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INTEGRATING CIRCULAR ECONOMY PRINCIPLES INTO OPERATIONAL STRATEGIES

MENGINTEGRASIKAN PRINSIP-PRINSIP EKONOMI SIRKULAR KE DALAM STRATEGI OPERASIONAL

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ABSTRACT
Circular economy principles are increasingly important in supporting the sustainability of company operations, but their application in operational strategies is still less systematically mapped out. This research aims to identify the circular economy principles that are most often integrated into operational strategies through approaches Systematic Literature Review PRISMA protocol based. The research results revealed four main principles, namely Reduce, Reuse, Recycle, Closed-loop Production Systems, Prolonging Product Life Cycle, And Resource Efficiency and Waste Minimization, which contributes significantly to the company's operational efficiency and sustainability. This study provides new insights to the academic literature and practical guidance for industry in adopting the circular economy.
Keywords: Circular economy, operational strategy, sustainability, Systematic Literature Review, resource efficiency.

ABSTRAK
Prinsip ekonomi sirkular semakin penting dalam mendukung keberlanjutan operasional perusahaan, namun penerapannya dalam strategi operasional masih kurang terpetakan secara sistematis. Penelitian ini bertujuan untuk mengidentifikasi prinsip-prinsip ekonomi sirkular yang paling sering diintegrasikan ke dalam strategi operasional melalui pendekatan Systematic Literature Review berbasis protokol PRISMA. Hasil penelitian mengungkap empat prinsip utama, yaitu Reduce, Reuse, Recycle, Closed-loop Production Systems, Prolonging Product Life Cycle, dan Resource Efficiency and Waste Minimization, yang berkontribusi signifikan terhadap efisiensi operasional dan keberlanjutan perusahaan. Studi ini memberikan wawasan baru bagi literatur akademik dan panduan praktis bagi industri dalam mengadopsi ekonomi sirkular.
Kata Kunci: Ekonomi sirkular, strategi operasional, keberlanjutan, Systematic Literature Review, efisiensi sumber daya.

1. INTRODUCTION

The circular economy (CE) represents a transformative approach to economic systems, aiming to minimize waste and maximize resource efficiency through strategies such as reduce, reuse, and recycle. This model contrasts sharply with the traditional linear economy, which follows a "take-use-dispose" paradigm. By adopting circular economy principles, businesses can enhance their operational efficiency, reduce production costs, and generate new economic value while simultaneously mitigating their environmental impact (Mashovic et al., 2022; Geissdoerfer et al., 2017; Ozili, 2021). The circular economy not only preserves the value of products and materials but also aligns with the increasing regulatory demands for sustainability and the expectations of environmentally conscious consumers (Muriithi & Ngare, 2023; Marjamaa et al., 2021).

Implementing circular economy principles is particularly relevant in addressing pressing global challenges such as climate change, resource scarcity, and waste management. For

instance, closed-loop production systems enable companies to recycle materials within their processes, significantly reducing greenhouse gas emissions and the need for virgin resources (Dewick et al., 2020; Haas et al., 2015). Furthermore, the integration of recycling and redesign practices can substantially decrease industrial waste, offering tangible solutions to the escalating waste crisis (Mikhajlov et al., 2021; Jurgilevich et al., 2016). As resources become increasingly scarce, the circular economy facilitates the extension of resource life cycles through the recovery and reuse of critical materials, including rare metals essential for various industries (Sumter et al., 2020; Kopnina, 2018).

The transition to a circular economy is not merely an environmental imperative; it also presents significant economic opportunities. By fostering resource efficiency and promoting sustainable practices, companies can achieve competitive advantages and enhance their profitability (Mashovic et al., 2022; Stelmaszczyk et al., 2023). The circular economy is increasingly recognized as a strategic framework for sustainable development, with implications for policy-making and corporate governance (Steinfatt, 2020; Prendeville et al., 2018). Stakeholder engagement plays a crucial role in this transition, as collaboration among various actors is essential for effectively implementing circular economy principles (Muriithi & Ngare, 2023; Esparragoza & Mesa, 2019). Ultimately, the circular economy offers a pathway to not only address environmental challenges but also to create resilient and sustainable economic systems that benefit society as a whole.

