publication data, including authors, yearly publications, journal distributions, and research areas, were compiled into an Excel file and then exported to a text format. This data was subsequently analyzed using the Bibliometrix R package (Version 4.3.0), which facilitates the creation of tables and network-based maps for further analysis. Then, the contributions made by the research of Dote-Pardo and Ceballos-Garrido [36] were considered, which allowed a descriptive study to be carried out to analyze the progression of research on this topic over time.

Additionally, bibliometric indicators were calculated, including the average number of authors per article, articles per journal, authors per organization, publications per author, and citations per author. Collaboration networks among authors were defined based on the criterion of having co-authored at least one article, illustrating the co-authorship networks among researchers in the field. The leading journals were then analyzed in detail.

To identify publication trends in scientific discourse and the prominence of key terms, the keywords from the various studies were analyzed. Based on Dote-Pardo and Ceballos-Garrido [36], through this analysis, you can gain insight into the topics that most concern researchers in this field. To identify future research directions, an analysis of Keywords Plus was conducted. These are terms that frequently appear in the titles of referenced works but are not included in the article's title itself. Using a specialized algorithm from Clarivate databases, Keywords Plus enhances the search power for cited references by analyzing all articles that have cited common references. Since Keywords Plus has been in use since 1991, it provides a valuable parameter for identifying emerging research trends. This study suggests these trends as potential future research lines, considering the limited research in this area. The names of each research line were derived from the most frequently occurring words within each cluster.

When analyzing the topics graphically, we identified four categories: (i) driving topics located in the first quadrant (top right) and characterized by a cluster network with high centrality and density, highlighting their importance and significant development within the research structure; (ii) niche topics in the second quadrant (top left) with high density but low centrality, suggesting limited relevance; (iii) emerging or declining topics in the third quadrant (bottom left) with low centrality and density, indicating early-stage or marginal development; and (iv) basic topics in the fourth quadrant (bottom right) distinguished by high centrality and low density, making them essential for transdisciplinary research [37].

3. Results

3.1. Evolution of the Number of Publications and Journals Focusing on ABC and Environmental Impact

Publications on activity-based costing and environmental impact have been found since 1998 in WoS, where the first articles "Activity based cost management—Part I: Applied to occupational and environmental health organizations" and "Activity based cost management—Part II: Applied to a respiratory protection program" by Brandt et al. [38,39] were published. Since these first publications, the research has evolved increasingly, reaching a first peak in 2018, with 11 articles in five different journals. Then, in 2019, three articles were published in two journals, and although the number of publications was reduced by 72.7% in one year, since 2021, the tendency has been increasing, reaffirming the importance of the environmental impact in different areas like activity-based costing. The number of journals that have been interested in publishing works on this topic has increased almost proportionally to the number of publications. Despite this, there are some years in which no publications are recorded, which is why it has captured the attention of researchers and journals worldwide; it is relatively emerging compared to other areas of research in accounting and finance (Figure 2).

To enhance and support the previous analysis, Table 1 presents a detailed summary of essential bibliometric indicators related to research on activity-based costing and environmental impact. These indicators provide a quantitative evaluation of research output and impact, offering valuable insights into publication trends, author contributions, and journal performance in this field.

