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Performance Management Framework for Circular Economy Strategies

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The existing literature emphasizes the importance of performance management as a vital component for increasing any company's competitive advantage. Companies can base their performance management on a variety of tools. In today's circular economy, managing companies' performance in terms of not just financial but also environmental concerns has become a strategic decision. Indeed, the study directions on performance management for circular economy strategies are diverse and quite scattered. This paper aims to propose a performance management framework under the balanced scorecard approach to be considered for the circular economy strategies implementation. A bibliometric approach was used to reveal the main directions of previous studies in performance management and circular economy strategies. Results revealed that the indicators of performance management under the balanced scorecard approach to be considered for the circular economy strategies implementation are various.

Keywords: *Circular Economy; Circular Economy Strategies; Balanced Scorecard; Performance Management; Indicators.*

Introduction

The extant body of literature underscores the significance of performance management as a critical element for enhancing the competitive advantage of any company. Companies can base their performance management on diverse methods and tools (Wick, 2021; Aryani & Setiawan, 2020; Taouab & Issor, 2019; Gawankar *et al.*, 2015). The context of performance measurement tools could be specified on business process improvement (e.g., by using the process mapping tool; lean Six Sigma indicators such as DMAIC (Define, Measure, Analyze, Improve, Control) and tools for tracking defect rates to help measure process improvement efforts), on financial performance analysis (e.g., using financial indicators like ROI (Return on Investment), ROA (Return on Assets), and profitability indicators assess a company's financial performance), on budget vs actuals (by comparing budgeted financial figures to actual performance helps evaluate financial health), on project management (by using Earned Value Management (EVM) to measure project performance by comparing planned vs actual progress and costs).

Nowadays, managing company performance concerning not only financial but also environmental interests (Baumgartner & Rauter, 2017), becomes a strategic decision, which is gaining attention in a circular economy (Sassanelli *et al.*, 2019). Indeed, the research directions on performance management for a circular economy are from different perspectives, such as indicators for circular products and services, indicators for manufacturing processes, or indicators for a sustainable supply chain (Tsai *et al.*, 2020; Dumitrascu *et al.*, 2020; Corona, *et al.*, 2019; Alamerew & Brissaud, 2019; Junior *et al.*, 2018; Helleno *et al.*, 2017).

A review of existing literature by Kirchherr *et al.* (2017), found 114 definitions of circular economy strategies, which include from the common '3Rs' (reduce, reuse, recycle) to '9Rs' (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover). However, the performance management for circular economy strategies has remained fragmented in the existing research. Therefore, a more comprehensive understanding is needed of how the circular economy strategies implementation can be ensured by using accurate performance management.

There is a lack of research that draws attention to changing performance management directions according to analyzing strategies for the circular economy. Therefore, this paper aims to propose a performance management framework under the balanced scorecard approach to be considered for the circular economy strategies implementation. Therefore, this study seeks to answer the following research question:

- RQ 1: What are the directions of previous studies in performance management?
- RQ 2: What are the directions of previous studies in circular economy strategies?
- RQ 3: What are the indicators in each balanced scorecard perspective to be considered for the circular economy strategies implementation?

Previous researchers have addressed the issues of performance management for circular economy strategies encompassing a variety of indicators for specific areas (e.g., indicators of waste generation, recycling rates, resource use, and economic aspects at a regional level (European Commission, 2020). A key problem with much of the literature regarding performance management for circular economy strategies is that it has been limited to a general approach lacking an appropriate framework for ensuring the implementation of performance management for circular economy strategies for different perspectives and indicators.

Thus, our study provides the framework of performance management for circular economy strategies in combination

with balanced scorecard perspectives and indicators. We believe that our results may improve knowledge about how to apply a "balanced" view of the business to analyse the complexity of performance management for circular economy strategies. It is in line with Kaydos's (2020) statements regarding performance management, including "balanced" view tools, and concise overview, multi-dimensional and integrated indicators across functions.

This study contributes to the strategic management accounting literature by offering novel evidence on future research directions in the area of performance management focusing on various circular economy strategies.

This paper is structured as follows: the Theoretical Background section represents conceptual perspectives on performance management, circular economy strategies, and indicators for the circular economy, then in the Research Methods section describes the used methods and research process. The following Results section represents the key findings and is followed by their discussion in connection with the previous studies in the Discussion section. This paper concludes with the Conclusions section, in which is finalized withdrawn conclusions, contributions, limitations, and future research suggestions.

Theoretical Background: Performance Management and Circular Economy Strategies

Performance Management. Over the last two decades, there has been an increasing focus on the research of performance management systems as instruments for effective strategy implementation (Liu, 2022; Song, 2022; Zhou *et al.*, 2022; Owais, 2021). Performance management is defined as "a system that generates performance information through strategic planning and performance management routines and that connects this information to decision venues, where, ideally, the information influences a range of possible decisions" (Moynihan, 2008; p. 5). Liu (2022; p. 3) explains that performance management "refers to the continuous cyclic process of performance plan formulation, performance coaching and communication, performance appraisal, application of performance results, and performance goal improvement in which managers and employees participate in order to achieve organizational goals". In relation to performance management, Kaydos (2020) states that: 1) a company's tools must provide a "balanced" view of the business; 2) the framework of indicators should provide a concise overview of the company's performance; 3) performance indicators should be multidimensional; 4) performance indicators should be integrated across all functions of the company and through its hierarchy; and 5) the performance management system can provide data to monitor progress. This means that indicators should measure both results and their drivers.

There are many different frameworks used to manage a company's performance. Kaydos (2020) identifies the most common performance management frameworks, one of which is the Balanced Scorecard. The balanced scorecard model was developed in the early 1990's by Robert Kaplan and David Norton. According to Taouab and Issor (2019), a balanced scorecard is a tool that is used to describe, elaborate, and apply a company's vision and strategy to specific targets and a clear set of financial and non-financial performance indicators. The balanced scorecard converts the company's mission and strategy into a set of performance indicators that serve as a model for the performance management system. With the implementation of a balanced scorecard, the goals, indicators, and strategic actions are allocated to concrete perspectives.