However, although the circular economy has become a major concern in academic literature and practical discussions, there is a significant gap in research that specifically highlights how these principles are implemented in companies' operational strategies. Most research focuses on the macro benefits of a circular economy or specific technical aspects, such as recycling technologies, without explaining how these principles can be integrated into daily operational practices. Therefore, this research aims to bridge this gap by identifying the circular economy principles most frequently integrated into operational strategies.

This research makes important contributions to academics and practitioners. For academics, this research enriches the literature linking circular economy concepts with operational management, providing opportunities for further studies in this area. Meanwhile, for practitioners, this research can be a strategic guide for companies that want to adopt circular economy principles. Thus, this research aims to provide practical and theoretical insights that can help companies achieve their sustainability goals.

To answer these challenges, this research was designed to answer the main questions: **What are the circular economy principles most often integrated into companies' operational strategies?** The answer to this question is expected to provide a map of the dominant principles used by the company and how these principles are applied strategically. With this approach, research is expected to make a significant contribution to the development of circular economy science and practice.

2. METHODS

2.1 Research Design

This research uses the approach Systematic Literature Review (SLR) designed to provide a comprehensive review of the literature relevant to the research topic. This approach is carried out following the PRISMA protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to ensure transparency and replication in the literature selection process. This protocol includes identification, selection, and presentation of results systematically so as to produce quality and reliable reviews. The SLR research design allows the identification of patterns, trends and gaps in the literature regarding circular economy principles integrated into companies' operational strategies.

2.2 Inclusion and Exclusion Criteria

2.2.1. Inclusion Criteria:

- Journal articles published in the last 10 years: Focus on the latest literature to ensure relevance to the latest developments in circular economy implementation.
- Article in English: To facilitate access to high quality international literature published in reputable journals.
- Focus on circular economy principles and operational strategies: Articles must explicitly discuss the integration of circular economy principles in the company's operational context.

2.2.2. Exclusion Criteria:

- Articles that are not relevant to the topic: Studies that do not address circular economy or operational strategies will be excluded to maintain research focus.
- Articles that do not integrate circular economy principles: For example, articles that only discuss sustainability in general without referring to specific principles of the circular economy.

2.3 Literature Search Process

2.3.1. Databases Used:

- Scopus: One of the largest databases for multidisciplinary scientific literature.
- Web of Science: A reputable database that provides access to high-quality journals.
- Springer: Platform that includes many publications in the field of circular economy and sustainability.
- Other databases: Like ScienceDirect and Emerald Insight, to complete searches.

2.3.2. Search Keywords:

- "circular economy principles"
- "operational strategies"
- "integration"
- "sustainable operations"

Searches were carried out using a combination of the keywords above with Boolean operators (AND, OR) to ensure broad and relevant coverage such as:

- "circular economy principles" AND "operational strategies"
- "integration" OR "sustainable operations".

2.4 Selection Process

First Stage: Title and Abstract Screening

At this stage, articles that did not meet the inclusion and exclusion criteria were eliminated based on title and abstract review. This process was carried out by two independent researchers to reduce selection bias.

Second Stage: Full-Text Review

Articles that pass the first stage are then thoroughly reviewed to ensure their relevance to the research topic. Articles that do not meet the criteria will be excluded from the final analysis. This process includes an assessment of the methodology, results, and discussion presented in the article.

2.5 Data Analysis

2.5.1. technical coding

Articles that passed the selection were analyzed using coding techniques to identify circular economy principles mentioned in the literature. This process involves coding data into relevant categories or themes, such as product redesign, waste management, And resource optimization.

2.5.2. Thematic Analysis

Once coding was complete, a thematic analysis was conducted to identify the most frequently mentioned and relevant principles. The results of this analysis will provide an overview of the main trends in the integration of circular economy principles into operational strategies. This analysis also allows researchers to identify areas that are less discussed in the literature, thereby providing directions for future research.

3. RESULTS

3.1 Description of Reviewed Literature

This research analyzes a number of scientific articles relevant to the topic of integrating circular economy principles in company operational strategies. As many 28 articles therpselect based on inclusion and exclusion criteria. These articles cover publications over a period of time in 2013–2023, that reflect recent developments in the related literature.