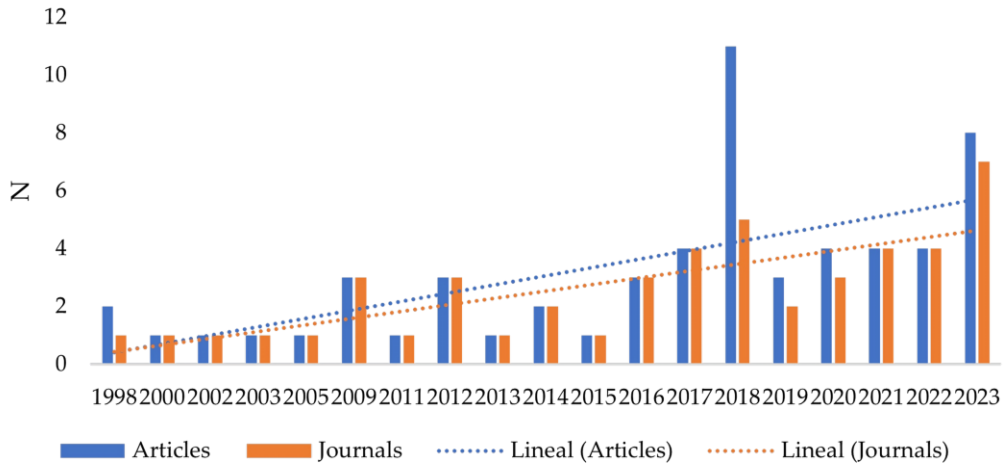

Figure 2. Articles and journals per year on activity-based costing and environmental impact.

Table 1. Key bibliometric indicators.

Indicator	1998–2014	2015–2023	Total
Articles	16	42	58
Authors	45	120	165
Journals	11	21	33
Organizations	25	77	102
Countries	8	28	36
Citations	828	450	1278
Authors/Article	2.8	2.9	2.8
Articles/Author	0.4	0.4	0.4
Articles/Journal	1.5	2.0	1.8
Articles/Organization	0.6	0.5	0.6
Articles/Country	2.0	1.5	1.6
Journals/Country	1.4	0.8	0.9
Organizations/Country	3.1	2.8	2.8
Authors/Organization	1.8	1.6	1.6
Authors/Country	5.6	4.3	4.6
Citations/Article	51.8	10.7	22.0
Citations/Author	18.4	3.8	7.7
Citations/Journal	75.3	21.4	38.7
Citations/Organization	33.1	5.8	12.5
Citations/Country	103.5	16.1	35.5

Source: self-made.

3.2. Authors and Co-Authorship Analysis

The authors with the greatest number of published works are presented in Table 2, where it can be seen that Tsai, W.H. has contributed 20 articles on ABC and environmental

impact (34.5%), which represents the largest number of citations in the WoS. Tsai is followed by authors such as Baird, K. and Chen, H.C. with four publications each (6.9%).

Table 2. Main authors according to the number of citations in their works.

N	Author	WoS Cites	Publications	H Index	Institution (Country)
1	Tsai, W.H.	3.060	20	31	National Central University (Taiwan)
2	Baird, K.	2.118	4	23	Macquarie University (Australia)
3	Chen, H.C.	277	4	7	National Yunlin University of Science & Technology (Taiwan)
4	Hsieh, C.L.	67	3	5	National Taichung University of Science & Technology (Taiwan)
5	Lee, H.L.	243	3	6	Veterans Affairs Council (Taiwan)
6	Su, S.	452	3	12	Macquarie University (Australia)
7	Tung, A.	595	3	12	Macquarie University (Australia)
8	Yang, C.H.	601	3	14	Ming Chuan University (Taiwan)

Source: self-made.

The nine authorship networks detected are dispersed, the largest being the one made up of Tsai, W.H. (National Central University, Taiwan), Jhong, S.Y. (National Central University, Taiwan), Lee, H.L. (Vet Affairs Council Tainan Vet Home, Taiwan), Chang, Y.C. (National Taitung University, Taiwan), Shen, Y.S. (Sichuan University, China), Liu, J.Y. (Chinese Culture University, Taiwan), and Chow, Y.W. (National Tsing Hua University, Taiwan). This shows the relevance of institutions located in countries like Taiwan and China. A second identified authorship network is made up of Beatty, E., Belanger, L., Desjardins, A., Dancause, V., Bluteau, A., Bergeron, F., and Berthelot, S. In this case, all the authors are affiliated with Laval University, Canada (Figure 3).