The balanced scorecard shows the organizational performance from four perspectives (Taouab & Issor, 2019):

- financial perspective – focuses on the company's financial performance and the use of financial resources;
- customer perspective – focuses on the customer's view of the company;
- internal processes perspective - focuses on internal business processes linked to strategic objectives;
- innovation and learning perspective - focuses on the organizational capabilities to train and develop its human resources.

The company's performance has been evaluated based on an analysis of financial performance indicators; however, it has been observed that in today's dynamic business environment, it is critical to monitor performance in a timely manner, focusing not only on financial but also on non-financial performance indicators. The balanced scorecard is referred to as "balanced" because it includes a combination of financial and non-financial indicators (Gazi, *et al.*, 2022). It is noted that traditionally, the most commonly used indicators in the balanced scorecard are (Liu, 2022; Song, 2022; Nn Cristea, 2021; Arpini & Dutra, 2021; de Sousa, 2020):

- financial perspective – operating income, profitability, and return on investment;
- customer perspective – number of customers, number of new customers, market share, customer satisfaction, net promoter score, number of lost customers, average turnover per customer, average profitability of a customer group, customer lifetime value, average cost of serving a customer;
- internal processes perspective – defect rate, defect rectification costs, average response time to customer inquiries, inventory turnover, average transaction costs, downtime, new product introduction time, customer acquisition costs, and service delivery costs;
- innovation and learning perspective – staff turnover, the average investment in training per staff member, number of training hours, staff satisfaction, staff engagement, staff problem-solving efficiency, the effectiveness of inter-departmental cooperation, and number of violations of internal rules.

Benkova *et al.* (2020) argue that the concept of a balanced scorecard allows companies to obtain feedback on their control from each organizational unit, which will assist the companies in achieving greater financial performance and the ability to innovate in various areas of the company. Generally, performance management is the process of measuring, analysing, and adapting a company's performance in the face of a changing environment to ensure its long-term viability and competitiveness.

Circular economy strategies. According to Govindan and Hasanagic (2018), a growing population puts pressure on natural resources, and this unconstrained growth requires a shift from the traditional linear model to a circular economy. Ferasso *et al.* (2020; p. 3007) describe the circular economy as a transformation in the "way resources are used, moving

from existing open production systems (i.e., traditional linear systems where resources are used to produce final products and become waste after consumption) to closed production systems (i.e. circular systems where resources are reused and stored in the production and consumption chain)". According to de Angelis *et al.* (2018), the circular economy is about retaining the value of products and materials for as long as possible; waste and the use of resources are minimised, and resources are kept in the economy at the end of a product's lifetime to be used over and over again to create further value. Galati *et al.* (2018) stress that the circular economy "focuses on the (re)design of processes and products aiming to minimize the negative environmental impact". Roos *et al.* (2020) explain the concept of circular economy as a combination of value retention, hierarchical structure, and multiplicity:

- circular economy strategies aim to decouple resource extraction and growth.
- circular economy provides a hierarchical framework that guides the prioritization of resource management choices.
- the impact of the circular economy should be multifaceted: environmentally friendly, economically viable, and socially just.

Focusing on circular economy strategies, it is noticed that they may be classified differently. Yu *et al.* (2021) and Leong *et al.* (2022) describe 4R circular economy strategies as reduce, reuse, recycle, and renew. Moraga *et al.* (2019) concentrate on 6R strategies for a circular economy: 1) maintain the functionality of products or services given via circular business models such as sharing platforms, product-service systems, and schemes that promote product redundancy and multifunctionality; 2) preserve the product itself by increasing its lifetime with strategies such as durability, reuse, restore, refurbish, and remanufacture; 3) preserve the product's components by reusing, recovering, and repurposing parts; 4) preserve the materials by recycling and downcycling; and 5) preserve the embodied energy by energy recovery at incineration facilities and landfills. 6) Assess the status, progress, or regress towards the circular economy using the linear economy as the reference scenario or the absence of a preservation strategy. The 9Rs are a circular economy framework that examines how materials can be used and reused at their highest value while minimizing waste and environmental destruction, according to Kirchherr *et al.* (2017) this framework consists of such strategies as refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover.

Circular economy indicators. Circular indicators play a crucial role in assessing progress and measuring the effectiveness of circular economy strategies. These indicators provide a comprehensive understanding of the transition from a linear, wasteful economy to a more regenerative and sustainable circular economy. The identification of circular indicators has received considerable attention from the authorities responsible for setting and implementing sustainable targets. International Resource Panel has developed a comprehensive set of indicators specifically for Asia to measure resource efficiency and circular economy progress. These indicators encompass areas such as material consumption, recycling rates, and sustainable consumption patterns (IRP, 2019). They reflect the unique challenges and opportunities of transitioning to a circular economy in the Asian context. World Resources Institute has proposed a set of circular economy indicators that focus on the design, consumption, and disposal phases of products. These indicators emphasize indicators related to product lifetime extension, material efficiency, and waste reduction (WRI, 2019). They help companies and policymakers understand how circular economy strategies are impacting resource use and environmental outcomes. The European Commission has introduced a Circular Economy Monitoring Framework, which includes a range of indicators to assess progress toward a circular economy. These indicators cover areas like waste generation, recycling rates, resource use, and economic aspects related to circular economy (European Commission, 2020). This framework supports policy development and implementation at a regional level. The Ellen MacArthur Foundation has been a prominent advocate for circular economy principles and has developed a set of circular economy indicators. These indicators measure aspects such as resource productivity, product circularity, and value retention in a circular system (Ellen MacArthur Foundation, 2021). They serve as a foundation for evaluating circular economy performance across various sectors. The OECD Inventory of Circular Economy Indicators collects 474 circular-economy-related indicators, classified into five main categories, such as environment, governance, economic and business, infrastructure and technology, and jobs (OECD, 2020). In addition, various academic studies have explored the implementation of circular indicators in different sectors and regions. For instance, research by Azevedo *et al.* (2017) proposed a Sustainable Circular Index (SCI) based on a five-phase framework to assist managers in analysing their level of sustainability and circular economy. Research by Bocken *et al.* (2016) discusses circular economy business models and the use of indicators to measure their performance. Cayzer *et al.* (2017) explore the measurement of product performance concerning circular economy principles. Elia *et al.* (2017) compared the global efficacy based on quantitative indicators in measuring the real level of application of circular economy strategies to organizations, products, or services. Di Maio *et al.* (2017) proposed a new value-based indicator to assess the performance of actors in the supply chain focusing on resource efficiency and circular economy. Smol *et al.* (2017) proposed circular economy indicators for regional policy. Howard *et al.* (2019) presented a framework for developing circular economy indicators that link to the core goals, and principles of a circular economy. Saidani *et al.* (2019) reviewed and classified 55 sets of circular economy indicators. Figge *et al.* (2018) developed indicators for circular economy and longevity by focusing on the contribution that companies and other resource users make to the sustainability of resource use. Helander *et al.* (2019) suggested complementing circular economy management indicators with indicators capturing basic environmental pressures concerning the respective circular economy activity. Kristensen *et al.* (2020) reviewed and analysed 30 indicators at the micro level that focus on the circular economy. 41 circularity indicators for application in agricultural systems were also comprehensively assessed to determine their strengths and weaknesses by Velasco-Munoz *et al.* (2021). De Pascale *et al.* (2021) analysed indicators measuring the circular economy by grouping them by using a

