

# Scopus Indexed and VOSviewer-Based Environmental Management Accounting System Mapping: Bibliometrics and Visualization

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**Abstract.** The analysis was carried out to observe and classify systematically by imaging and describing the Scopus indexed Management Accounting System research literature from 2017 to June 2021. This study provides bibliometric analysis information about Environmental Management Control Systems and Environmental Management Accounting on Managerial Performance through Accounting Systems. Management demonstrated through VOSviewer Mapping is still rarely studied. In addition, the visualization in this study will show keywords, co-citation relationships, file citations, and points of view contained in the articles, such as the total articles published per year, journals, topics, and authors. The review in this study consisted of 89 articles which were analyzed and the results illustrated graphically using VOSviewer software. VOSviewer generates a graphical representation of bibliographic data based on co-occurrence, co-citation, and coupling. This study provides a comprehensive understanding of past trends as well as information on research that has potential in the future by reviewing and analyzing research on Management Accounting Systems as an intervening variable

**Keywords:** Environmental Management Accounting System, Bibliometric, VOSviewer, Scopus.

## 1. Introduction

Organizational business decisions are based on economic considerations, which have had an impact on socio-environmental issues in several countries over the years. The number of environmental issues that occur, will make people demand companies to pay attention to social and environmental impacts [1]. To find solutions to these problems, the idea of sustainable development emerged, which was simultaneously based on three points of view: economic, social, and environmental. Therefore, the strategy is that the needs of the present generation can be met but do not risk the needs of future generations [2]. Growing awareness of the impact of industrialization, economic growth, and development that has exceeded boundaries on the environment around the world has made stakeholders take policy decisions [3]. To be truly sustainable, future generations must be better than the current generation [4].

The high increase in environmental protection has resulted in an increase in the demand for environmental data on company practices. Thus, the need for accounting is increasing for organizations that play a role in assessing their environmental impacts and achievements as well as disclosing required environmental related data [5], [6]. This need is the basis for the

escalation of environmental management accounting. It is an inclusive field of accounting, with the provision of relevant information as another relevant term for stakeholders on what the company has done for its environment [7]–[9].

For managerial aspects, environmental management accounting practices have an important role in environmental management practices in manufacturing companies. Environmental management accounting practice requirements can be met by implementing environmental management systems in manufacturing companies, this can help organizations manage, measure, and improve environmental management. Therefore, the environmental management system provides direction for manufacturing companies to improve environmental management accounting practices and the company's environmental performance [10].

Coercive pressures can have a significant positive impact on Environmental Management Accounting. That is, the coercive pressure that affects the implementation of Environmental Management Accounting comes from environmental regulations, pressure from shareholders and the local community. So it can be said that company size is the only moderating contingent factor that has a significant effect on the implementation of Environmental Management Accounting [8].

The composite of resources contained within the organization such as Environmental Strategy, Top Management Commitment and awareness of environmental uncertainty can continue to improve Environmental Performance. Environmental Management Control System and Environmental Management Accounting are two different instruments and media, both of which can improve a company's environmental performance according to environmental cost management [11].

## **2. Literature Review**

Environmental Management Accounting can be developed to assist the achievement of company managers in making decisions and also to help improve the company's environmental performance [8], [12]. Environmental Management Accounting is a step to generate, analyze, and use financial and non-financial information that can have an impact on improving environmental performance and company performance, so that the company can run a sustainable business [7].

The Environmental Management System that is implemented can provide many benefits for the company. For example, the company states that the Environmental Management System implemented can reduce risks that occur in the company's environment, comply with environmental regulations, and improve the utilization of company resources and employee utilization, as well as protect the company's reputation [10], [13], [14].

Management accounting tool in environmental performance that can be used is the company's environmental performance analysis system. Four basic measures of the balanced scorecard underpin the system. Social responsibility and the balanced scorecard are combined based on these four basic measures. This is to optimize four basic measures, namely finance, stakeholders, internal management, and learning and growth. Because the social responsibility aspect overshadows the analysis system [11], [15].

Several studies of environmental related literature have been carried out, including analytical techniques using bibliometrics on environmental management accounting systems. The network of research contributions and related research contributors can be classified and described by this technique, because it is considered reliable and accurate [16]. Mougnot and Doussoulin (2021) used this technique to examine the conceptual evolution of bioeconomics.