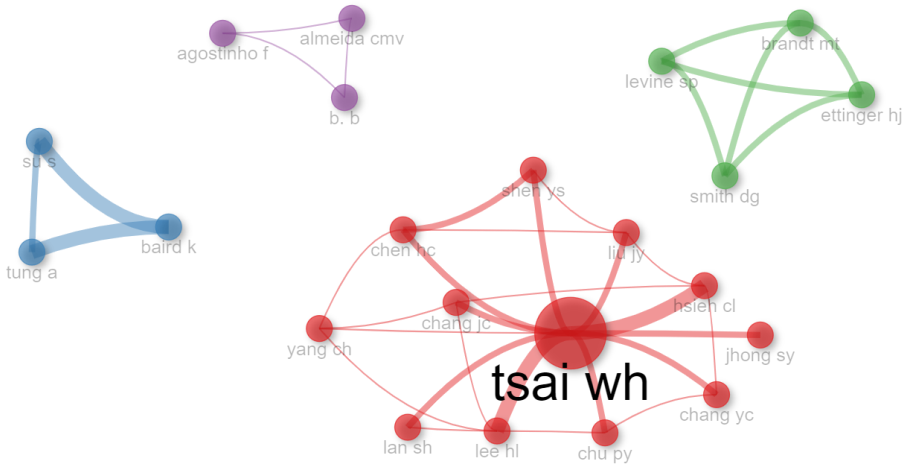

Figure 3. Authorship networks in publications on ABC and environmental impact.

3.3. Main Countries

The countries that have produced the most publications on ABC and environmental impact are China (42.2%), Canada (13.7%), and the USA (11.8%). Moreover, the countries

that have developed a greater number of collaboration networks to publish on this topic are: (i) China, which has collaborated with France, Lebanon, Pakistan, Saudi Arabia, and Sweden; (ii) the USA, which has collaborated with Korea, New Zealand, and Sweden; and (iii) Sweden, in collaboration with countries like Egypt, Finland, and the United Kingdom. Countries such as Canada, Egypt, France, Saudi Arabia, Brazil, Ecuador, Finland, Greece, and Lebanon have developed collaboration networks but to a lesser extent. The map uses darker colors to represent countries with a higher volume of publications on the topic, making it easy to identify global leaders in the field. Countries shaded in darker tones indicate those with a greater research output, while lighter shades represent countries with fewer publications.

The lines between countries illustrate the networks of research collaboration. Thicker lines signify stronger collaborative ties, meaning that those countries have frequently co-authored research papers or engaged in joint research projects. Thinner lines, on the other hand, suggest less frequent collaborations. This visual depiction not only highlights the geographic spread of research activity but also underscores the strength and extent of international research partnerships (Figure 4).

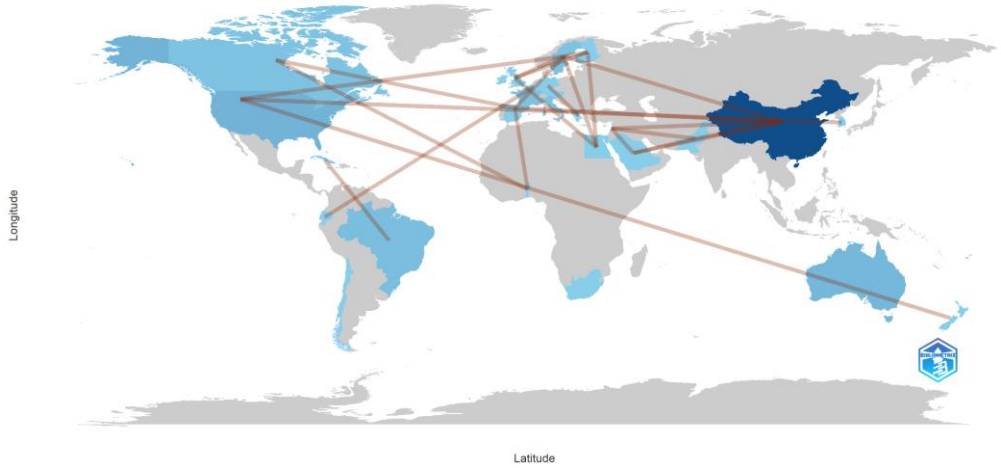

Figure 4. Publications and collaboration between countries.

