# IDENTIFICATION OF RISKS IN CIRCULAR ECONOMY PRACTICES: A SYSTEMATIC REVIEW OF ACADEMIC STUDIES

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## Abstract

The circular economy (CE) is gaining significant attention as a sustainable alternative to the traditional linear model of production and consumption. This study explores the complexities of implementing CE practices across diverse industries, focusing on the political, economic, social, technological, and environmental (PESTE) risks involved (Tsytsyna, 2019). By analyzing literature and case studies from companies such as Lucozade, McDonald's, Volkswagen (Vollero, 2022), and H&M, the research identifies key barriers such as inconsistent regulatory frameworks, high initial costs, greenwashing practices, and technological challenges. These issues often hinder the seamless integration of CE principles into business operations. The paper argues that a comprehensive risk management framework is essential for overcoming these obstacles, promoting transparency, and enhancing stakeholder collaboration. Moreover, the study provides insights into how businesses can align their strategies with CE principles, thus contributing to a more sustainable and resilient economic model. Practical recommendations are offered to policymakers and industry leaders to foster innovation, encourage compliance, and facilitate the widespread adoption of CE practices, ultimately aiming for a balanced and sustainable development that benefits both the economy and the environment.

**Keywords:** Circular Economy, Risks, Political Risk, Economic Risk, Technological Risk, Social Risk, Environmental Risk, Greenwashing

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## 1. INTRODUCTION

The circular economy (CE) is gaining traction among academics, professionals, decision-makers, and businesses as a way to replace the take-make-dispose linear model of production and consumption and promote more sustainable development (Mora-Contreras et al., 2023; Prendi & Gashi, 2023; Prendi & Murrja, 2023).

Both researchers and practitioners are very interested in the CE concept since it is considered an operationalization for businesses to apply the much-discussed idea of sustainable development (Kirchherr et al., 2017).

Some academics emphasize the significance of researching the relationships between different business environmental policies and organizational performance (ORM), social performance (SOP), economic performance (ECO), and environmental performance (ENP). The CE helps to harmonize all of the factors because of its fundamental reasoning, which is primarily environmental and political, as well as economic and business (Mora-Contreras et al., 2023; Birat, 2015; Ellen MacArthur Foundation, 2013).

This research aims to present an analysis of the CE, with a specific emphasis on the barriers and risks related to its adoption in the areas of the political, economic, social, technological, and

environmental (PESTE). While addressing the uneven implementation across different countries, the study intends to enhance our understanding of CE's global adoption and its creative approach to sustainable development. The goal of the study is to highlight ways to improve environmental standards compliance, transparency, and policy support for the efficient application of CE principles by classifying and identifying the main obstacles to CE.

The objective of this paper is to investigate and assess the potential hazards linked to the implementation of CE practices across different industries. Through an extensive review of existing literature and analysis of case studies, the paper seeks to classify and pinpoint these risks using the PESTE framework. The primary goal of this study is to establish a comprehensive framework for effectively managing these risks and to offer valuable insights that can help facilitate the successful integration of CE principles.

These objectives have been crafted to enhance comprehension of the complexities of the CE and provide practical perspectives for companies, governments, and other stakeholders involved in the shift towards a more sustainable economic model.

- Identify and classify risks: The goal is to pinpoint the different risks linked to the implementation of CE practices and classify them using the PESTE framework.
- Examine case studies: The aim is to scrutinize specific instances of companies integrating CE practices, such as Lucozade, McDonald's, Volkswagen, and H&M, in order to comprehend the practical challenges and outcomes.
- Comprehend barriers: The objective is to explore the primary obstacles hindering the full implementation of the CE, encompassing financial, regulatory, technological, and social barriers.
- Assess greenwashing impact: The plan is to assess the influence of greenwashing on consumer behavior and the overall effectiveness of environmental policies and to recommend strategies to mitigate its effects.
- Offer policy suggestions: The purpose is to propose policies and supportive measures that can reduce regulatory obstacles, promote technological innovation, and encourage the adoption of CE practices.
- Promote inclusivity and fairness: The focus is on ensuring that CE activities are inclusive and fair, benefiting all social groups and preventing the worsening of socioeconomic disparities.
- Strengthen risk management: The aim is to create a framework for effective risk management within the CE context, ensuring that potential disruptions are identified, evaluated, addressed, and monitored.

The paper's general structure is as follows. Section 2 provides a review of relevant literature on CE implementation, focusing on identifying barriers and risks classified by the PESTE framework. Section 3 outlines the research methodology and tools used, explaining both systematic and narrative review approaches and the data collection process. Section 4 analyzes the findings, using case studies of Lucozade, McDonald's, Volkswagen, and H&M to showcase practical challenges and outcomes. Section 5 summarizes the results, discussing identified risks, obstacles to CE implementation, the impact of greenwashing, and offering recommendations for businesses and policymakers; discusses the research limitations, acknowledging constraints related to the early stage of CE application, reliance on literature, and the rapidly changing regulatory environment.

## 2. LITERATURE REVIEW

This section summarizes the literature on CE efforts, highlighting the need for further research and framework development due to growing interest since 2015 (Mehmood et al., 2021). Risk is generally defined as "a probability or threat of damage, injury, loss, or another negative occurrence due to vulnerabilities, which can be mitigated by preemptive action" (Insure Your Company, n.d., para. 1). Fan and Stevenson (2018) describe risk as involving the identification, assessment, treatment, and monitoring of potential supply chain disruptions. Jorion (2006) explains it as the probability of financial loss due to market fluctuations.