This is done because the concept has potential related to environmental management and maintenance in order to answer the existing challenges. The database related to this potential was obtained from Scopus indexed references from 1999 to 2018 [17].

Taqi *et al.*, (2021) mapped biometrics on environmental accounting: a scientometric using biblioshiny [18]. Taqi *et al.*, (2021) research articles quoted from various scientific journal references and other sources based on environmental accounting research topics on accounting, energy and environmental research globally [18]. The bibliometric analysis is sourced from 500 published articles. Furthermore, Fusco & Ricci (2018) also analyzed bibliometric research on environmental and social accounting in the public sector and identified their articles from 1997 to 2017, with references from 21 journals indexed by Web of Science, Scopus, and Google Scholar, and 65 researchers who studied contributed to bibliometric analysis [19]. Therefore, there is not much literature related to environmental management accounting systems based on mapping and bibliometric analysis.

### **3. Research Methodology**

This study uses a literature-based mapping system research method using bibliometric analysis. Coupling (dependency between modules), co-citation (some documents are quoted together with other documents) and citation analysis can be used as mapping. In addition, mapping systems research methods can group and visualize contributions and their interconnected network of contributors [16], [20]–[22]. In this study, we extracted data on bibliometrics related to the management accounting system from the Scopus indexed database. The search criteria for the topic of management accounting system, with a time span: 2017 to 2021 (June) with keywords/terms/title words (management accounting system). One hundred and ninety (190) documents relating to the management accounting system have been published. Then refined based on the type of document in English. After that, eighty nine (89) documents appear to be analyzed, then the documents or articles are analyzed using VOS Viewer and Microsoft Excel.

### **4. Result and Discussion**

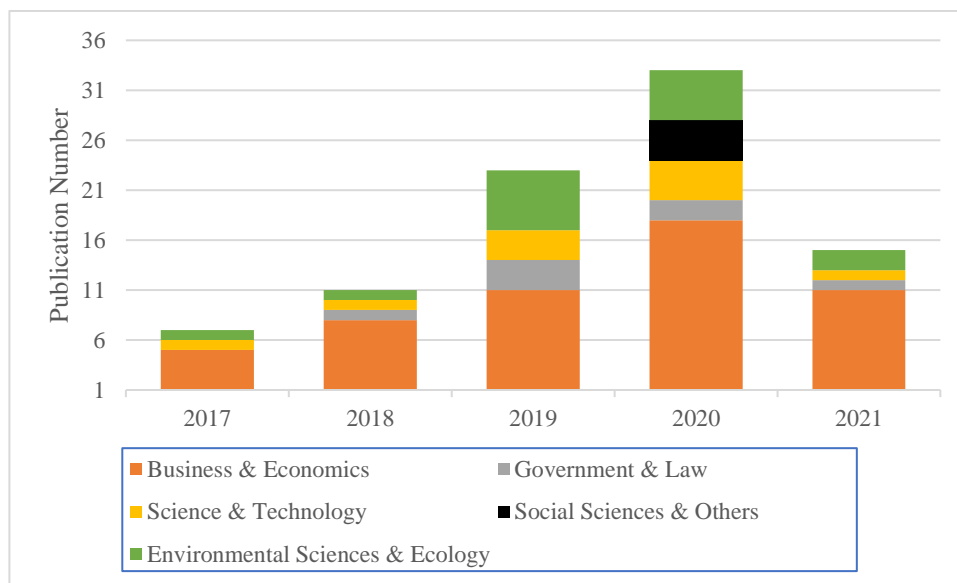
Fig. 1 describes the research area of management accounting systems and the number of publications per year. In 2017 there were 7 articles published regarding the management accounting system. Only 1 article in 2017 discussed the environmental management accounting system. This system optimizes material use efficiency and reduces environmental impact. In addition, the flow of materials through the supply chain of production and related consumption activities can be tracked by the system. The system is also integrated with the economic model; predict possible overloads on the capacity of waste management facilities and provide decisions for designing strategies for resource sustainability.