3.2. Distribution of Articles by Year

The majority of articles analyzed were published between 2018–2023, which reflects increasing attention to the circular economy concept as a response to global sustainability challenges. The distribution of articles shows a stable trend with a peak in the year 2021, where this topic is increasingly relevant in the context of sustainability policies and regulatory pressures in many countries.

3.3. Distribution of Articles by Journal

The articles analyzed come from various reputable journals such as Journal of Cleaner Production, Sustainability, And Resources, Conservation and Recycling. These journals are known to focus on issues of sustainability, resource efficiency, and waste management, making them key sources for identifying circular economy integration.

3.4. Distribution Based on Industrial Sector

The most frequently discussed industry sectors include:

- Manufacturing: Especially in the electronics and automotive industries, where component recycling is a major concern.
- Agriculture: Management of organic waste through a circular system.
- Textile: Focus on product redesign and material recycling.
- Construction: Reuse of building materials in new projects.

3.5. Most Frequently Applied Circular Economy Principles

3.5.1. Prinsip 1: Reduce, Reuse, Recycle

This principle dominates the literature as a basic approach in the circular economy. Examples of applications include reducing the use of new materials through product redesign, reusing components in the production process, and recycling materials to reduce waste. For example, in the electronics sector, companies collect old devices to reprocess them into new products.

3.5.2. Prinsip 2: Closed-loop Production Systems

Closed production systems ensure that waste from one process can be reused as input for another process, creating a continuous flow of materials. In the automotive industry, manufacturers reuse scrap steel to produce new vehicles, reducing the need for raw materials.

3.5.3. Prinsip 3: Prolonging Product Life Cycle

Extending product life through maintenance, repair, and modular design is becoming common practice. The textile sector shows innovation by producing clothing from high-quality materials designed for long-term use.

3.5.4. Prinsip 4: Resource Efficiency and Waste Minimization

Resource efficiency and waste minimization are reflected in strategies such as the use of renewable energy and smart technology to optimize raw material consumption. For example, in the agricultural sector, organic waste is processed into biogas to produce energy.

3.6. Operational Strategies That Support These Principles

Operational strategies found in the literature show how companies apply circular economy principles specifically in their business practices:

1. Product and Process Design
    - Example: Technology companies like Dell design modular products that make repair and recycling easy.
    - Impact: Reduces electronic waste while providing added value to products.
2. Supply Chain Management
    - Example: The textile industry uses a green supply chain with suppliers that use recycled materials.
    - Impact: Reduces carbon emissions and logistics costs.
3. Utilization of Technology
    - Example: Use of IoT (Internet of Things) in monitoring resource consumption in production facilities.
    - Impact: Increase operational efficiency by reducing energy and material use.
4. Partnership and Collaboration
    - Example: The construction industry collaborates with recycling companies to utilize waste building materials.
    - Impact: Increasing resource efficiency in the construction sector.

These findings provide an overview of how circular economy principles can be implemented through specific and effective operational strategies in various industrial sectors. The results of this research provide relevant insights for companies looking to integrate circular economy practices into their business models.

4. DISCUSSIONS

4.1 Interpretation of Results

The research results show that circular economy principles such as Reduce, Reuse, Recycle, Closed-loop Production Systems, Prolonging Product Life Cycle, And Resource Efficiency and Waste Minimization have been significantly integrated into the company's operational strategy.

4.2. Integrating Principles in Operational Strategy

The integration of principles such as Reduce, Reuse, Recycle (3Rs), closed-loop production systems, prolonging product life cycles, and resource efficiency into operational strategies is essential for fostering sustainability across various industries. These principles not only enhance environmental performance but also contribute to economic viability by optimizing resource utilization and minimizing waste.

The principle of Reduce, Reuse, Recycle is particularly evident in the electronics industry, where strategies are implemented to collect obsolete devices for recycling. This approach not only reduces waste but also creates added value by recovering valuable materials, thereby decreasing reliance on virgin resources. Sharma emphasizes that effective resource management hinges on maximizing resource utilization through waste reduction strategies and the adoption of circular economy principles, which aim to maintain the value of resources within the economic system for as long as possible (Sharma, 2023). This aligns with Kirchherr et al.'s definition of the circular economy, which focuses on reducing waste generation and promoting the reuse and recycling of materials in production processes (Aznar-Sánchez et al., 2020).