double classification: spatial dimensions of sustainability (macro, micro, and meso) based on the 3R circular economy principles. Calzolari *et al.* (2022) examined decision support tools, and related indicators, employed for assessing the performance of circular supply chains. De Oliveira and Oliveira (2023) created a scarcity relation of indicators with protecting and strengthening natural capital and sustainable development goals.

De Mattos and De Albuquerque (2018) argue that there is a lack of research examining circular economy strategies and practices based on the principles that guide the development of companies to rationalize the use of natural resources, reduce their consumption, or stimulate their restoration. It should be mentioned that performance management must be in line with changes that are necessary in an ever-changing environment and effect changes in the performance of businesses. However, performance management issues in the context of a circular economy are complex and multifaceted (Torgautov *et al.*, 2022; Zharfpeykan & Akroyd, 2022; Mook, 2020; Moraga *et al.*, 2019). Therefore, with a high demand for a circular economy, researchers are called upon to investigate the implementation of circular economy strategies by incorporating it into the company's performance management by using a balanced scorecard approach.

Research Methods

The research design with the aim to define the key directions of performance management regarding circular economy was identified using a bibliometric method. This approach identifies competing theme networks within a topic based on the co-occurrence of terms or words.

The dataset for the bibliographic analysis was created by searching papers in the Web of Science bibliographic database while concentrating on keywords associated with the subject under this study. The analysis's time frame is from 2012 to 2022. The VOSviewer program was used for the co-word analysis by mapping and clustering words to networks. For this, various keywords in the field of performance management under the balanced scorecard approach regarding circular economy were selected:

- "balanced scorecard" – total record including citations > binary counting > the minimum number of occurrences of a term: 15 > the number of words 890/46812 > map > result: 534 items in 4 clusters;
- "circular economy strategies" – total record including citations > binary counting > the minimum number of occurrences of a term: 15 > the number of words 1653/84727 > map > result: 992 items in 3 clusters;
- "performance management, balanced scorecard, and circular economy strategies" – total record including citations > binary counting > the minimum number of occurrences of a term: 10 > the number of words 321/12727 > map > result: 193 items in 3 clusters.

Meanwhile, a thorough literature analysis was conducted to determine how the publications tackled performance management through various circular economy strategies. The systematic literature review was prepared using the Web of Science (WoS) database. As a result, the material was refined and a critical analysis of what may be used in the search was performed. Following that, the content was theoretically categorized. Finally, a comprehensive analysis was carried out to classify, arrange, and show the content. All of these processes were completed by the research team without the need for additional verification of the results, which can be viewed as a limitation of the method used.

According to the network for the co-citation of journals for the 2012–2022 period, three clusters of publication sources serve as the foundation for the performance management and circular economy fields, despite their extremely high overall density showing the journals are highly interconnected through co-citation relationships (Figure 1).

Figure 1. The Co-Citation Network of Journals (2012–2022; based on the Web of Science bibliographic database)

The first cluster represents the strategic management field (journals such as *Strategic Management Journal; Harvard Business Review; Academy of Management Journal*; etc.). The second cluster is the practices in product development (journals such as the *International Journal of Production Economics; International Journal of Production Research;* etc.). The third cluster represents (e.g., *Waste Management & Research, Business Strategy; the Environment, etc.*) journals focusing on environmental issues.

Results: Research Directions of Performance Management and Circular Economy Strategies

The co-word analysis (from Web of Science) results for the period 2012–2022 were created by taking into account several keywords in the disciplines of performance management, balanced scorecard, and circular economy strategies. Given the importance of performance management in providing relevant information for a company's strategy implementation, the dynamic nature of the business environment necessitates that performance management should be in line with it.

Directions of previous studies in performance management. Researchers agree that performance management is an important and increasingly demanding practice, mainly due to the increasingly competitive environment that successful strategy implementation can bring (Arpini & Dutra, 2021). According to the search results, there were 14,371 results from the Web of Science Core Collection for the performance management keyword during the examined period. Publications analysing performance management have increased fast since 2017 (1,049) and reached 2,577 by 2022. The majority of search results were discovered in management (3,022) and business (1,670) fields (Figure 2).

