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# EFFECTS OF THE ENVIRONMENTAL MANAGEMENT SYSTEM AND TOP MANAGEMENT SUPPORT ON THE RELATIONSHIP BETWEEN ENVIRONMENTAL MANAGEMENT ACCOUNTING PRACTICES AND PERFORMANCE

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## Abstract

**Objective:** to analyze the mediating effects of the environmental management system and senior management support on the relationship between environmental management accounting practices and performance.
**Methodology:** descriptive, quantitative research (MEE) and survey, with the participation of 121 controllers from Brazilian industries.
**Originality/Relevance:** is based on the lack of studies that focus on the factors (environmental management system and administration support) that influence the relationship between environmental management accounting practices and environmental performance, making the study relevant for discussion and expanding the scope of research in the field of strategy and performance.
**Main results:** the results showed a positive relationship between environmental management accounting practices and financial and environmental performance. These practices were positively related to the environmental management system and senior management support and this support had positive effects on operational and financial performance. Furthermore, the environmental management system and top management support influence the relationship between practices and business performance.
**Theoretical/methodological contributions:** this study adds value to the literature by revealing the importance of the environmental management system and senior management support for the development of environmental management accounting practices and the promotion of operational, financial and environmental performance.
**Contributions/management:** for company management, the results contribute by highlighting the benefits of the environmental management system and senior management support for promoting sustainable practices and consequently obtaining better performance.

*Keywords:* environmental management system, senior management support, environmental management accounting practices, performance

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## Efeitos do Sistema de Gestão Ambiental e do Suporte da Alta Administração na relação entre Práticas de Contabilidade de Gestão Ambiental e Desempenho

### Resumo

**Objetivo:** analisar os efeitos mediadores do sistema de gestão ambiental e suporte da alta administração na relação entre as práticas de contabilidade de gestão ambiental e o desempenho.
**Metodologia:** pesquisa descritiva, quantitativa (MEE) e de levantamento, com a participação de 121 *controllers* de indústrias brasileiras.
**Originalidade/Relevância:** baseia-se na carência de estudos que focam nos fatores (sistema de gestão ambiental e suporte da administração) que influenciam a relação entre práticas de contabilidade de gestão ambiental e o desempenho ambiental, o que torna o estudo relevante para a discussão e ampliação do escopo de pesquisas no campo da estratégia e desempenho.
**Principais resultados:** os resultados evidenciaram uma relação positiva entre as práticas de contabilidade de gestão ambiental e o desempenho financeiro e ambiental. Estas práticas se relacionaram positivamente com o sistema de gestão ambiental e o suporte da alta administração e este suporte apresentou efeitos positivos no desempenho operacional e financeiro. Além disso, o sistema de gestão ambiental e o suporte da alta administração influenciam a relação entre as práticas e o desempenho empresarial.
**Contribuições teóricas/metodológicas:** este estudo agrega valor à literatura ao revelar a importância do sistema de gestão ambiental e do suporte da alta administração para o desenvolvimento de práticas de contabilidade de gestão ambiental e a promoção do desempenho operacional, financeiro e ambiental.
**Contribuições/gestão:** para a gestão das empresas, os resultados contribuem ao evidenciar os benefícios do sistema de gestão ambiental e do suporte da alta administração para a promoção de práticas sustentáveis e consequentemente a obtenção de melhor desempenho.

*Palavras-chave:* sistema de gestão ambiental, suporte da alta administração, práticas de contabilidade de gestão ambiental, desempenho

## Efectos del Sistema de Gestión Ambiental y el Apoyo de la Alta Dirección en la relación entre las Prácticas Contables de la Gestión Ambiental y el Desempeño

### Resumen

**Objetivo**: analizar los efectos mediadores del sistema de gestión ambiental y el apoyo de la alta dirección sobre la relación entre las prácticas contables de gestión ambiental y el desempeño.
**Metodología:** investigación descriptiva, cuantitativa (MEE) y encuesta, con la participación de 121 controladores de industrias brasileñas.
**Originalidad/Relevancia:** se basa en la falta de estudios que se centren en los factores (sistema de gestión ambiental y apoyo a la administración) que influyen en la relación entre las prácticas contables de gestión ambiental y el desempeño ambiental, lo que hace que el estudio sea relevante para la discusión y ampliación del alcance de la investigación en el campo de la estrategia y el desempeño.
**Principales resultados:** los resultados mostraron una relación positiva entre las prácticas contables de gestión ambiental y el desempeño financiero y ambiental. Estas prácticas se relacionaron positivamente con el sistema de gestión ambiental y el apoyo de la alta dirección y este apoyo tuvo efectos positivos en el desempeño operativo y financiero. Además, el sistema de gestión ambiental y el apoyo de la alta dirección influyen en la relación entre las prácticas y el desempeño empresarial.

**Contribuciones teóricas/metodológicas:** este estudio agrega valor a la literatura al revelar la importancia del sistema de gestión ambiental y el apoyo de la alta dirección para el desarrollo de prácticas contables de gestión ambiental y la promoción del desempeño operativo, financiero y ambiental.
**Aportes/gestión:** para la gestión de la empresa, los resultados contribuyen al resaltar los beneficios del sistema de gestión ambiental y el apoyo de la alta dirección para promover prácticas sustentables y consecuentemente obtener un mejor desempeño.

*Palabras clave:* sistema de gestión ambiental, apoyo de la alta dirección, prácticas contables de gestión ambiental, desempeño

## 1 Introduction

Today, climate change is considered a challenging issue and companies have the power to transform this reality (Tuesta et al., 2021). In this sense, environmental challenges require various accounting efforts to assess the practices of organizations (Nkundabanyanga et al., 2021), with environmental sustainability being an aspect considered by companies (Sari et al., 2021), given the growing environmental concerns of all stakeholders (Yang & Zhang, 2017) and the level of public awareness of the importance of environmental sustainability (Sari et al., 2021).

The deterioration of the environment and the scarcity of natural resources are putting pressure on companies to implement environmental management practices in their operations (Wang et al., 2018), as many stakeholders are increasingly aware of environmental problems (Wang et al., 2019). Companies are therefore looking for efficient systems and strategies to increase company performance (Bresciani et al., 2022).

In response to the inadequacy of traditional accounting systems in providing information related to environmental issues for managers to make decisions, a new field of accounting called environmental management accounting has emerged (Phan et al., 2018). Therefore, companies must have environmental management accounting (EMAP) practices to deal with environmental protection issues, environmental costs and other related issues (Sari et al., 2021).

EMAP is considered a significant area of discussion in academia, as it helps management recognise and exploit the information needed to increase environmental performance (Tashakor et al., 2019). Thus, they play a key role in minimizing environmental problems (Tashakor et al., 2019), as they are considered a fundamental part of business by allowing companies to evaluate and gather different types of information that tend to improve business performance (Bresciani et al., 2022).