3.4. Main Journals with Publications on ABC and Environmental Impact

Among the journals publishing research on ABC and environmental impact, 74.1% of the articles (43 papers) are featured in seven distinct journals. Notably, several of these journals are indexed in the Science Citation Index Expanded (SCIE), indicating that this area of research is more closely linked to engineering and process issues than to management, accounting, and finance (see Table 3).

Table 3. Main journals with publications on ABC and environmental impact.

No.	Journal	JCR Category	WoS Index	Quartile (Q)	Articles
1	Sustainability	Environmental Sciences	SCIE	Q2	22
		Environmental Studies	SSCI	Q2	
		Green and Sustainable Science and Technology	SCIE	Q3	
		Green and Sustainable Science and Technology	SSCI	Q3	

Table 3. *Cont.*

No.	Journal	JCR Category	WoS Index	Quartile (Q)	Articles
2	Journal of Cleaner Production	Engineering, Environmental	SCIE	Q1	7
		Environmental Sciences	SCIE	Q1	
		Green and Sustainable Science and Technology	SCIE	Q1	
3	Energies	Energy and Fuels	SCIE	Q3	5
4	International Journal of Production Research	Engineering, Industrial	SCIE	Q1	3
		Engineering, Manufacturing	SCIE	Q1	
		Operations Research and Management Science	SCIE	Q1	
5	American Industrial Hygiene Association Journal	Environmental Sciences	SCIE	Q2	2
		Public, Environmental, and Occupational Health	SCIE	Q2	
6	Business Strategy and the Environment	Business	SSCI	Q1	2
		Environmental Studies	SSCI	Q1	
		Management	SSCI	Q1	
7	Processes	Engineering, Chemical	SCIE	Q2	2

Source: self-made.

3.5. Most Relevant Contributions to Activity-Based Costing and Environmental Impact

The article that received the greatest number of citations addresses the ABC costing system in remanufacturing processes in products such as household appliances and automobile parts, showing that this method is suitable for companies that do not have too many activities, and where the costs of research and development of new products can be properly accounted for. It is highlighted that in the functional sales industry, significant decreases have been obtained in the environmental impact generated by the productive processes of companies, which can be optimized using ABC systems [40].

A highly cited study proposes a set of principles and procedures to minimize the cost of implementing Environmental Management Accounting (EMA) systems. The activity-based costing (ABC) system is instrumental in achieving this goal, as it enables companies to allocate costs across different cost centers and production areas, thereby optimizing the identification and tracking of cost sources [41]. Similarly, the utility of ABC has been demonstrated by optimizing treatment and recycling systems for waste electrical and electronic equipment, where its application makes these processes more efficient and cost-effective [42]. These studies highlight the practical benefits of ABC in enhancing the efficiency of environmental management practices.

The application of the activity-based costing (ABC) system has yielded positive outcomes across various industries, especially when combined with life-cycle assessment (LCA). In the sustainable construction sector, programming models that integrate ABC and LCA contribute to three key areas: (i) better allocation of funding for energy-saving

activities, (ii) improved decision-making in managing tenders for sustainable construction projects, and (iii) more effective management of sustainable construction costs [43].

Similarly, in the sustainable transportation industry, one of the main objectives is to reduce energy consumption. The integration of ABC with carbon footprint analysis and LCA has been shown to be an optimal, practical approach for obtaining environmental cost information, which aids in decision-making and reduces the environmental impact of these projects [44].

The textile industry, recognized as a major contributor to global environmental pollution, has also benefited from ABC. Mathematical programming models that combine ABC with the Theory of Constraints (TOC) have generated decision models aimed at optimizing carbon emissions, energy recycling, waste reuse, and material use in a cost-effective manner [45].