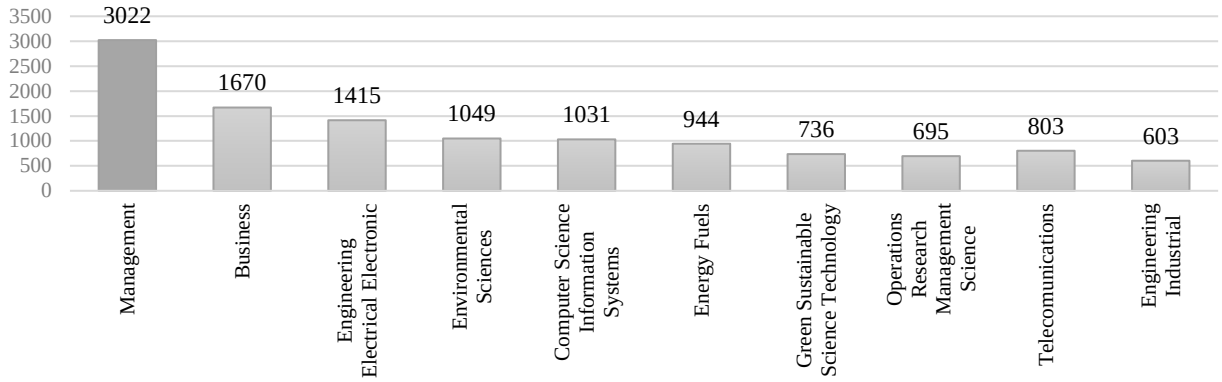

Figure 2. Research Field: Performance Management (*Source: Web of Science Core Collection*)

The application of a balanced scorecard as a tool of performance management contributes to the realization of corporate strategic goals by paying attention to other aspects besides financial indicators, which can significantly improve the company's performance management (Song, 2022). As a result, there will be more research on this topic. According to the search results, there were 2,723 results from the Web of Science Core Collection for the balanced scorecard keywords during the examined period. The number of publications analysing balanced scorecard is fairly stable from year to year (around 250 per year). The majority of search results were related to management (769) and business (418) fields.

The analysis showed four main clusters: "*relationship*", "*criterium*", "*performance measurement*", and "*strategic management*" (Figure 3).

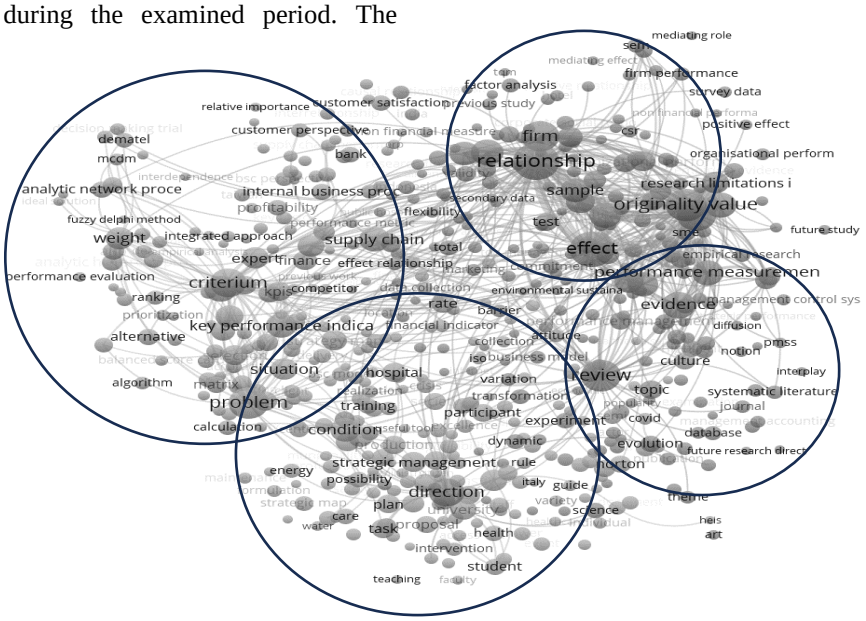

Figure 3. The Co-Occurrence Network of Terms in the Field "Balanced Scorecard" (2012–2022; based on Web of Science bibliographic database)

It is noteworthy that the "*performance measurement*" frame reveals aspects related to evaluation, such as evaluation direction, evaluation topic, and databases for evaluation. The "*performance measurement*" frame is related to the "*criterium*" frame, which refers to key performance indicators and internal business processes. The internal business processes have a link through the value chain to another important frame called "*relationship*". This frame unfolds as company, effect, and implication. The "*strategic management*" frame combines all the highlighted frames and shows the importance of revealing aspects such as needed actions for taking strategic decision-making (e.g., training, current situation analysis, tasks, and plan setting).

Directions of previous studies in circular economy strategies. Moraga *et al.* (2019; p. 452) stress that the circular economy "is a growing topic, especially in the European Union, that promotes responsible and cyclical use of resources possibly contributing to sustainable development". According to the search results, there were 18,232 results from the Web of Science Core Collection for the circular economy keyword during the studied time. Publications analysing the circular economy have constantly grown since 2019 (2,040). It is noticed that in 2022 publications number under these keywords was 5,558. The majority of search results were related to environmental sciences (6,899) and green sustainable science technology (5,161) fields (Figure 4).

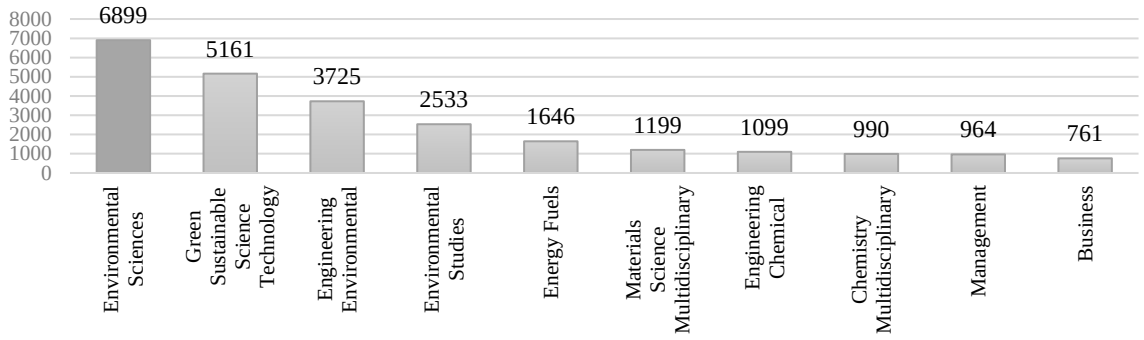

Figure 4. Research field: the circular economy *(Source: Web of Science Core Collection)*