In 2018, there was 1 article published regarding the management accounting system that had to be adjusted following changes in the business environment. The Management Accounting system must be modified in order to adapt to changes in the business environment, Management Accounting system information acts as a mediation in the relationship between integrated manufacturing practices and organizational performance [9]. This shows that if the company's performance wants to increase, then managers can use a management accounting information system where managers can focus on broad scope, timely, integrated and aggregated information. So managers can make better decisions.

Therefore, in the manufacturing practice environment, the use of management accounting information systems is very relevant, because its use can help companies achieve organizational goals.

In the research in the following years, the discussion about the management accounting system is increasingly diverse, starting from optimizing the efficiency of material use and reducing environmental impacts, using appropriate and accurate information for decision making, until in 2019 there were 6 articles discussing the management accounting system. The management accounting system developed with other variables such as ecological innovation and energy efficiency for the development and improvement of company performance and provides the highest competitive advantage for the organization [23].

Meanwhile, in 2020, there were 5 articles related to the management accounting system, but in 2021, only 2 articles regarding the management accounting system had a major impact on the company's performance. This is possible if the company streamlines the management accounting system, it will have an impact on the company's performance. In addition, the efficiency of the management accounting system in anticipating environmental uncertainty and corporate risk management will assist companies in implementing sophisticated systems, so as to improve their performance. The implementation of corporate risk management can also improve the quality of information, quality control, and reduce the risks faced [24].



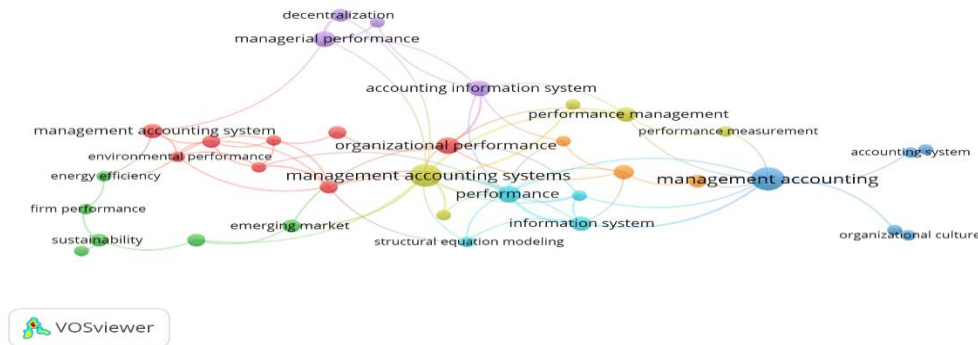
**Fig. 1** The subject area of research is management accounting systems and the number of publications per year

## 4.2 Analysis of bibliometric visualization

### 4.2.1 Keywords for Co-occurrence

Keywords from 89 published and collected data were then analyzed using VOS viewer software to understand research areas and trends in management accounting systems. Network

map and overlay visualization of shared events based on keywords are shown in Fig.2. The keyword minimum is set to 2, and 56 keywords are visible.



**Fig. 2** Keyword network visualization map in management accounting system based on co-occurrence

Based on the display in Fig.2, the color of the nodes represents different clusters, in addition to the color of the nodes, the size of the circle also represents the frequency. There are five term items based on the results of the VOS viewer. There are some items that don't show labels on the picture, this is done to avoid overlapping boundaries. Red, yellow, green, blue, and purple are the cluster colors displayed. Generally, management accounting system research is indicated in the yellow cluster. "Management accounting system" in the yellow cluster became the central term; Closely related terms include "management accounting", "accounting system", and "accounting information system".