In the pulp and paper industry, ABC has proven effective for calculating environmental costs and addressing the shortcomings of traditional accounting systems by offering more precise estimates of environmental expenses. This improved accuracy facilitates more responsible corporate decisions. However, it was noted that research in this area tends to focus on single industries, prompting a recommendation for future studies to explore ABC's applicability across multiple sectors [11].

One noteworthy study presents an integrated methodology combining LCA and ABC for the metallurgical industry, allowing clearer identification of the production stages with the highest environmental impact and associated costs [46].

While most research on ABC and environmental impact focuses on production processes, there are also studies highlighting the potential of ABC to monitor and gradually reduce the ecological footprint of consumer decisions [47].

Lastly, another influential study proposes an environmental costing system for managing the flows of products, by-products, and waste in manufacturing plants. This approach, based on ABC, goes beyond merely costing expected products by incorporating by-products and waste into the costing process, enabling eco-efficient and sustainable decision-making [48].

These studies demonstrate the broad applicability and versatility of ABC for addressing environmental challenges, with the most frequently cited articles in this area summarized in Table 4.

Table 4. The most cited publications on activity-based costing and environmental impact.

No.	Article	Year	Authors	WoS Cites	Total Cites
1	Making functional sales environmentally and economically beneficial through product remanufacturing	2005	Sundin, E. and Bras, B. [40]	284	623
2	The use of Environmental Management Accounting (EMA) for identifying environmental costs	2003	Jasch, C. [41]	134	553
3	Treatment and recycling system optimisation with activity-based costing in WEEE reverse logistics management: an environmental supply chain perspective	2009	Tsai, W.H. and Hung, S.J. [42]	82	139
4	An Activity-Based Costing decision model for life cycle assessment in green building projects	2014	Tsai, W.H., Yang, C.H., Chang, J.C., and Lee, H.L. [43]	70	133

Table 4. *Cont.*

No.	Article	Year	Authors	WoS Cites	Total Cites
5	Incorporating carbon footprint with activity-based costing constraints into sustainable public transport infrastructure project decisions	2016	Yang, C.H., Lee, K.C., and Chen, H.C. [44]	50	79
6	Green production planning and control for the textile industry by using mathematical programming and industry 4.0 techniques	2018	Tsai, W.H. [45]	41	74
7	Integrating information about the cost of carbon through activity-based costing	2012	Tsai, W.H., Shen, Y.S., Lee, P.L., Chen, H.C., Kuo, L.P., and Huang, C.C. [11]	40	79
8	An integrated methodology for environmental impacts and costs evaluation in industrial processes	2009	da Silva, P.R.S. and Amaral, F.G. [46]	37	76
9	Giving the consumer the choice: A methodology for product ecological footprint calculation	2009	Limnios, E.A.M., Ghadouani, A., Schilizzi, S.G.M., and Mazzarol, T. [47]	36	87
10	Eco-efficiency for sustainable manufacturing: an extended environmental costing method	2012	Cagno, E., Micheli, G.J.L., and Trucco, P. [48]	32	66

Source: self-made.

3.6. Keywords Plus Mapping

The keywords that appear most frequently in articles published on ABC and environmental impact are management (10 occurrences), life-cycle assessment (eight occurrences), model (eight occurrences), programming approach (eight occurrences), systems (seven occurrences), energy (six occurrences), framework (six occurrences), impact (six occurrences), performance (six occurrences), and sustainability (six occurrences). These 10 keywords together represent 49.0% of the total occurrences of all the keywords that have been used in this topic. These keywords provide an initial notion about the concepts that are most important in the scientific discourse on ABC and environmental impact in the WoS, and how relevant terms related to costs and sustainability are found (Figure 5).

Figure 5. Keywords with the highest occurrence in publications about ABC and environmental impact.

The importance that keywords used in publications in this area of research have acquired has varied over the years. However, there are keywords that stand out above the others, due to their greater permanence over time in publications on ABC and environmental impact. Words such as system, optimization, industry, impact, carbon, sustainability, implementation, design, management, emission, energy, and indicators, have received greater attention from the scientific community, showing permanence over time, highlighting at least four continuous years of research (Figure 6).