Scarcity of resources, increased waste, and rising raw material prices are forcing companies to make more efficient decisions and shift away from the current paradigm (e.g., linear economy) and toward more sustainable models (e.g., embracing circular economy strategies) (Torgautov *et al.*, 2022; Norouzi *et al.*, 2021). According to the search results, there were 4,506 hits from the Web of Science Core Collection for the phrase circular economy strategies during the studied time. Publications analysing circular economy strategies were produced the fastest in 2021 (1,242) and in 2022 (1,413). Most search results (1,927) are linked to environmental sciences, green sustainable scientific technology (1,525), and engineering environmental (1,010) areas. The analysis showed the main three clusters: "*innovation*", "*production*", and "*life cycle assessment*" (Figure 5). Frames "*innovation*" (through business model, product-service systems, and strategy) and "*production*" (taking into account different types of materials and products) in academic research were understood as possible tools to ensure higher circularity. The "*life cycle assessment*" framework indicated that, in addition to instruments for establishing a circular economy, measuring environmental outcomes leads to a more circular future.

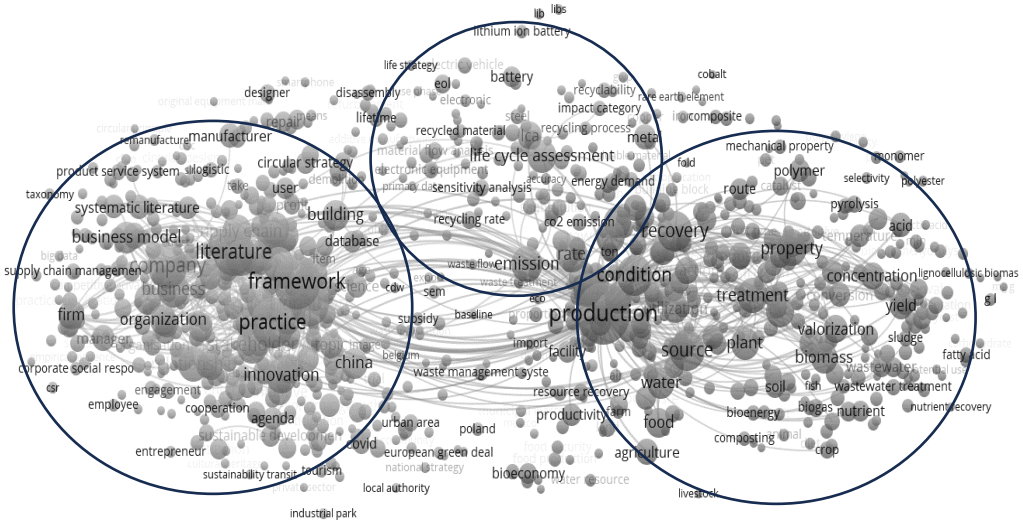

Figure 5. The Co-Occurrence Network of Terms in the Field of "Circular Economy Strategies" (2012–2022; based on Web of Science bibliographic database)

Indicators for the circular economy strategies implementation. It can be observed that performance management through the balanced scorecard can assist in the circular economy implementation process through different strategies. However, it is noticeable that this is a very fragmented research topic (Moraga *et al.*, 2019; Torgautov *et al.*, 2022). The search results revealed that there were 653 results from the Web of Science Core Collection for the keywords performance management, balanced scorecard, and circular economy strategies during the examined period. Publications analysing these terms doubled from 2020 (112) to 2022 (228). The majority of search results (319) were connected to environmental sciences, followed by green sustainable scientific technology (235) (Figure 6).

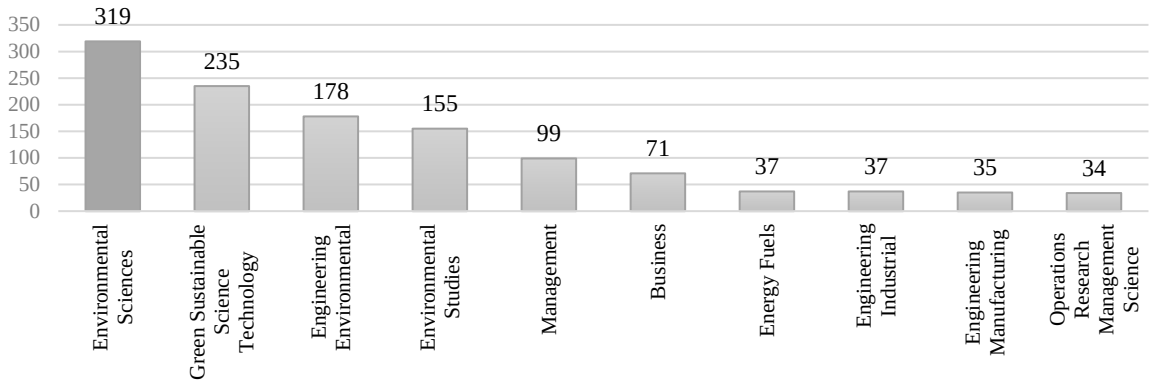

Figure 6. Research Field: Performance Management, Balanced Scorecard, and Circular Economy Strategies

(Source: Web of Science Core Collection)

The analysis indicated the main three frames: adoption, waste assessment, and environmental impact (Figure 7). Frame "*adoption*" is understood through different aspects, such as innovation, circular business model, capabilities, and relationships in the supply chain. The "*assessment*" frame demonstrated that it is critical in scientific research to monitor company performance (taking into consideration various indicators, waste assessment, environmental performance, and investments). Both of these frames should complement each other and lead to the "*environmental impact*" frame. Life cycle assessment and environmental benefits can ensure the "*environmental impact*" frame.