The use of EMAP has benefited companies by providing information on operating activities, especially those related to the environment and environmental performance (Solovida & Latan, 2017). In this sense, several companies have started to implement a sustainable environmental strategy and use environmental management accounting to promote better environmental performance (Bresciani et al., 2022; Fuzi et al., 2020). Thus, EMAP tends to promote better business performance (Asiaei et al., 2021; Bresciani et al., 2022; Fuzi et al., 2020; Sari et al., 2021; Solovida & Latan, 2017), as environmental management accounting contributes effectively to dealing with environmental issues and economic and financial performance (Wang et al., 2019).

EMAP improves environmental performance by reducing environmental costs, which improves environmental management, maximizes the use of renewable sources and reduces the use of materials (Solovida & Latan, 2017). The relationship between EMAP and corporate performance has been analyzed in various ways. Wang et al. (2019) analyzed the effects of institutional pressures on EMAP and how these effects are affected by top management support and perceived benefit. De Sales (2019) analyzed the mediating effects of green innovation on the relationship between EMAP and financial performance. Fuzi et al. (2020) analyzed the relationship between EMAP, environmental management system (EMS) and financial performance. Sari et al. (2021) analyzed the mediating effects of process innovation on the relationship between EMAP and financial and non-financial performance. Bresciani et al. (2022) observed the influence of EMAP and environmental knowledge management on environmental performance with the mediating role of top management support.

There is evidence in the literature of the direct impact of EMAP on business performance; however, the results are controversial, as positive findings have been obtained (Asiaei et al., 2021; Bresciani et al., 2022; Chaudhry & Amir, 2020; Fuzi et al., 2020; Nkundabanyanga et al., 2021; Sari et al., 2021; Solovida & Latan, 2017) and without statistical significance in this relationship (De Sales, 2019), which indicates that the effects of EMAP on business performance are unclear (Bresciani et al., 2022). This fact motivates the analysis of mediating variables in the relationship between EMAP and corporate performance. In addition, there is limited evidence in the literature to support that environmental management accounting is important for the success of companies (Bresciani et al., 2022; Sari et al., 2021). Therefore, this study seeks to verify the mediating effects of EMS and Top Management Support (TMS) on the relationship between EMAP and business performance, effects that have been little explored in the literature.

In this sense, EMS is a requirement for the implementation of environmental management accounting, as it is an important tool for managing environmental issues in companies (Fuzi et al., 2020) and for facilitating internal decision-making and contributing to business performance (Bresciani et al., 2022; Fuzi et al., 2020; Phan & Baird, 2015; Semenova & Hassel, 2016; Zobel & Malmgren, 2016). The EMS is therefore necessary for the successful implementation of EMAP (Fuzi et al., 2020), as it provides a guideline for managing the environment (Phan and Baird, 2015) and thus tends to improve the relationship between EMAP and performance.

In addition, TMS on environmental issues is relevant to the implementation of EMAP (Fuzi et al., 2020; Rötzel et al., 2019). In the same way as the EMS, the importance of the TMS (Wang et al., 2019) can be seen in explaining the relationship between EMAP and company performance. Wang et al. (2019) emphasize that top management support can mediate the effects of institutional pressures on environmental management accounting. Through this support, the EMS can contribute to improving the organization's performance (Yang & Zhang, 2017).

Given the context presented, it appears that investigating the mediating effects of EMS and TMS can help explain the conflict of previous results on the relationship between EMAP and performance. In addition, this research adds value to the literature by focusing on factors that affect business performance, measured by three dimensions: financial, operational and environmental, since most research on the subject focuses on environmental performance, which also encourages this research to be carried out.

Based on the gap identified in the literature, this research aims to answer the following problem question: What are the effects of the environmental management system and top management support on the relationship between environmental management accounting practices and business performance (operational, environmental and financial)? The aim is therefore to analyze the effects of EMS and TMS on the relationship between EMAP and business performance in Brazilian industries.

This research advances the study by Bresciani et al. (2022) and Fuzi et al. (2020) by proposing the effects of EMS and TMS on the relationship between EMAP and performance, as these studies analyzed such effects in isolation. In addition, Fuzi et al. (2020) analyzed operational and financial performance, and Bresciani et al. (2022) environmental performance.

This research is justified because EMAP is considered an incipient concept in the management accounting literature (Tashakor et al., 2019), and this research aims to document the importance of such practices to assist companies in obtaining accurate information on

environmental issues and environmental costs, among other factors (Sari et al., 2021). EMAP is effective for companies to minimize the negative influence of their activities on the environment, and this fact has made this research topic promising (Wang et al., 2018). Analyzing the effects of the EMAP is also justified, as research on this topic is mainly focused on Western countries and this field of accounting in the developing world has attracted less attention from researchers (Asiaei et al., 2021).

Another justification comes from the arguments of Phan et al. (2018), as they argue that future studies can examine the relationship between EMAP with both the environmental performance and the financial performance of companies, thus seeking to fill this gap. It is also noteworthy that there are limited studies that provide evidence on how top management support influences the implementation of EMAP and business performance (Wang et al., 2019), which also justifies analyzing mediating variables in the proposed relationship. Therefore, what is still unclear in the literature is the nature of the managerial processes through which companies manage to translate their environmental resources into improved performance, and it is crucial to investigate how EMAP plays a role in raising corporate performance (Asiaei et al., 2021).

The results of this research contribute to the literature on EMAP, EMS, TMS and business performance. Therefore, the study contributes to environmental management accounting by analyzing the mediating effects of EMS and TMS on the relationship between EMS and performance in Brazilian industries. Thus, these effects enrich the literature on environmental management by proposing a comprehensive research framework, as the joint effects proposed have not yet been analyzed in the management accounting literature.

This research contributes to the industries analyzed by highlighting a significant issue: how top management uses EMS and TMS to improve EMAP and, consequently, business performance (financial, operational and environmental). Therefore, it contributes in a practical way by revealing that companies should focus on EMS and TMS to examine the effects of EMAP on performance. In addition, industries can develop strategies and training aimed at improving EMS and especially TMS, given the benefits of such variables for EMAP and business performance, which denotes the importance of implementing EMS and TMS.

As a social contribution, the analysis of environmental issues in Brazilian industries is based on the *controllers*' perception of accounting practices, and as soon as the negative effects of companies' activities on the environment are minimized, this will benefit society as a whole.

## 2 Theoretical Basis and Hypotheses

### 2.1 Environmental management accounting practices and business performance

EMAP refers to long-term planning and quality management actions (Fuzi et al., 2020). Companies are more likely to adopt EMAP when they come under pressure from a wide range of stakeholders (Tung et al., 2014; Jamil et al., 2015; Mohamed & Jamil, 2018) and performance, especially environmental performance, has become an area of concern for researchers and entrepreneurs due to growing environmental concerns and pressures on companies (Chaudhry & Amir, 2020). As a result, companies are looking for effective systems and strategies to improve environmental performance, such as EMAP, which shows that the adoption of such practices plays an important role in increasing business performance (Chaudhry & Amir, 2020; Kong et al., 2022), as this performance is an indicator of the company's level of success in achieving its goals (Sari et al., 2021).