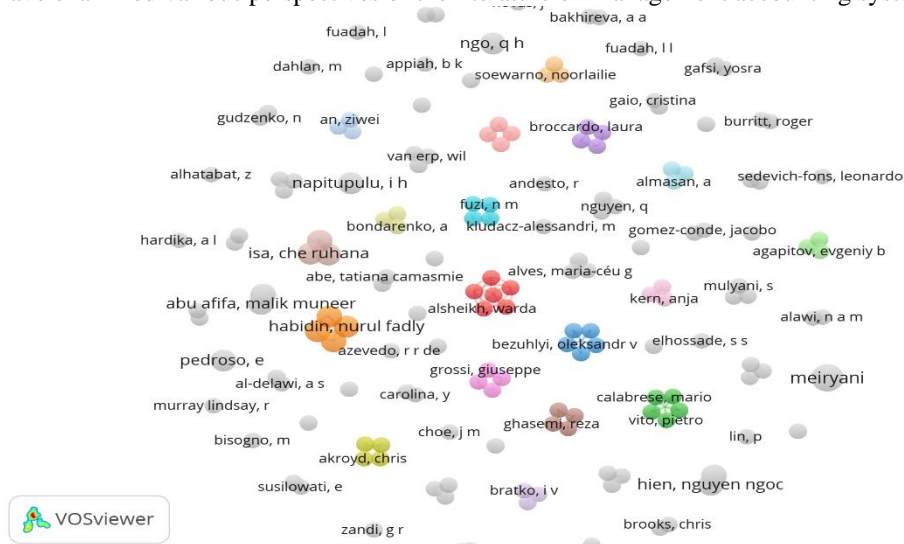
The second cluster is related to environmental performance, energy efficiency, financial performance, and managerial performance as red term. In this cluster, the most frequently used terms are “management accounting system”, “environmental performance”, and “managerial performance”. Green clusters represent environmental management that optimizes the efficiency of material use and reduces environmental impact. Items from this group include "environmental management" and "emerging markets".

Furthermore, the blue cluster describes the achievement of the company's performance. Environmental management accounting and environmental management systems can improve environmental and corporate performance by generating, analyzing, and using appropriate financial and non-financial information. Thus, it can help reduce the risk or impact on the company's environment, where related terms it influences such as “environmental performance”, “operational performance”, and “financial performance”. The purple cluster shows the achievements of the management accounting system and decentralization as the delegation of authority over to the subordinates regarding the system to facilitate the company's managerial planning and supervision, with the keywords appearing "managerial performance" and "decentralization". Overall, the five clusters become the main aspects of current management accounting systems research at the global level that are revealed.

#### 4.2.2 Co-Authorship

The results showed that there were researchers who wrote 89 articles as the most prolific writers on management accounting systems, including a network of co-authors. In addition,

the author or leading group becomes an article search that must be understood as a field limitation that is carried out. There are two results of co-authorship visualization, namely: first to identify authors who have researched management accounting systems research, and second to identify all authors who have contributed to their research well. Fig.3 Shows the results of the co-authorship visualization through the VOS viewer. The six authors shown in the figure have examined various perspectives of the literature on management accounting systems.



**Fig. 3** Network visualization mapping of co-authoring in Management Accounting Systems

Based on the visualization analysis of the writing network in Figure 3 above, it can be seen that the most productive writers are Janudin, sharul effendy, Alsheikh, awatif, Bezuhlyi, oleksandr, Broccardo, laura, Grossi, giuseppe, Calabrese, mario, Ghasemi, reza, dan Akroyd, chris. The most productive writers in their research always focus on management accounting systems which have an impact on environmental management accounting in facilitating information systems, efficiency, planning and supervision, in addition to environmental management in reducing risk and uncertainty so as to improve organizational performance.

#### 4.2.3 Publications and most citations



**Fig. 4** The journal with the most published papers

Based on the Publications graph in Figure 4 above, it can be seen that the first highest publication or the one that frequently publishes many articles is the International Journal of Energy Economics and Policy with 4 articles. The second is Advanced Science Letters with 3 articles and other publications publishing 2 articles each, while the remaining publications only publish 1 article each related to the management accounting system. With a total of 89 articles.

Table 1. shows the top five articles most cited by researchers. In Table 1, the document with the highest citation published in 2020, this is the first article contained in the database discussing organizational management accounting systems in public sector organizations. The other 4 most cited articles from 2017 to 2019 on management accounting systems relate to several different directions of study. For example, the discussion of management accounting system policies in intellectual capital development, capital cost accounting in company management systems, and integration of accounting systems with environmental innovation practices based on control systems and management accounting.

By analyzing the sources of the most cited articles, it was found that the Journal of Accounting, Auditing & Accountability was the journal reference that was most cited by researchers and occupied the top articles. It was also found that the Journal of Accounting, Auditing & Accountability classified Q1 as the best quartile. In addition, based on the ranking by the Scimago institution, other journal references such as the Journal of Intellectual Capital are in the first quartile (Q1), the Journal of the Academy of Accounting and Financial Studies in the fourth quartile (Q4), European Research Journal Studies that do not have a quartile, and the Journal of Accounting , Auditing & Accountability are in the first quartile (Q1).