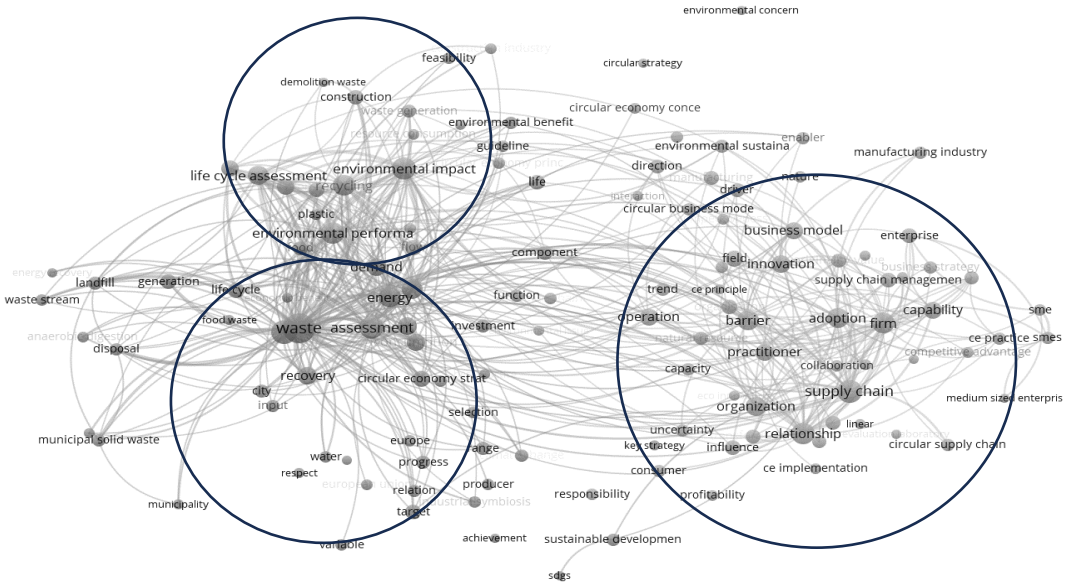

Figure 7. The Co-Occurrence Network of Terms in the Fields "Performance Management, Balanced Scorecard, and Circular Economy Strategies" (2012–2022; based on Web of Science bibliographic database)

By using a bibliometric method, we also tried to identify the key indicators of performance management concerning the circular economy. However, the research that analyses performance management by applying a balanced scorecard to ensure the implementation of circular economy strategies (Torgautov *et al.*, 2022; Saroha *et al.*, 2022) is fragmented. Taking into account that the "9R" framework is a way to categorize strategies within the circular economy, focusing on various stages of a product's life cycle, where each "R" represents a different strategy aimed at reducing waste and promoting sustainability. The balanced scorecard approach provides a comprehensive framework for evaluating the companies' performance across various perspectives, including financial, customer, process, and learning and growth. Hence, below we provide a possible framework of performance management for circular economy strategies under a balanced scorecard, which indicates the possible logic of indicators (Figure 8).

The smarter product use and manufacture category focuses on three strategies – Rethink, Refuse, and Reduce. *Rethink* strategy encourages rethinking the design of products and systems to ensure their longevity, durability, and ease of repair or upgrade. *Refuse* strategy promotes the reduction of waste by refusing or eliminating unnecessary or harmful products. Reduce strategy focuses on minimizing the consumption of resources by using materials more efficiently. An analysis of the scientific literature (Oliveira & Oliveira, 2023; Calzolari *et al.*, 2022; Torgautov *et al.*, 2022; Zharfpeykan & Akroyd, 2022; Ellen MacArthur Foundation, 2021; Velasco-Munoz *et al.*, 2021; De Pascale *et al.*, 2021; Mook, 2020; Kristensen *et al.*, 2020; European Commission, 2020; OECD, 2020; Moraga *et al.*, 2019; IRP,

2019; WRI, 2019; Howard *et al.*, 2019; Saidani *et al.*, 2019; Helander *et al.*, 2019; Figge *et al.*, 2018; Cayzer *et al.*, 2017; Elia *et al.*, 2017; Di Maio *et al.*, 2017; Smol *et al.*, 2017; Azevedo *et al.*, 2017; Bocken *et al.*, 2016; Lieder & Rashid, 2016) shows that the most frequently mentioned indicators in this category under the balanced scorecard approach, are focused on the resource efficiency (e.g., the amount of material/water/energy used per unit of product output), waste reduction (e.g., the amount of waste generated compared to the amount of product manufactured; number of employees trained in waste reduction; the reduction in production costs achieved through resource efficiency and waste reduction).

Extend the lifespan of products and their parts category includes five strategies – Reuse, Repair, Refurbish, Remanufacture, and Repurpose. *Reuse* strategy encourages the reuse of products or components instead of discarding them. *Repair* strategy promotes repairability and provides resources for repairing products. Remanufacture strategy involves the process of refurbishing used products to a "like-new" condition. *Repurpose* strategy focuses on designing products to fit within a circular economy framework from the start. Extending the lifespan of products is a fundamental principle of the circular economy, as it reduces resource consumption, waste generation, and environmental impacts. An analysis of the scientific literature (Oliveira & Oliveira, 2023; Calzolari *et al.*, 2022; Torgautov *et al.*, 2022; Zharfpeykan & Akroyd, 2022; Ellen MacArthur Foundation, 2021; Velasco-Munoz *et al.*, 2021; De Pascale *et al.*, 2021; Mook, 2020; Kristensen *et al.*, 2020; European Commission, 2020; OECD, 2020; Moraga *et al.*, 2019; IRP, 2019; WRI, 2019; Howard *et al.*, 2019; Saidani *et al.*, 2019; Helander *et al.*, 2019; Figge *et al.*, 2018; Cayzer *et al.*, 2017; Elia *et al.*, 2017; Di Maio *et al.*, 2017; Smol *et al.*, 2017; Azevedo *et al.*, 2017; Bocken *et al.*, 2016) shows that the most frequently mentioned indicators in this category under the balanced scorecard approach, are focused on the product life extension (e.g., the average lifespan of products before they need to be replaced; indicating the demand for and viability of extended product lifespans; the length of time a manufacturer guarantees a product's functionality) and new design opportunities (percentage of products or components successfully reintegrated into new products; modularity; the extent to which products are designed with features that promote durability, repairability, and upgradability; the number of used products sold).