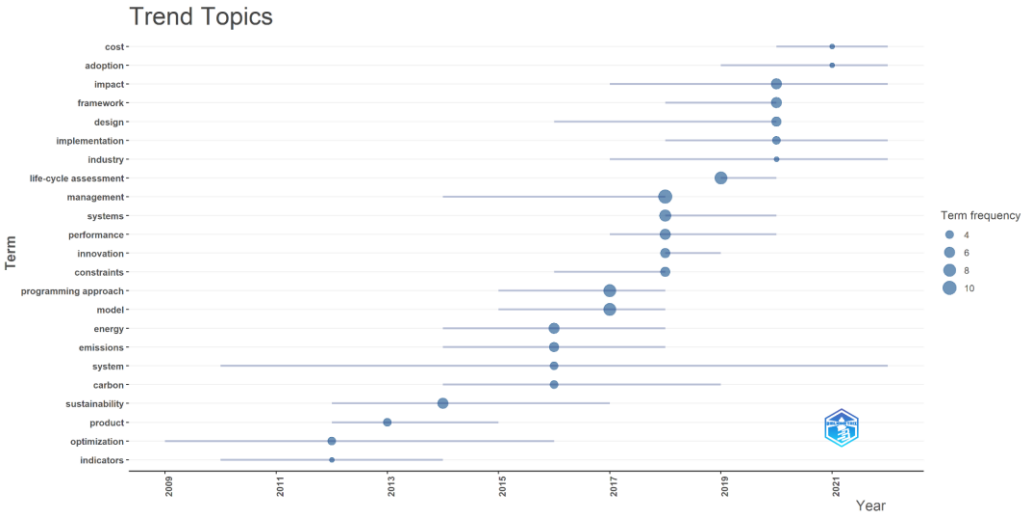

Figure 6. Keywords with the highest occurrence over the years.

When analyzing the Keywords Plus networks, five clusters can be identified. The first cluster (blue) is made up of words such as management, carbon, constraints, costing model, logistics, decision-model, supply chain, capacity, and industry. The second cluster (red) is made up of keywords such as systems, impact, performance, innovation, implementation, corporate, adoption, cost, environmental management, and system. The third cluster (purple) contains the words sustainability, emissions, energy, product, green, methodology, and optimization. The fourth cluster (green) groups the words model, framework, and design. The fifth cluster (orange) contains the words life-cycle assessment and China (Figure 7).

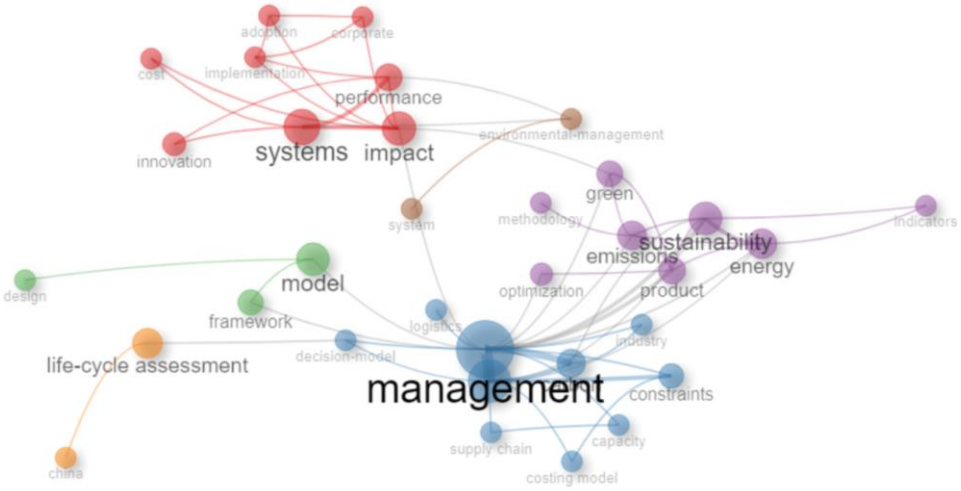

Figure 7. Keywords Plus network.