In management accounting, EMAP tends to improve corporate environmental performance (Kong et al., 2022), as it provides information from financial accounting, cost accounting and material flow to improve material efficiency, reduce environmental impacts and risks, as well as minimize environmental protection costs (Bresciani et al., 2022; Saeidi et al., 2018; Schaltegger, 2018; Sari et al., 2021). In addition, as a decision-making tool, EMAP can also affect companies' operational and financial performance (Saeidi et al., 2018). However, companies will only fulfill their environmental responsibilities when this environmental protection brings economic benefits (Wang et al., 2019), which suggests that the adoption of such management practices is supported by the perception of achieving such gains (Rahman et al., 2020).

Companies that have greater knowledge of the environmental impact they generate from their activities will consequently have greater opportunities to minimize this impact, which results in greater environmental performance (Phan et al., 2018), as the implementation of EMAP can reduce costs and energy, as well as increase production efficiency and thus minimize waste (Schaltegger, 2018). Therefore, EMAP emphasizes the importance of environmental costs and provides information on material flows aimed at improving environmental and economic performance. In addition, EMAP increases internal visibility and control of environmental management, which has an impact on business performance (Albelda, 2011).

Evidence found in the literature revealed that if management focuses on environmental issues, it tends to improve environmental performance (Asiaei et al., 2021; Bresciani et al.,

2022; Chaudhry & Amir, 2020; Nkundabanyanga et al., 2021; Sari et al., 2021; Solovida & Latan, 2017), operational (Fuzi et al., 2020; Solovida & Latan, 2017) and financial (Fuzi et al., 2020; Sari et al., 2021). These results suggest that when environmental and monetary information is utilized and environmental costs are classified and allocated by management, companies are likely to disclose their performance information to stakeholders and thus raise corporate performance (Nkundabanyanga et al., 2021). Thus, companies that use EMAP to a greater extent experience higher levels of environmental (Phan et al., 2017), operational and financial performance (Fuzi et al., 2020). On the other hand, De Sales (2019) identified that EMAP does not influence the financial performance of companies due to the increase in production costs. Based on the discussion presented, the following hypotheses were drawn up:

*H1a: environmental management accounting practices have a positive impact on operational performance.*
*H1b: Environmental management accounting practices have a positive impact on environmental performance.*
*H1c: Environmental management accounting practices have a positive impact on financial performance.*

## 2.2 Environmental management accounting practices, environmental management system and top management support

EMAP can also have an effect on EMS and TMS, as it supports management in exploiting the information needed to improve performance. There is a (traditional) deficiency in the processing of environmental information, which requires the qualification of environmental management practices, as a way of improving the processing and obtaining of useful information aimed at supporting the environmental management process in organizations (Gibassier & Alcouffe, 2018; Rahman et al., 2020), which can be achieved with the use of complementary environmental management practices, such as EMS and from TMS.

In addition, EMAP is an internal management tool for dealing with environmental issues and conventional company practices (Qian et al., 2018). In this sense, high environmental awareness and commitment can help companies implement EMAP and help them gain social legitimacy, maintain good relations with stakeholders and achieve success (Wang et al., 2018). This is because adopting such management practices improves not only the company's environmental (Kong et al., 2022), operational and financial performance (Saeidi et al., 2018), but also its organizational reputation and sense of environmental concern (Kalyar et al., 2019).

The EMAP and the EMS are related in companies to improve environmental management (Fuzi et al., 2020). Therefore, in order to improve EMAP, companies can apply EMS as an important guideline (Fuzi et al., 2020), as this system can improve the production process, reduce waste and environmental pollution of industries (Gunarathne & Alahakoon, 2016), which directly reflects on their performance. These results can be achieved by using the EMS to assess the organization's environmental impact (Fuzi et al., 2020).

The implementation of EMAP generally requires the outlay of many resources, such as investments in environmental issues, employee training and the adoption of techniques (Bennet et al., 2002; 2003). Such resources can largely be provided with the support of top management. In addition, companies that have top management support implement EMAP more easily, and top management support is important for the adoption of such practices (Wang et al., 2019), since investment decisions require authorisation from senior managers.

Evidence located in the literature has revealed positive effects of EMAP on EMS (Fuzi et al., 2020; Qian et al., 2018) and on TMS (Bresciani et al., 2022; Phan et al., 2017). These results show that the EMAP acts as a facilitating mechanism for the EMS by reinforcing four elements: commitment to the continuous improvement of environmental performance; compliance with environmental legislation; communication with interested parties; and employee involvement. However, in this scenario, the role of accounting is to facilitate environmental management (Albelda, 2011), which improves the support provided by companies' top management (Bresciani et al., 2022; Phan et al., 2017).

The results of Peixe et al. (2019) showed that the factors that influence the level of maturity of the EMS are: ISO 14001 certification; participation in the carbon market; disclosure of environmental information in reports; having a project to reduce water consumption; having a professional management model; having insurance for environmental accidents; age of the company; operating in the textile sector; and legal constitution (Ltda). These results show the importance of the EMAP in improving companies' EMS and TMS. The following hypotheses have therefore been drawn up:

*H2. Environmental management accounting practices have a positive impact on the environmental management system.*

*H3. Environmental management accounting practices have a positive impact on top management support.*

### *2.3 Environmental management system, top management support and business performance*

Stakeholders influence the orientation and decision-making of companies in relation to determining corporate strategies related to the environment (Kalyar et al., 2019). Thus, in addition to EMAP, EMS and TMS also tend to improve business performance. An EMS aims to encourage organizations to control their environmental impacts and promote continuous improvements to boost environmental performance (Albelda, 2011). This is because the EMS integrates procedures for training staff, monitoring and reporting environmental information to interested parties, and is designed to help companies with management control aimed at minimizing environmental impacts (Yang & Zhang, 2017) and preventing a decline in environmental performance (Solovida & Latan, 2017).

In order to minimize environmental impacts, companies need information related to the environmental costs of their activities (Bennet et al., 2002; 2003; Beuren & Zonatto, 2010). To this end, companies are starting to implement EMS in order to improve environmental performance (Solovida & Latan, 2017), as environmental accounting information is important for companies to improve their environmental and financial performance (Spencer et al., 2013). This is because EMS translates top management's commitment to environmental sustainability into actions that result in greater environmental performance for companies (Spencer et al., 2013).

In addition, companies that carry out environmental management tend to incur lower costs from fines and penalties related to environmental activities (Spencer et al., 2013). This occurs when these organizations manage to improve their management processes, enhancing their control system and reducing the likelihood of incurring non-compliance with the relevant legislation or generating environmental damage as a result of the inappropriate exploitation of a certain activity. In this way, companies tend to implement an EMS to ensure the protection of the natural environment (environmental performance) and increase their ability to make a profit in the long term (operational and financial performance) (Kalyar et al., 2019).

Fuzi et al. (2020) revealed positive effects of EMS on financial and operational performance. On the other hand, Phan and Baird (2015) showed positive effects of EMS on environmental performance. These results show that EMS is based on continuous improvement to control environmental and operational activities (Semenova & Hassel, 2016; Spencer et al., 2013; Zobel & Malmgren, 2016), which tends to have positive effects on business performance. Thus, EMS implementation can help companies improve financial and operational performance (Fuzi et al., 2020) and environmental performance (Phan & Baird, 2015).