Useful application of materials category focuses on two strategies – Recycle and Recover. *Recycle* strategy involves converting discarded materials into raw materials for new products. *Recovery* strategy focuses on energy recovery from non-recyclable waste materials. The use of recycled materials is a key component of the circular economy, as it reduces the demand for virgin resources and helps divert waste from landfills. An analysis of the scientific literature (Oliveira & Oliveira, 2023; Calzolari *et al.*, 2022; Torgautov *et al.*, 2022; Zharfpeykan & Akroyd, 2022; Ellen MacArthur Foundation, 2021; Velasco-Munoz *et al.*, 2021; De Pascale *et al.*, 2021; Mook, 2020; Kristensen *et al.*, 2020; European Commission, 2020; OECD, 2020; Moraga *et al.*, 2019; IRP, 2019; WRI, 2019; Howard *et al.*, 2019; Saidani *et al.*, 2019; Helander *et al.*, 2019; Figge *et al.*, 2018; Cayzer *et al.*, 2017; Elia *et al.*, 2017; Di Maio *et al.*, 2017; Smol *et al.*, 2017; Azevedo *et al.*, 2017; Bocken *et al.*, 2016) shows that the most frequently mentioned indicators in this category under the balanced scorecard approach, are focused on the recycling rates (such as the percentage of recycled materials used in the production process; the percentage of a product's components that are made from recycled materials; the percentage of waste generated from production and consumption that is recycled rather than disposed of.; the percentage of suppliers that incorporate recycled materials in their products or processes; the capacity of local recycling facilities to process and supply recycled materials; willingness to pay more for products containing recycled materials).

Taking into account the balanced scorecard approach, it could be stated that: 1) financial indicators emphasize the financial benefit gained while doing more circular activities; 2) customer perspective indicators highlight the importance of understanding and meeting customer preferences, values, and expectations in a circular economy context; 3) process perspective indicators emphasize the importance of optimizing various stages of the product lifecycle to achieve circular economy goals; and 4) indicators in learning perspective emphasize the importance of ongoing education, training, and skill development within companies and industries transitioning to a circular economy. Hence, by assessing these indicators, companies and policymakers can track the progress of integrating recycled materials into production processes, identify areas for improvement, and work towards a more sustainable and circular approach to resource use.

These provided indicators using the balanced scorecard approach offer a well-rounded view of the company's performance within each 9R strategy in the context of the circular economy. A proposed performance management framework for circular economy strategies using the balanced scorecard approach is worth considering due to its ability to provide a comprehensive and balanced view of the company's efforts in adopting circular economy principles. A circular economy emphasizes sustainability, resource efficiency, and value creation, and the balanced scorecard approach offers a structured way to measure and manage progress in these areas. The proposed framework is flexible and can be applied to companies of various sizes, in a wide range of industries. However, it is crucial to adapt it to the specific context of the company and its industry.

By summarizing the findings of co-word analysis (from the Web of Science Core Collection) from 2012 to 2022, it was possible to determine that performance management through the use of a balanced scorecard is an appropriate tool for ensuring the implementation of circular economy strategies and overall company performance. However, it should be noted that to accomplish this, the collection of indicators in the balanced scorecard framework must be tailored to the nature of the company's activity, the market, and the stakeholders involved.