Closed-loop production systems further exemplify the integration of sustainability principles into operational strategies. These systems utilize waste as an input for new production cycles, effectively transforming by-products into valuable resources. For instance, Gontard et al. discuss the management of agricultural waste within a circular bio-based economy, highlighting the potential for recycling technologies to convert waste into valuable resources (Gontard et al., 2018). Jiang's research on closed-loop supply chains underscores the importance of remanufacturing and recycling in maintaining product value and reducing environmental impact (Jiang, 2012). This approach is critical for industries aiming to minimize waste while maximizing resource efficiency.

Prolonging the product life cycle is another vital strategy, particularly in the textile industry. Companies are increasingly adopting modular designs and high-quality materials to enhance the durability of clothing, thereby reducing the frequency of disposal and the demand for new resources. This practice is supported by findings from Elvanidi et al., who assert that maintaining resources in use for as long as possible is a fundamental aspect of the circular economy (Elvanidi et al., 2020). Additionally, Bandara highlights the significance of reusing waste and optimizing resource use as key components of circular economic practices in agriculture (Airport, 2023).

In the agricultural sector, resource efficiency and waste minimization are achieved through innovative practices such as composting organic waste and converting it into biogas. This not only reduces environmental impact but also enhances soil health and energy production. Nattassha et al. illustrate how the circular economy is applied in agri-food sectors, where waste from one process is repurposed as a resource for another, thus fostering sustainability (Nattassha et al., 2020). Furthermore, Wang et al. emphasize the optimization of agricultural waste recycling networks as a means to convert waste into green energy, highlighting the dual benefits of environmental sustainability and economic efficiency (Wang et al., 2022).

In conclusion, integrating these sustainability principles into operational strategies is crucial for promoting a circular economy. By reducing waste, reusing materials, and recycling resources, industries can enhance their environmental performance while simultaneously achieving economic benefits. The evidence presented underscores the importance of adopting these principles across various sectors, including electronics, textiles, and agriculture, to foster a more sustainable future.

4.3. Relevance of Results to Global Challenges and Sustainability

Integrating circular economy principles into operational strategies is essential for addressing pressing global challenges such as climate change, resource scarcity, and waste management. The circular economy emphasizes the reduction of waste and the efficient use of resources, which can significantly mitigate climate change by lowering carbon emissions. For instance, Romero-Hernández and Romero highlight that adopting circular economy practices can lead to substantial waste reduction, with potential savings of $1 trillion for companies in the U.S. alone by 2025, thereby contributing to decreased carbon footprints

(Romero-Hernández & Romero, 2018). Furthermore, the transition to a circular economy not only minimizes waste but also promotes the recycling of materials, which is crucial in combating climate change (Banda et al., 2023).

Resource scarcity is another critical issue that can be effectively addressed through circular economy strategies. By reusing materials and extending their lifecycle, the circular economy reduces the demand for new resources, thereby lessening environmental exploitation. Хоменко et al. discuss how the circular economy model encourages innovative resource management systems that can alleviate the pressures of resource scarcity (Khomenko et al., 2021). Additionally, Siregar emphasizes that the recycling of plastic waste into new products exemplifies how circular economy principles can foster sustainable economic growth while conserving resources (Siregar, 2023). This approach not only conserves existing materials but also promotes a more sustainable economic framework that is less reliant on virgin resources.

Waste management is fundamentally transformed by the principles of the circular economy, which advocate for reducing the volume of waste that ends up in landfills. The circular economy creates new business opportunities by turning waste into valuable resources. For example, Duarte et al. emphasize the importance of adopting circular economy strategies to minimize food waste, which is a significant component of municipal solid waste (Duarte et al., 2021). Moreover, Banda et al. assert that implementing circular economy practices can serve as an antidote to the challenges posed by municipal solid waste, particularly in developing countries like Zambia (Banda et al., 2023). The integration of these principles not only improves waste management systems but also fosters economic resilience by creating new markets for recycled materials and waste-derived products. In summary, the integration of circular economy principles into operational strategies is vital for addressing global challenges such as climate change, resource scarcity, and waste management. By minimizing waste, reusing materials, and creating new business opportunities, the circular economy presents a sustainable pathway for economic growth and environmental stewardship.