In relation to the effects of TMS on business performance, Blass et al. (2014) point out that the top management of companies is an important internal force driving certain behavior and results. Thus, when top management is committed to the environment, it tends to adopt an accounting system that provides the information needed to improve economic and environmental performance (Christ & Burritt, 2015). In addition, top management motivation increases environmental sustainability when managers see that this can increase environmental performance (Latan et al., 2018).

In the literature, researchers have recognised that top management support plays a valuable role in resolving environmental issues, which increases environmental performance (Bresciani et al., 2022; Ilyas et al., 2020; Kalyar et al., 2019; Spencer et al., 2013). However, the lack of TMS can result in conflicts to adopt green practices and activities, which consequently tends to negatively impact environmental performance (Ilyas et al., 2020). This evidence highlights the importance of top management involvement and support for environmental management (Tung et al., 2014). Therefore, top management is encouraged to understand the relevance of environmental management, establish environmental policies and objectives, communicate these objectives to subordinates to increase staff buy-in and commitment to environmental management, which leads to greater environmental, financial and operational performance (Tung et al., 2014). Based on the above context, the following hypotheses were drawn up:

*H4a. The environmental management system has a positive impact on operational performance.*
*H4a. The environmental management system has a positive impact on environmental performance.*
*H4a. The environmental management system has a positive impact on financial performance.*
*H5a. Top management support has a positive impact on operational performance.*
*H5a. Top management support positively impacts environmental performance.*
*H5a. Top management support positively impacts financial performance.*

### *2.4 Mediating effects of the environmental management system and top management support*

EMAP helps companies measure, control and disclose environmental performance (Tuesta et al., 2021). However, the relationship between EMAP and business performance can be strengthened with EMS and TMS. Regarding the mediating effects of EMS on the relationship between EMAP and business performance, Yang and Zhang (2017) point out that

the environmental awareness of customers and the increase in the environmental image of companies in the market have led companies to increasingly adopt an EMS. Therefore, environmental strategies have led companies to introduce an EMS along with environmental accounting (Kong et al., 2022), and this system tends to have an impact on EMAP and performance as it is an important tool for managing environmental issues (Fuzi et al., 2020).

Implementing an EMS improves EMAP and organizational performance (financial and operational), as it tends to reduce environmental costs, increase the quality of environmental management, reduce the consumption of materials and energy, and assess the environmental impacts of processes. The implementation of such practices directs efforts towards more assertive interventions, which maximize the usefulness of the environmental management actions implemented, with a view to increasing business performance. Therefore, EMS can be considered to improve EMAP and organizational performance (Fuzi et al., 2020).

Fuzi et al. (2020) showed a positive mediating effect of EMS on the relationship between EMAP and financial and operational performance. Rötzel et al. (2019) revealed that EMS has mediating effects on the relationship between environmental strategy and environmental performance. In addition, they emphasize that EMSs are important mechanisms for translating environmental strategy into management performance, and a high level of integration tends to strengthen the role of EMSs in companies (Rötzel et al., 2019).

In this sense, the adoption of EMAP can stimulate environmental performance, since these practices allow the organization to better understand the EMS and thus make more effective decisions regarding environmental issues (Chaudhry & Amir, 2020). Thus, an EMS helps companies make the right decisions that can help improve environmental performance (Asiaei et al., 2021), but this requires the commitment of top management and planning that is capable of integrating the EMAP and the EMS to promote better performance (Latan et al., 2018).

With regard to top management support, Phan et al. (2017) point out that this variable is considered one of the relevant factors affecting the adoption of various accounting systems, and, in this way, the TMS can have an impact on the relationship between EMAP and business performance. The support of top management is fundamental to ensuring companies' commitment to environmental issues (Kong et al., 2022), as organizational resources, such as TMS, are necessary to achieve high environmental performance (Latan et al., 2018). Senior management deliberates on the use of resources and the realization of long-term investments. It determines the organizational strategy and the environmental management directions to be adopted by the company. Therefore, top management first promotes initiatives related to

EMAP, which consequently tend to subsidize companies' environmental and social performance (Ilyas et al., 2020).

The research by Bresciani et al. (2022) revealed that TMS positively mediates the relationship between EMAP and environmental performance. The findings of Ilyas et al. (2020) confirmed that TMS is essential for EMAP. Kong et al. (2022) analyzed the mediating effects of TMS on the relationship between institutional pressures, EMAP and environmental performance. The results also revealed the benefits of TMS for managers' involvement in EMAP.

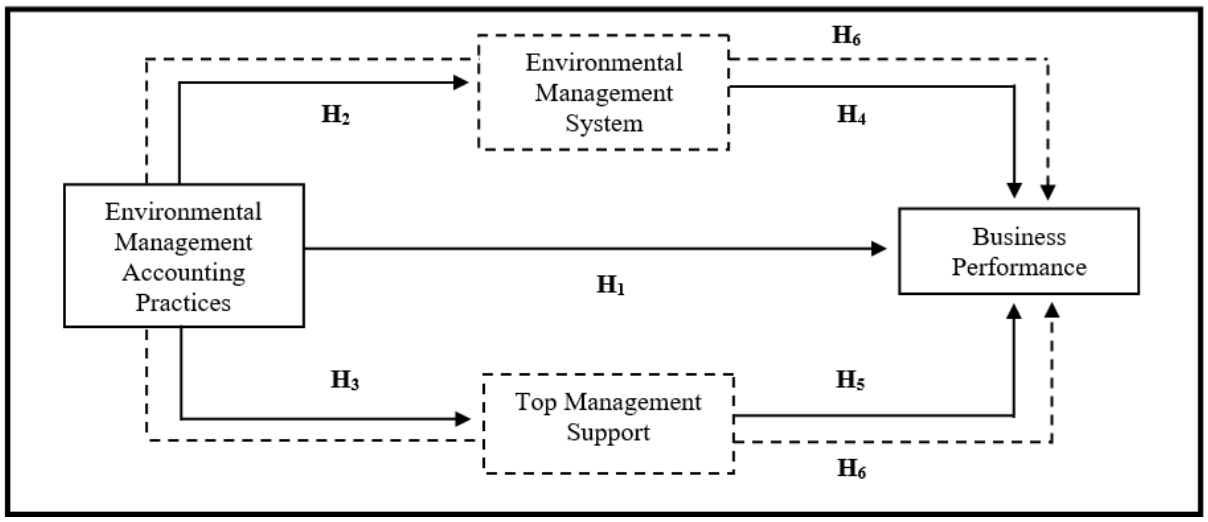
From these results, it can be seen that TMS is a key factor in the adoption and development of EMAP. It is therefore essential that top management has a good understanding of EMAP and provides the necessary resources to support such practices so that commitment to environmental issues is leveraged. Another important issue is for top management to develop actions to implement the EMS, given its importance, along with the TMS, in raising EMAP and business performance (Phan et al., 2017). Therefore, each of the organizational factors, be it TMS or EMS, creates favorable conditions for improvements in environmental management processes, thus facilitating subsequent improvements in environmental performance (Tung et al., 2014).