To identify future lines of research according to the Keywords Plus analysis, five clusters have been generated, which were classified into quadrants based on the development

degree (density) and the relevance degree (centrality). From this, five lines of research were identified that represent challenges that must be covered to continue developing this topic. Among the lines of research classified as emerging are: (i) implementation of costing systems to reduce environmental impact; (ii) cost management models to optimize supply chains; and (iii) technologies for environmental challenges on production processes. In addition, two lines of research were identified that are classified as motor themes, that is, they are fundamental to continue developing this area, which are: (i) life-cycle assessment management models and (ii) performance and impact of systems for environmental cost management (Figure 8).

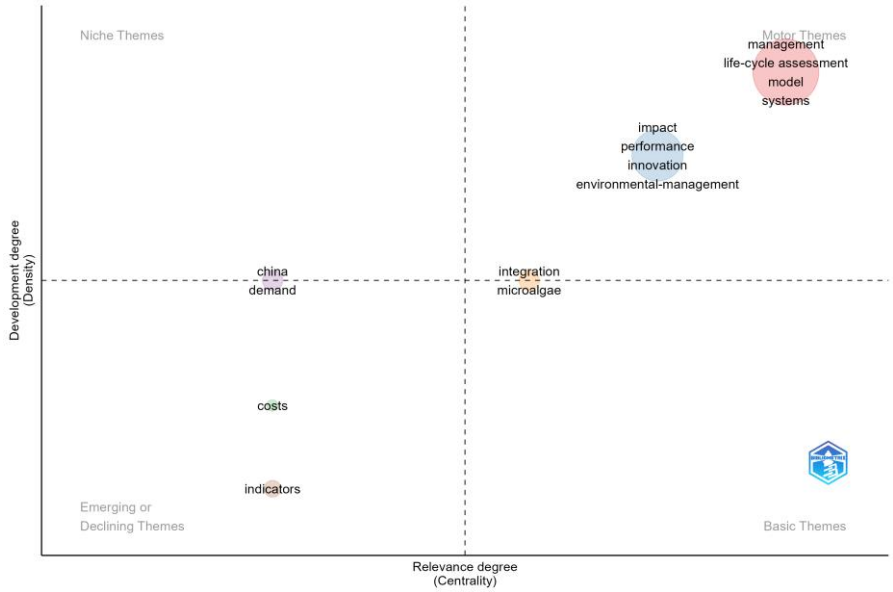

Figure 8. Keywords Plus network with the highest occurrence.

4. Conclusions and Future Directions

This study highlights the significant potential of activity-based costing (ABC) in mitigating environmental impacts and underscores the essential role of accounting professionals in this area [11,49–51]. By systematically reviewing 58 articles published between 1998 and 2023, this research provides a comprehensive overview of the evolving landscape of ABC in relation to environmental impact. Utilizing analytical tools such as Excel and the R package Bibliometrix, the results reveal a substantial increase in research activity in this area and identify key contributions of ABC in enhancing sustainability across diverse sectors, including sustainable construction [43], the electrical and electronic industry [28], the pulp and paper industry [11], mining and metallurgy [52,53], transportation [44], and manufacturing [19,40,46,48–64].

In the construction industry, a company implemented ABC to identify energy-intensive activities, such as those consuming significant water and energy during building phases. This allowed them to adopt energy-efficient equipment and materials with lower carbon footprints, leading to more sustainable practices and eligibility for certifications like LEED. Similarly, in the metallurgy and mining sector, a firm used ABC to track energy and water consumption across its operations, allowing it to optimize processes, adopt water recycling systems, and reduce resource usage. These measures not only decreased environmental costs but also improved transparency with stakeholders, enhancing the company's reputation.