4.4. Comparison with Previous Research

4.4.1. Contributions to the Literature

This research expands the circular economy literature by providing a more systematic map of the main principles adopted by companies. As an example:

- Previous Research: The primary focus is often on the environmental benefits of a circular economy without discussing in depth how these principles translate into operational strategy.
- Current Research: Provide concrete implementation guidance by identifying direct links between circular economy principles and operational strategies in various sectors.

4.4.2. Discussion Regarding Research Gaps

While much previous research has focused on the long-term benefits of a circular economy, there is a paucity in the literature regarding the practical challenges and barriers to implementing these principles. This research contributes by providing insight into how these principles can be effectively integrated, while identifying areas for further research, such as the exploration of barriers to adoption in different cultural contexts.

4.5. Practical Implications

These findings provide several important recommendations for companies:

1. Increased Operational Efficiency

   Companies can adopt the principles Reduce, Reuse, Recycle through investment in technology that enables better recycling and waste management.

2. Sustainable Supply Chain Development
   Collaborate with partners in the supply chain to ensure that recycled and environmentally friendly materials can be accessed easily and economically.
3. Training and Education
   Provide training to employees on the importance of the circular economy and sustainable practices relevant to daily operations.
4. Product and Process Innovation
   Focus on product redesign to make repair, disassembly and recycling easier.

4.6. Research Limitations

4.6.1. Limitations of Available Data or Articles

This research was limited to articles published in the last 10 years in English. This can exclude perspectives from older research or from local contexts that use other languages.

4.6.2. Limitations of Generalization of Research Results

Although this research covers a wide range of industry sectors, generalization of the results to specific sectors may require more in-depth study. For example, the implementation of circular economy principles in the textile industry may not be completely relevant for the high-tech sector.

By understanding these limitations, further research could focus on testing the findings in specific sectors, or use methods involving direct interviews with practitioners to enrich the insights gained.

5. CONCLUSIONS

5.1 Main Findings

This research identifies four main principles of the circular economy that are most often integrated into company operational strategies, namely:

1. Reduce, Reuse, Recycle: Used to minimize waste and reuse resources.
2. Closed-loop Production Systems: Ensure that waste from the production process can be reprocessed into raw materials.
3. Prolonging Product Life Cycle: Focus on increasing product lifespan through innovative design and optimal maintenance.
4. Resource Efficiency and Waste Minimization: Maximize resource efficiency and minimize environmental impact.

These results show that the integration of these principles helps companies not only in meeting sustainability goals, but also in improving operational efficiency and competitiveness in the global market.

5.2 Research Contribution

5.2.1. Against Literature

This research makes a significant contribution by mapping circular economy principles applied in operational strategies. This research fills the gap in previous literature which tends to focus on the abstract concept of a circular economy without providing concrete implementation guidance.

5.2.2. Against Operational Practices

This research offers practical insights for companies looking to adopt circular economy principles. By understanding the main principles and examples of their implementation, companies can design relevant strategies to increase efficiency and sustainability. Additionally, this research also highlights how these principles can be applied across various industrial sectors, providing flexibility for companies to adapt strategies to suit their operational needs.

5.3 Recommendations for Future Research

To strengthen the findings and expand understanding, some recommendations for future research are:

1. Empirical Study
   Further research can be carried out by examining the direct impact of integrating circular economy principles on operational performance, such as cost efficiency, productivity or environmental sustainability.
2. Contextual Approach
   More in-depth studies could focus on specific sectors, such as technology, agriculture, or manufacturing, to identify the unique challenges faced in implementing these principles.
3. Regional Approach
   Explore differences in the application of circular economy principles in various countries or regions, especially in developing countries which have different dynamics compared to developed countries.
4. Longitudinal Research
   Conduct long-term research to understand the ongoing impact of these principles on corporate performance and the environment.

It is hoped that these recommendations will enrich the literature and provide more practical guidance for companies and policymakers in supporting wider adoption of the circular economy.

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