Based on the above, the following hypotheses were drawn up about the mediating effects of EMS and TMS on the relationship between EMAP and business performance:

*H6a. Environmental management accounting practices have an impact on operational performance and this relationship is mediated by TMS and EMS.*
*H6b. Environmental management accounting practices have an impact on environmental performance and this relationship is mediated by TMS and EMS.*
*H6c. Environmental management accounting practices have an impact on financial performance and this relationship is mediated by TMS and EMS.*

**Figure 1**

*Theoretical model of analysis and research hypotheses*




*Source:* Prepared by the authors.

## 3 Research Method and Procedures

The research is classified as descriptive, with a survey and a quantitative approach to the data. The study population comprises *controllers* from industrial organizations operating in Brazil and the sample consists of 121 responses. The choice of professionals working in the area of controllership is justified by the subject matter of the study (environmental management accounting practices). The term *controller* is usually used to define the nomenclature of the position (CBO) held by professionals responsible for the controllership area in organizations.

*Controllers* are managers who support the process of structuring the management control system. They therefore support the structuring of the environmental management system in the environment studied (industrial organizations). Similarly, they are professionals who liaise between senior management (strategic level) and unit managers (operational level). As such, they are suitable managers to answer the questions posed in this research.

The research carried out does not involve any kind of potential bias introduced during the sampling process. The research participants were selected non-probabilistically and by accessibility. By accessing the LinkedIn® Business Network, the terms "*Controller*" and "Industrial Organisations" were searched for. Based on the responses obtained, invitations were sent out asking the professionals identified to voluntarily take part in this research. In this way, there was no control over the size of the companies or any restriction by branch of activity. Of the total number of invitations sent via the LinkedIn® platform from April to July 2022 (600

invitations), 420 were accepted and 121 questionnaires were voluntarily answered by the invited professionals, which represents a return rate of 28.81% of the accepted invitations and 20.17% of the total number of invitations sent.

We chose to analyze organizations in the industrial sector because responsibility for the environment is related to the companies' operations and the sector in which they operate. Industries are organizations that process inputs to generate new products, which in itself denotes the possibility of an impact on the environment. In this sense, industries need to measure the environmental impact (physical and monetary) of their activities, and the EMAP and EMS are a solution to this problem (Sari et al., 2021).

Table 1 shows the research construct, the variables analyzed, their operational definition, indicators, scale and the authors who developed the instrument used to collect the data.

**Table 1**

*Research construct*

| Construct/Variable | Operational Definitions | Indicators/Scale | Authors |
|---|---|---|---|
| Financial Performance (FP) | This refers to the company's financial performance compared to its main competitors, in terms of: return on sales, profitability over the years and dividends distributed to shareholders over the years. | 3 Indicators/*Likert* 7 points | Xue et al. (2019) |
| Operational Performance (OP) | This refers to the company's operational performance compared to its main competitors, in terms of: outstanding product lines, better capacity utilization, excellent customer satisfaction and shorter response times to market needs. | 4 Indicators/*Likert* 7 points | Xue et al. (2019) |
| Environmental Performance (EP) | This refers to the company's environmental performance compared to its main competitors, in terms of its ability to reduce atmospheric emissions, environmental accidents and pollutants emitted. | 3 Indicators/*Likert* 7 points | Xue et al. (2019) |
| Environmental Management Accounting Practices (EMAP) | This variable was measured using five factors and aims to measure the extent to which the company uses EMAP in relation to: environmental cost (5), environmental regulation (5), environmental safety (5), management commitment (5) and customer focus (5) | 25 Indicators/*Likert* 7 points | Fuzi et al. (2020). |
| Environmental Management System (EMS) | This variable was measured using four factors and aims to measure the extent to which the company uses the EMS in the activities of: planning (5), implementation and operation (5), auditing and evaluation (5) and for verification and corrective action (5). | 20 Indicators/*Likert* 7 points | Fuzi et al. (2020). |
| Top Management Support (TMS) | It refers to the company's top management support for implementing EMAP, the resources offered by top management for implementing such practices and top management's assessment of the impact of the business on the environment after adopting EMAP. | 4 Indicators/*Likert* 7 points | Wang et al. (2019) |

*Source:* Prepared by the authors

Descriptive statistics were used to analyze the data, showing the actual range (minimum and maximum), mean and standard deviation of the indicators analyzed. Subsequently, the measurement constructs were validated using confirmatory factor analysis, with the aim of guaranteeing the validity of the measurement instruments. In addition to these procedures, discriminant validity was also analyzed using the Fornell and Larcker (1991) criterion and then the method bias test, since this research collected data from *controllers* using a questionnaire on variables over time and, therefore, there is the possibility of bias problems in the responses (Bido et al., 2018; Bresciani et al., 2022). This set of procedures allows inferences to be made about the predictive quality of the measurement models and the validity of the structural model tested, given the constructs selected.

Finally, Structural Equation Modeling (SEM) was carried out using the *SmarthPLS software*, observing the following indicators: reliability (Cronbach's alpha (CA)), composite reliability (CC), average variance extracted (AVE), and the quality criteria used (maximum VIF, $R^2$, predictive relevance ($Q^2$) and effect size ($f^2$)). Hypotheses were tested using the value of the t-test result and the statistical significance of the relationships assessed. The results of the study are presented below.

## 4 Research results

### *4.1 Validation of the Measurement Constructs*

The exploratory factor analysis in Table 2 achieved significant cro*nbach*'s alpha coefficients and total explained variance values of over 0.50 in all cases. With regard to the factor loadings of the indicators for each construct analyzed, it can be seen that no variable was excluded from the model, as all the indicators were grouped into their factors and showed loadings higher than those recommended in the literature (Hair Jr. et al., 2005). Table 2 shows the descriptive statistics, reliability and discriminant validity of the data.

**Table 2**

*Descriptive statistics, reliability and discriminant validity*

| Variables | Interval Real | Average | Standard Deviation | Factor Loadings | Cronbach's alpha | Reliability Composite | AVE |
|---|---|---|---|---|---|---|---|
| P.EC | 1.00 - 7.00 | 4.23 | 1.80 | [0.656; 0.787] | 0.786 | 0.854 | 0.540 |
| P.ER | 1.00 - 7.00 | 5.30 | 1.57 | [0.643; 0.829] | 0.805 | 0.864 | 0.562 |
| P.ES | 1.00 - 7.00 | 4.96 | 1.51 | [0.633; 0.878] | 0.879 | 0.914 | 0.683 |
| P.MC | 1.00 - 7.00 | 5.04 | 1.53 | [0.755; 0.924] | 0.916 | 0.938 | 0.752 |
| P.CF | 1.00 - 7.00 | 5.30 | 1.57 | [0.755; 0.928] | 0.902 | 0.933 | 0.778 |
| EMS.PL | 1.00 - 7.00 | 4.96 | 1.51 | [0.773; 0.856] | 0.864 | 0.902 | 0.648 |
| EMS.IO | 1.00 - 7.00 | 5.04 | 1.53 | [0.813; 0.842] | 0.854 | 0.901 | 0.694 |
| EMS.AE | 1.00 - 7.00 | 4.77 | 1.62 | [0.647; 0.831] | 0.809 | 0.868 | 0.570 |
| SEM.CA | 1.00 - 7.00 | 5.12 | 1.77 | [0.751; 0.875] | 0.871 | 0.907 | 0.661 |
| TMS | 1.00 - 7.00 | 4.93 | 1.53 | [0.904; 0.934] | 0.906 | 0.941 | 0.841 |
| OP | 1.00 - 7.00 | 4.93 | 1.53 | [0.861; 0.923] | 0.924 | 0.946 | 0.814 |
| EP | 1.00 - 7.00 | 5.11 | 1.32 | [0.930; 0.936] | 0.925 | 0.952 | 0.869 |
| FP | 1.00 - 7.00 | 4.51 | 1.72 | [0.910; 0.944] | 0.922 | 0.950 | 0.865 |