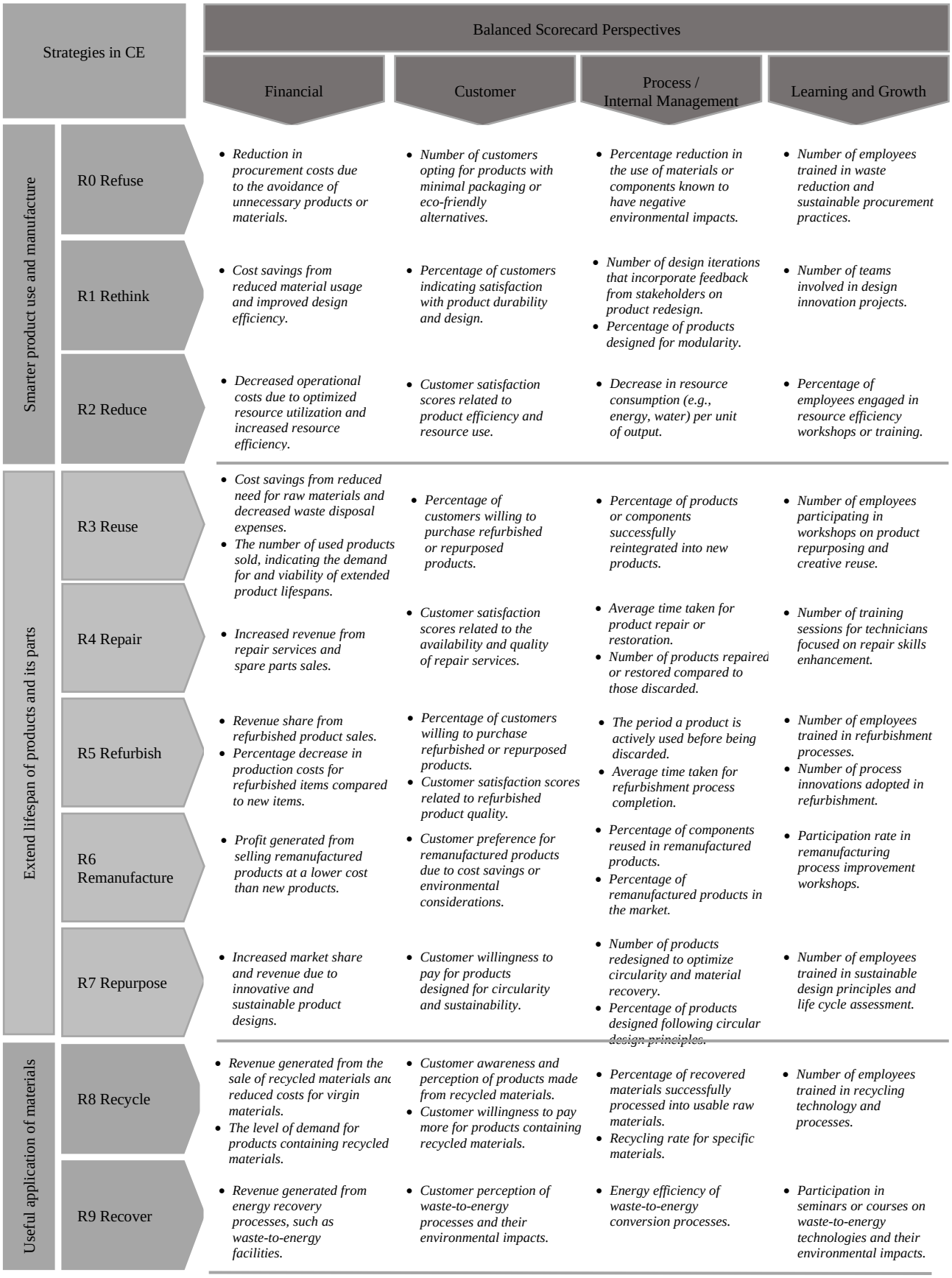

Figure 8. The Framework of Performance Management for Circular Economy Strategies under a Balanced Scorecard

Discussion

Regarding RQ1, the analysis helped us to separate the key directions of performance management such as performance measurement, criteria, relationship, and strategic management. It can be observed that our results are in line with Song (2022), Zhou, *et al.* (2022), and Owais (2021) as they identified that for performance management to be effective, companies' performance needs to be measured by a range of indicators (including financial and non-financial), have clear linkages, and lead to strategic decision-making.

Furthermore, the RQ2 allowed for the determination of the main research directions of the circular economy and its implementation strategies. The analysis of the co-occurrence data demonstrated that the relevance of technologies (particularly innovation) in industrial activities is obvious in scientific research, not only to ensure cleaner production but also to achieve significant environmental impact (Khan *et al.,* 2022; Ucar *et al.,* 2020; Pagoropoulos *et al.,* 2017).

Finally, the research results revealed that performance management by applying a balanced scorecard is an appropriate tool to ensure the implementation of circular economy strategies and overall company's performance, as the adoption of circular economy strategies and assessment of the company's performance should be in line and lead it to the environmental impact. This result is in line with Gazi *et al.* (2022), Tsai *et al.* (2020), Alamerew and Brissaud (2019), and Baumgartner and Rauter (2017). However, it is important to note that performance management needs to be continuously adapted to the evolving (circular economy) strategy of the company. This could be ensured by identifying the indicators in each balanced scorecard perspective to be considered for the circular economy strategies implementation. From the analysis of scientific literature, we observed that there is a growing corpus of research on the development of circular economy indicators. However, it is crucial to note that the aforementioned research is emphasized on different perspectives, such as the validity of indicators based on circular economy goals (Corona *et al.,* 2019), circular supply chain management (Vegter *et al.,* 2021), different levels (such as micro, meso, and macro levels) (Ghisellini *et al.,* 2016), different sector or industry (Torgautov *et al*., 2022; Zimmermann & Bliklen, 2020; Brown & Bajada, 2018; Graedel *et al*., 2011; Olugu *et al*., 2011). In addition, other scientists' research (such as Betts *et al.,* 2022; De Pascale *et al.,* 2021; Saidani *et al.,* 2019) emphasized attention to circular economy strategies and possible indicators framework based on the balanced scorecard approach for the implementation of circular economy strategies. Implementing a performance management framework for circularity using the balanced scorecard approach can guide companies in their journey toward adopting circular economy principles, optimizing resource utilization, and contributing to a more sustainable future. However, it must be stressed that the proposed model must be adapted as it may vary based on factors such as industry, region, and specific business practices.

Conclusions

The research results provide new insights into the changing performance management aspects according to strategies for the circular economy. The bibliographic analysis allowed us to reveal the main aspects of previous studies in performance management and circular economy strategies. The circular economy requires a shift from linear to closed-loop thinking. The balanced scorecard approach aligns with this shift by encouraging companies to consider not only financial performance but also environmental and societal impacts.

We argue that depending on the industrial context, among other factors, the performance management of companies using different circular economy strategies differs in its focus. The company's focus on different circular economy strategies (R9) leads to different attention to the performance perspective (balanced scorecard perspectives). Hence, the measures of performance management under the balanced scorecard approach to be considered for the circular economy strategies implementation are various. In addition, the proposed framework enables organizations to define clear indicators and metrics for each circular economy strategy (e.g., 9R strategies) and track progress over time. This facilitates accountability and supports data-driven decision-making. The successful set of measures for each balanced scorecard perspective ensures the implementation of a circular economy strategy. Thus, this not only ensures that financial and environmental interests are aligned but also allows the company to increase its competitive advantage in the market. The balanced scorecard links performance measures to strategic goals. By applying this approach to circular economy strategies, companies can ensure that their efforts to become more circular are in line with their long-term objectives.

Limitations and future research directions. The main limitation of the bibliometric research approach is that the results were not verified. As a result, empirical testing of research outcomes to determine if they are statistically significant is necessary and suggests a potential area for future research. In addition, the proposed model of performance management for circularity under a balanced scorecard must be specified with detailed indicators about the nature of the company's activities, the nature of the market/industry/sector, or the stakeholders involved.

This study contributes to the strategic management accounting literature by providing unique evidence on future research directions in the domain of performance management focusing on various circularity tactics. Furthermore, the findings assist managers in measuring their company's success by developing an efficient measures framework based on the balanced scorecard approach for the implementation of circular economy strategies.

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