**Table 1.** Top 5 research articles cited in the Management Accounting System study

No	Title	Author	Journal	Year	Total Citation
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1	Accounting, performance management systems and accountability changes in knowledge-intensive public organizations: A literature review and research agenda	Giuseppe Grossi, Kirsi-Mari Kallio, Massimo Sar giacomo, Matti Skoog	Accounting, Auditing & Accountability Journal	2020	73
2	The role of management accounting systems in the development of intellectual capital	Jorge Casas Novas, Maria do Céu Gaspar Alves, António So usa	Journal of Intellectual Capital	2017	62
3	Human capital cost accounting in the company management system	Hilorme, Tetiana; Perevozova, Iryna; Shpak, Lyubov; Mokhnenko, Andriy; Korovchuk, Yu	Academy of Accounting and Financial Studies Journal	2019	57
4	Formation of an integrated accounting and analytical management system for value analysis purposes	L.N. Usenko, I.N. Bogataya, N.V. Bukhov, T.B. Kuvaldina, A.V. Pavlyuk	European Research Studies Journal	2018	52
5	Environmental innovation practices and operational performance: The joint effects of management accounting and control systems and environmental training	Jacobo Gomez-Conde, Rogerio Joao Lunkes, Fabricia Silva Rosa	Accounting, Auditing & Accountability Journal	2019	51

### 4.3 Discussion

The results show that 89 articles were published by 167 authors from several countries, in addition, 89 articles were published among 68 journals, and were cited more than 500 times which could map the related management accounting systems. Based on these results, the researcher identified three research views and the results have the same meaning for the simplification of the five clusters. Thus, based on the final result, there are three clusters as keyword terms or titles, namely management accounting system, environmental management accounting, and environmental management control system.

The first cluster is the management accounting system. This cluster discusses the breadth of scope, timeliness, aggregation, and integration that are characteristics of a management accounting system. In the first cluster, the focus of the management accounting system is on environmental management and its impact on performance. A system that makes it easier for managers to prepare good planning and supervision, in order to streamline resources and reduce risks that will occur.

The second cluster is research related to management accounting systems that have an impact on environmental performance, energy efficiency, financial performance, and



managerial performance. In each of these relationships, the management accounting system seeks to make efficient use of resources for the company's financial and non-financial performance, in addition, system efficiency can also anticipate environmental uncertainty and company risk management, which in turn makes the company implement a more sophisticated system transition, thus assisting companies in improving the quality of information and the level of supervision.

Furthermore, the third cluster shows environmental management that seeks to optimize the use of materials and reduce environmental impacts. This will also have an impact on the environmental management control system which has a function, one of which is to try to anticipate environmental uncertainty by giving full trust to employees to develop innovations that certainly do not violate the boundaries of legal norms, which then provide feedback on the usefulness of the organization's achievements. so that top managers can make decisions according to good inputs from subordinates for the sake of company sustainability.

The results of the mapping show that the management accounting system can be used as a recommendation for further research. In addition, based on some of these mapping analyzes, management accounting research can be a potential research in the future. Topics in further research can analyze environmental management accounting systems during the Covid-19 pandemic which have an impact on the company's financial and non-financial performance, environmental management control systems by developing digital technology innovations, and environmental management that is able to anticipate the environment. uncertainty by continuing to innovate from various lines, such as energy innovation, information systems, and others.

## 5. Conclusion

This study analyzes and visualizes the management accounting system literature to assist further research in the future. The analysis conducted on 89 articles on management accounting systems published from 2017 to 2021, showed that the journals published on the topic of management accounting systems mainly cover the fields of business and economic research as well as high impact journals. Based on the results of the analysis study, it can be concluded that there are main keywords such as management accounting system, environmental management accounting system, and environmental management control system. Analysis of research publications, author network connections, and citations shows trends in various studies and guidelines. The keyword overlay visualization provides a good overview for future management accounting systems research. There are limitations in this study, namely; First, the data is taken from Scopus indexed journals from 2017 to 2021, so that future researchers can use a wider database. Then, this research is limited to the topic of management accounting systems, further research is expected to discuss the topics of accounting systems in other fields, such as management accounting information systems, control systems and management accounting, and others.

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