**Discriminant Validity (Fornell e Larcker, 1991)**

| Variables | P.EC | P.ER | P.ES | P.MC | P.FC | EMS.PL | EMS.IO | EMS.AE | EMS.CA | TMS | OP | EP | FP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P.EC | **0.735** | | | | | | | | | | | | |
| P.ER | 0.634 | **0.750** | | | | | | | | | | | |
| P.ES | 0.528 | 0.420 | **0.826** | | | | | | | | | | |
| P.MC | 0.520 | 0.423 | 0.619 | **0.867** | | | | | | | | | |
| P.CF | 0.539 | 0.392 | 0.724 | 0.790 | **0.882** | | | | | | | | |
| EMS.PL | 0.260 | 0.211 | 0.237 | 0.265 | 0.306 | **0.805** | | | | | | | |
| EMS.IO | 0.204 | 0.125 | 0.240 | 0.187 | 0.232 | 0.304 | **0.833** | | | | | | |
| EMS.AE | 0.268 | 0.205 | 0.226 | 0.156 | 0.147 | 0.341 | 0.515 | **0.755** | | | | | |
| EMS.CA | 0.282 | 0.274 | 0.248 | 0.206 | 0.281 | 0.213 | 0.483 | 0.667 | **0.813** | | | | |
| TMS | 0.188 | 0.213 | 0.242 | 0.289 | 0.301 | 0.317 | 0.473 | 0.651 | 0.676 | **0.917** | | | |
| OP | 0.179 | 0.129 | 0.178 | 0.238 | 0.273 | 0.395 | 0.271 | 0.301 | 0.252 | 0.436 | **0.902** | | |
| EP | 0.251 | 0.174 | 0.355 | 0.374 | 0.329 | 0.316 | 0.279 | 0.284 | 0.162 | 0.337 | 0.532 | **0.932** | |
| FP | 0.161 | 0.184 | 0.285 | 0.195 | 0.258 | 0.171 | 0.265 | 0.348 | 0.307 | 0.405 | 0.566 | 0.422 | **0.930** |

Caption: P.EC: Practices related to Environmental Costs; P.ER: Practices related to environmental regulation; P.ES: Practices related to environmental safety; P.MC: Practices related to management commitment; P.CF: Practices related to customer focus; EMS.PL: Environmental Management System related to Planning; EMS. IO: Environmental Management System related to implementation and operation; EMS.AE: Environmental Management System related to auditing and evaluation; EMS.CA: Environmental Management System related to corrective action; TMS: Top Management Support; OP: Operational Performance; EP: Environmental Performance; FP: Financial Performance.

*Source:* Prepared by the authors.

The results of the descriptive analysis show that all the indicators analyzed showed minimum and maximum responses on the scale used, which suggests a total degree of

agreement (7) and disagreement (1) in relation to the questions among some of the *controllers* who took part in the study. These results show that in the industries in which these professionals work, the EMAP and the EMS receive more attention in some industries than in others. Similarly, it can be seen that some of the *controllers* in the sample have a higher TMS when compared to other *controllers* in the sample.

In general, the averages of the indicators used to measure the EMS were high, with variable verification and corrective action standing out as having a higher average than the others in the construct. With regard to the standard deviation, it can also be seen that the variables corresponding to the EMS showed the greatest deviations, which reveals greater dispersion between the answers obtained. The lowest mean and highest standard deviation among the indicators of this construct are found in the P.EC variable (mean 4.23 and deviation 1.80), which investigates how organizations identify environment-related costs, how they allocate environment-related costs to production processes and products, whether the organization creates and uses environment-related cost accounts and whether the organization improves the management of environment-related costs. It can therefore be inferred that in the EMAP, *controllers* tend to prioritize information such as environmental safety, management components, customer focus and environmental regulations over the accounting of environmental costs.

Another result worth highlighting is in relation to business performance, as the environmental performance variable had a higher mean and lower standard deviation than the other performance indicators (operational and financial). As this variable explores the items: reduction of emissions, environmental accidents and other pollutants, the *controllers*' concern with these issues can be seen.

The results found for the method bias test revealed that the set of indicators were grouped into 13 different factors, with the first factor explaining only 25.608% of the total variance explained, which indicates that there is no method bias (Bido et al., 2018; Podsakoff et al., 2003).

### *4.2 Presentation of results*

Once the reliability and discriminant validity of the measurement constructs that make up the structural model had been assessed, the SEM was then carried out to verify the effects of EMS and TMS on the relationship between EMAP and business performance, as established in the theoretical analysis model (Figure 1). Table 3 shows the standardized coefficients and significance of the relationships in the structural model tested.

**Table 3**

*Standardized coefficients and significance of the relationships in the structural model tested*

| Hip | Structural Path | Stand. Coef. | Stand. Error | *T-values* | *P-values* | Results | Max. VIF | $R^2$ | $Q^2$ | $f^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| H1a | EMAP → OP | 0.108 | 0.086 | 1.259 | 0.209$^{ns}$ | No Sup. | 1.165 | 0.214 | 0.170 | 0.677 |
| H1b | EMAP → EP | 0.289 | 0.078 | 3.710 | 0.000* | Supported | 1.165 | 0.204 | 0.171 | 0.703 |
| H1c | EMAP → FP | 0.142 | 0.082 | 1.734 | 0.083** | Supported | 1.165 | 0.194 | 0.153 | 0.692 |
| H2 | EMAP → EMS | 0.370 | 0.089 | 4.162 | 0.000* | Supported | 1.000 | 0.137 | 0.044 | 0.288 |
| H3 | EMAP → TMS | 0.312 | 0.079 | 3.964 | 0.000* | Supported | 1.000 | 0.097 | 0.079 | 0.649 |
| H4a | SEM → OP | 0.137 | 0.119 | 1.152 | 0.250$^{ns}$ | No Sup. | 2.158 | 0.214 | 0.170 | 0.677 |
| H4b | EMS → EP | 0.111 | 0.109 | 1.012 | 0.312$^{ns}$ | No Sup. | 2.158 | 0.204 | 0.171 | 0.703 |
| H4c | EMS → FP | 0.118 | 0.119 | 0.991 | 0.322$^{ns}$ | No Sup. | 2.158 | 0.194 | 0.153 | 0.692 |
| H5a | TMS → OP | 0.304 | 0.097 | 3.124 | 0.002* | Supported | 2.064 | 0.214 | 0.170 | 0.677 |
| H5b | TMS → EP | 0.167 | 0.120 | 1.393 | 0.164$^{ns}$ | No Sup. | 2.064 | 0.204 | 0.171 | 0.703 |
| H5c | TMS → FP | 0.276 | 0.107 | 2.567 | 0.011* | Supported | 2.064 | 0.194 | 0.153 | 0.692 |
| **Indirect effects of EMAP → EMS → TMS → BP** | | | | | | | | | | |
| H6a | EMAP → DO | 0.146 | 0.050 | 2.887 | 0.004* | Supported | 2.158 | 0.214 | 0.170 | 0.677 |
| H6b | EMAP → DA | 0.093 | 0.037 | 2.494 | 0.013* | Supported | 2.158 | 0.204 | 0.171 | 0.703 |
| H6c | EMAP → DF | 0.095 | 0.044 | 2.962 | 0.003* | Supported | 2.158 | 0.194 | 0.153 | 0.692 |