In the transportation and logistics sector, a logistics company applied ABC to analyze the environmental costs of different transportation routes and modes. The data revealed opportunities for route optimization and a shift towards more fuel-efficient vehicles, sig-

nificantly reducing the company's carbon footprint. Such approaches can be replicated by other logistics companies seeking to provide greener services. The manufacturing industry also benefits from ABC by identifying the environmental costs associated with raw materials, energy use, and waste generation in production processes. By using ABC, a manufacturing firm was able to replace high-impact materials with sustainable alternatives and implement recycling processes for by-products, reducing waste disposal costs while improving overall efficiency.

To apply these findings broadly, businesses can integrate environmental data—such as carbon emissions, water usage, and waste production—into their ABC systems for a comprehensive understanding of costs. Fostering collaboration between departments like finance, sustainability, and operations ensures that insights from ABC translate into actionable sustainability strategies. Additionally, using ABC data to justify investments in renewable energy sources or energy-efficient technologies can yield long-term cost savings. These efforts not only drive cost reductions but also support companies in meeting sustainability goals, enhancing their appeal to consumers and investors focused on Environmental, Social, and Governance (ESG) criteria. Through these pathways, the role of ABC extends beyond traditional cost management to become a key driver of sustainable business practices.

The literature emphasizes that ABC not only facilitates the reduction of environmental impacts but also supports the development of more effective environmental management strategies. Emerging research directions suggest that future studies should focus on the implementation of advanced costing systems tailored to environmental objectives, the optimization of supply chain management through cost management models, and the application of innovative technologies to address environmental challenges in production processes.

Moreover, the study identifies two pivotal research themes: the life cycle assessment management model and the performance and impact of environmental cost management systems. These themes are fundamental to advancing the field of sustainable business practices, as they address key aspects of how businesses can manage and reduce their environmental footprint. The life cycle assessment management model provides a framework to assess the environmental impacts of a product or service across its entire life cycle, from raw material extraction to disposal. By adopting this model, businesses can make more informed decisions that minimize negative environmental effects and enhance sustainability.

Similarly, the study highlights the significance of understanding the performance and impact of environmental cost management systems, particularly the way they integrate with ABC approaches. These systems play a crucial role in identifying, measuring, and controlling environmental costs associated with business operations, allowing organizations to allocate resources more effectively towards sustainable initiatives. By refining these systems, companies can better assess the economic benefits of reducing their environmental impact, which in turn can drive more sustainable business strategies.

These research themes are not only crucial for the advancement of sustainable business practices but also warrant further investigation to refine and expand the application of ABC in promoting environmentally responsible behaviors within organizations. This research contributes valuable insights into the intersection of activity-based costing and environmental impact assessment, offering a solid foundation for future exploration and development. It paves the way for deeper understanding and innovation in integrating environmental considerations into financial and managerial decision-making, making it an essential area of study for achieving long-term sustainability goals.

Despite the valuable insights provided by this study, several limitations must be acknowledged. These limitations can be considered to develop future research that contributes to this field of study. (i) This study exclusively reviewed articles published in the Web of Science database, which may limit the breadth of literature considered. Important research published in other databases or in non-English languages might not have been included, potentially narrowing the scope of the review. (ii) This review focuses on publications from 1998 to 2023. As the field of environmental accounting and ABC is continually evolving, more recent developments post-2023 might not be reflected in the study, potentially impacting the relevance of the findings. (iii); The quality and rigor of the reviewed studies vary. Some articles might lack methodological robustness or might not be generalizable, which could affect the overall conclusions drawn about the effectiveness of ABC in reducing environmental impact. (iv) Although the study highlights key industries such as sustainable construction, metallurgy, transportation, and manufacturing, the findings may not be equally applicable to all sectors. The unique challenges and practices within other industries might not be fully addressed. (v) The identification of emerging research themes is based on current literature trends. These themes may evolve as new technologies and methodologies develop, potentially shifting the focus of future research.

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