Caption: EMAP: Environmental Management Accounting Practices; EMS: Environmental Management System; TMS: Top Management Support; OP: Operational Performance; EP: Environmental Performance; FP: Financial Performance; BP: Business Performance. * p<0.5; ** p<0.10; ns. Non-significant relationship.
*Source:* Prepared by the authors.

As shown in Table 3, in relation to the direct effects of EMAP on business performance (H1), the results revealed that these practices have a positive impact on environmental performance and financial performance, results that confirm the hypotheses (H1b and H1c). These findings suggest that when industries use EMAP in relation to environmental cost, environmental regulation, environmental safety, management commitment and customer focus

(Fuzi et al., 2020), environmental and financial performance tends to be higher, which refers to reductions in emissions, environmental accidents and other pollutants and return on sales, profitability over the years and dividends distributed (Xue et al., 2019). The positive effects of EMAP on environmental performance were also found by Asiaei et al. (2021), Bresciani et al. (2022), Chaudhry and Amir (2020), Nkundabanyanga et al. (2021), Phan et al. (2018), Sari et al. (2021) and Solovida and Latan (2017) and on financial performance were also confirmed by the following research: Fuzi et al. (2020) and Sari et al.

EMAP also had positive and significant direct effects on EMS and TMS, results that confirm hypotheses H2 and H3. This evidence indicates that when *controllers* and the industries analyzed adopt practices in relation to environmental cost, environmental regulation, environmental safety, management commitment and customer focus (Fuzi et al., 2020), the better the planning, implementation and operation, auditing and evaluation activities and corrective actions tend to be (Fuzi et al., 2020), as well as the greater the support offered by top management in terms of resources to maintain these practices, evaluation of the impact of these practices on the environment (Wang et al., 2019). These results corroborate the research findings of Fuzi et al. (2020) and Qian et al. (2018), as they also found positive effects of EMAP on EMS. In addition, they are similar to the findings of Bresciani et al. (2022) and Phan et al. (2017) for the effects of EMAP on TMS.

Another relationship tested was the direct effects of EMS on the performance of the industries (financial, operational and environmental) (H4) in the sample. These relationships were not confirmed (H4a, H4b and H4c), as EMS did not influence financial, operational and environmental performance. These results differ from the studies by Fuzi et al. (2020) and Phan and Baird (2015). These results show that in the sample analyzed, the activities of planning, implementation and operation, auditing and evaluation and corrective actions with regard to environmental issues (Fuzi et al., 2020) do not interfere with return on sales, profitability and dividends distributed (financial performance), outstanding product lines, better capacity utilization, customer satisfaction (operational performance), the ability to reduce atmospheric emissions, environmental accidents and pollutants (environmental performance) (Xue et al., 2019).

On the other hand, the direct effects of TMS were positive and significant on operational and financial performance, providing support for hypotheses H5a and H5c. These findings differ from the research carried out by Bresciani et al. (2022), Ilyas et al. (2020), Kalyar et al. (2019), Spencer et al. (2013) and Tung et al. (2014), as these researchers recognised that TMS plays a valuable role in resolving environmental issues, which leads to increased environmental

performance. This evidence shows that top management support in terms of resources to maintain EMAP, assessment of the impact of these practices on the environment (Wang et al., 2019) only interferes with the operational performance (outstanding product lines, better capacity utilization, customer satisfaction) and financial performance (return on sales, profitability and dividends distributed) of the industries analyzed (Xue et al., 2019).

Finally, with regard to the indirect effects of the EMS and TMS on the relationship between EMAP and business performance (operational, environmental and financial), the results indicated positive and significant indirect effects of the EMS and TMS on the proposed relationship, evidence that confirms hypotheses H6a, H6b and H6c. Therefore, the environmental management system and top management support enhance the effects of EMAP on financial, operational and environmental performance. In this way, the implementation of an EMS and greater TMS provides better EMAP related to environmental cost, environmental regulation, environmental safety, management commitment and customer focus (Fuzi et al., 2020) and consequently raises the performance of the operational (outstanding product lines, better capacity utilization, customer satisfaction), financial (return on sales, profitability and dividends distributed) and environmental (ability to reduce air emissions, environmental accidents and pollutants) industries (Xue et al., 2019). These results corroborate the findings of Fuzi et al. (2020) and Rötzel et al. (2019) for the mediating effects of EMS and the evidence of Bresciani et al. (2022), Ilyas et al. (2020) and Kong et al. (2022) for the indirect effects of TMS on the relationship between EMAP and business performance.

Based on the indirect effects found in this research, we can see the importance of industries implementing an EMS, given its positive effects on EMAP and improvements in performance (Phan et al., 2017). In addition, they also show the relevance of TMS for the adoption and improvement of EMAP and business performance (Phan et al., 2017; Tung et al., 2014). Subsequently, a discussion with the literature of the findings is presented.

### *4.3 Discussion of results*

Faced with the need to address concerns about environmental issues, it can be seen that EMAP are important sources of information that can increase top managers' awareness of environmental issues and support managers' decision-making focused on achieving environmental, operational and financial results (Phan et al., 2017). Based on the above, this research has proven that EMAP improves environmental performance (H1b), financial performance (H1c), EMS (H2) and TMS (H3). Thus, EMAP can be considered a solution for

companies to improve their performance while keeping the production environment running (Sari et al., 2021).

Therefore, EMAP as a management accounting tool can be used by companies to overcome and solve environmental problems, improve performance (Bresciani et al., 2022; Sari et al., 2021), promote EMS adoption (Fuzi et al., 2020) and greater senior management involvement in implementing EMAP, providing adequate resources to support such practices and assessing business impacts on the environment (Wang et al., 2019). Thus, companies that show constant concern for the environment tend to attract more customers, which generates increased sales and good business performance (Sari et al., 2017).

Based on these results, it is recommended that industries use EMAP to improve environmental and financial performance, EMS and top management support. According to Bresciani et al. (2022), top management must record all inputs and outputs of water, materials, energy, emissions and waste. After this process recognizes the improvement of the product and the analysis of the environmental impact, an EMS is necessary to estimate and classify the costs related to environmental issues. In addition, top management must provide all the support for such practices to develop in companies (Fuzi et al., 2020). Thus, if managers want to improve business performance, EMS and TMS, EMAP must be part of decision-making (Bresciani et al., 2022). The more companies use EMAP, the better their environmental performance will be (Solovida & Latan, 2017).

Another point to be highlighted based on the results of hypotheses H1, H2 and H3 is that EMAP is considered an effective way for companies to deal with environmental problems and the associated economic performance (Wang et al., 2019), as they recognise the relevant role of accountants in managing environmental and financial issues, given the positive effects on business performance (Sari et al., 2021). In this way, EMAP enables companies to identify and eliminate activities that can cause environmental damage, which can increase environmental awareness through EMS and TMS and improve relationships with stakeholders (Phan et al., 2018).

However, the EMS did not have an impact on the business performance (financial, operational and environmental) (H4) of the industries analyzed, which indicates that there are other factors that should be considered by companies to promote performance, such as, for example, in this research the results revealed the EMAP and the TMS. Spencer et al. (2013) argue that this result may have occurred due to the lack of appreciation of the EMS for reducing environmental impacts, which consequently tends to impact operational and financial performance.

On the other hand, TMS showed positive effects on operational performance (H5a) and financial performance (H5c), which reveals that top management support is a relevant internal force for driving business behaviors and results (Blass et al., 2014). However, the lack of support can lead to conflicts when it comes to adopting green practices linked to environmental issues, which justifies the statistically insignificant result of TMS on environmental performance. Therefore, if company management provides the necessary support for the development of activities, operational and financial performance tend to improve.

The results also revealed positive indirect effects of EMS and TMS on the relationship between EMAP and business performance (operational, environmental and financial) (H6). Companies concerned with environmental issues are dependent on TMS to achieve competitive advantage and consequently increase performance (Spencer et al., 2013). These results suggest that EMS and TMS are relevant for companies to implement EMAP, given the benefits for operational, financial and environmental performance. Thus, when top management realizes the benefit of EMAP, they are more likely to support all initiatives, as with the support of top management, it would be possible to obtain the necessary resources to carry out such practices. Therefore, companies with EMS and TMS tend to have stronger abilities to implement EMAP (Wang et al., 2019).

Based on the indirect effects found in the study, the contribution of EMS and TMS to improvements in environmental management processes and the promotion of greater performance can be seen. These improvements concern the implementation of an environmental strategy and the management of environmental risks (Tung et al., 2014). Furthermore, business performance is influenced by environmental strategy and the implementation of EMAP depends on the commitment of top management (Kong et al., 2022).

In view of the results found in this research, it appears that companies must invest in EMAP in order to achieve environmental objectives and strategies and to obtain effective accounting information and control systems. Therefore, top management must prepare managers to pay attention to environmental issues and prepare them to be part of the organization's corporate governance and sustainable performance (Kong et al., 2022).

## 5 Final Considerations

EMAP can generate benefits for environmental and organizational management, as it provides the basis for determining more assertive environmental objectives (Sari et al., 2021). In view of the above, this research aimed to analyze the mediating effects of the environmental management system and top management support on the relationship between environmental

management accounting practices and business performance (operational, environmental and financial).

The results revealed that EMAP has positive effects on environmental performance, financial performance, EMS and TMS. These results have important implications for companies, as they suggest that the adoption of EMAP is a key factor in improving environmental performance, financial performance, EMS and top management support. In this way, EMAP will enable managers to make more accurate and efficient decisions related to the environment, so that resources are not wasted and environmental pollution is prevented (Solovida & Latan, 2017).

TMS had a positive impact on operational and financial performance, which shows that this characteristic of companies' top management is important for improving business performance. The results also show that the relationship between the EMAP and business performance is indirectly influenced by the EMS and the TMS. Thus, it can be identified that the relationship is dependent on various factors, and the company must converge its efforts so that environmental actions bring benefits not only to the environment, but also financially and operationally. In other words, the company's management must realize the need to implement these practices for better business performance, and, to do so, it must be supported by an EMS that enables a holistic view of the various environmental, economic and operational impacts resulting from industrial production.

The research's contributions lie in the advances provided to the literature on EMAP and corporate performance (financial, operational and environmental) by providing evidence on the mediating effects of EMS and TMS on the relationship between EMAP and performance. In addition, it contributes by highlighting environmental issues in Brazilian industries based on *controllers*' perceptions of environmental practices, highlighting the way companies are dealing with environmental issues in their accounting and their understanding of the impact of environmental actions on business performance. Thus, even if companies have valuable assets such as EMAP, these cannot be implemented without the support of top management (Bresciani et al., 2022) and EMS (Fuzi et al., 2020).

Therefore, this research contributes to the literature related to environmental issues and presents useful implications for the practice of managers and professionals, because if companies wish to improve their performance (financial, operational and environmental), they should focus on implementing EMAP and EMS and obtaining TMS. The top management of companies should encourage a culture of information sharing, as new ideas can be useful for

business success, and the support of top management is essential for achieving environmental (Bresciani et al., 2022) and organizational objectives.

In addition, EMS should be encouraged, as it provides diverse information about environmental management accounting to improve environmental performance (Fuzi et al., 2020). In this way, the results found highlight the importance of developing positive attitudes among managers, such as TMS and the implementation of an EMS, to encourage EMAP and increase business performance. To this end, companies should offer training to increase the understanding of all those involved in the process of the benefits of EMAP and EMS (Phan et al., 2018; Wang et al., 2019). Overall, the results can direct companies to formulate policies aimed at continuously improving their performance, given the potential of environmental strategies and environmental management accounting to boost performance (Sari et al., 2021; Solovida & Latan, 2017).

This study also contributes to public policy makers by revealing that environmental protection standards are indispensable for motivating companies to adhere to EMAP (Wang et al., 2018). In this sense, the results found can serve as a reference for the development of guidelines linked to environmental issues in industries (Fuzi et al., 2020). Therefore, public policies should emphasize the implementation of environmental strategies, with a view to encouraging the integration of environmental issues into business decision-making (Solovida & Latan, 2017).

The research has some limitations that do not allow its results to be generalized. However, given the methodological rigor adopted, it provides important evidence that could stimulate further studies on the subject. In terms of limitations, it is pertinent to recognise potential contextual restrictions within the study. Furthermore, given that the study was carried out as a snapshot, a longitudinal approach could potentially increase the robustness of the results. The research carried out is also based on the perception of a specific group of managers (the *controllers*). Studies with other samples or internal surveys can also contribute to understanding these relationships. Demographic information or the characteristics of those responsible for handling information in each divisional unit can also contribute to understanding the patterns of decisions made and their consequent effects on organizational performance.

It is also suggested that future research analyzes the relationship studied in different industrial sectors in order to identify how the relationship behaves depending on the area in which the industry operates. It is also recommended that other mediating variables be incorporated into the model to explain the effects of EMAP on corporate performance, as well

as carrying out additional subgroup analyses, which could help identify variations between different sectors or company sizes. This evidence constitutes opportunities for further studies.

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