Managing risk is essential for an organization's stability and sustainable development, impacting social, economic, and environmental aspects (AlMashaqbeh & Munive-Hernandez, 2023). In CE, risks are challenges from adverse ecosystem activities that can be managed with appropriate strategies (Tsytsyna, 2019). This paper utilizes the PESTE framework to assess risks from PESTE perspectives. The PESTE framework allows a comprehensive analysis of CE risks (Tsytsyna, 2019).

Other frameworks mentioned include strengths, weaknesses, opportunities, and threats (SWOT) analysis (internal and external factors influencing an organization) (Gürel & Tat, 2017), Porter's five forces (industry competition and trade factors) (Harvard Business School [HBS], n.d.), and value, rarity, imitability, organization (VRIO) (assessing organizational resources and capabilities for competitive advantage) (Murcia et al., 2022).

### 2.1. Political risks

Political risks in adopting a CE are complex and include inconsistent legislation, unclear legal frameworks, and a lack of complementary policies, which create uncertainty and hinder investment (Velenturf et al., 2019). Political instability can disrupt long-term CE programs due to changing policies (Kirchherr et al., 2017). Insufficient government support, including inadequate incentives and training, also poses significant barriers, especially for small and medium enterprises (SMEs) (Constantinos et al., 2010; Rizos et al., 2015). Weak enforcement of environmental regulations can lead to widespread noncompliance, undermining policy effectiveness (Prendeville et al., 2018). Additionally, lobbying by traditional industries often weakens CE legislation, delaying meaningful progress (Bocken et al., 2016). Lastly, variations in recovery regulations and quality standards across countries further complicate CE adoption (Tuni et al., 2023; Choudhary & Kumar, 2021).

### 2.2. Economic risks

Economic risks are crucial to investigate as they could undermine the entire ecosystem's viability if the CE is not economically sustainable. Financial difficulties may arise within organizations or from win-win collaborations, making symbiotic activities

unsustainable if not properly financed (Aid et al., 2017). Fluctuations in market demand can also create risks related to supply imbalances, affecting the stability of circular enterprises. Additionally, the initial investment needed for circular systems and technologies is substantial and not always economically viable due to the sector's developing nature (AlMashaqbeh & Munive-Hernandez, 2023). Moreover, total costs may be underestimated and become too high (Masi et al., 2017). Genovese et al. (2017) found that while circular supply networks can reduce costs, they also introduce new financial risks such as dependence on suppliers and complex logistics. Kirchherr et al. (2017) noted that funding CE projects is difficult due to perceived risks and uncertainties around returns on investment. Rizos et al. (2021) highlighted that nearly 19% of businesses see competition with linear models as a barrier, primarily due to higher costs associated with circular techniques.

## 2.3. Social risks

Social risks in a CE ecosystem include impacts on local communities and internal company dynamics. Trust among ecosystem actors is critical; mistrust over shared goals or unequal returns can harm collaboration (Aid et al., 2017). Remanufacturing companies often face skepticism about the quality of refurbished products, while leasing models are hindered by a preference for ownership (Rizos et al., 2021). Marginalized groups may not benefit equally from CE initiatives, which could deepen inequalities. Schroeder et al. (2019) emphasize the importance of inclusivity in CE projects to avoid exacerbating socioeconomic disparities.

Trust and cooperation among businesses, governments, and non-governmental organizations (NGOs) are essential for success. A lack of trust can impede collaboration, as shown by Govindan and Hasanagic (2018). Effective communication within organizations is also key to adopting circular practices. Lieder and Rashid (2016) stress the need for open communication, continuous learning, and alignment of corporate goals with CE principles.

## 2.4. Technological risks

Technological risks in the CE stem from the novelty of products and the lack of expertise in handling waste streams. Bilitewski (2012) warned of potential threats to consumer safety, with new harmful items possibly entering the market. Developing and implementing circular technologies involves high research and development (R&D) costs, uncertainty about technological viability, and challenges in integrating innovations into existing systems (AlMashaqbeh & Munive-Hernandez, 2023). Bocken et al. (2016) highlighted the difficulties in developing circular products, while uncertainty around new technologies may hinder adoption. Consumer reluctance due to concerns over performance, quality, and safety is another challenge. Understanding consumer behavior and using effective marketing and education strategies are key to overcoming these barriers (Linder & Williander, 2017).

## 2.5. Environmental risks

Environmental risk in the CE involves potential negative impacts from its implementation, requiring new tools for accurate assessment and proactive sustainability measures (AlMashaqbeh & Munive-Hernandez, 2023). While the CE aims to break the link between economic growth and environmental harm, practices like recycling and remanufacturing may have unintended effects, such as emissions and energy use (Zink & Geyer, 2017). Additionally, improper handling of secondary raw materials, such as electronic waste, can release harmful substances, emphasizing the need for strict regulations (Cucchiella et al., 2015).

## 2.6. Research questions

Based on the literature review we develop our research answer the following research questions:

*RQ1: How is the circular economy implemented in different companies?*

*RQ2: What are the main obstacles limiting the complete implementation of the circular economy?*

*RQ3: What are the risks associated with the circular economy?*

*RQ4: How does greenwashing impact consumer behavior and the overall effectiveness of environmental policies, and what strategies can be developed to mitigate its effects on sustainable consumer practices?*

*RQ5: How do case studies of major companies like Lucozade, McDonald's, Volkswagen, and H&M illustrate the practical challenges and outcomes of implementing circular economy practices, and what can be learned about overcoming the political, economic, social, technological, and environmental barriers to effective circular economy adoption?*

# 3. RESEARCH METHODOLOGY

The purpose of this research is to examine the types of risks that firms face as a result of implementing CE in manufacturing. The study employs a two-pronged literature review approach, utilizing both systematic and narrative methodologies to provide a comprehensive analysis of the existing body of knowledge on the subject.

Systematic review: a systematic review is a thorough examination of the corpus of previous research using predefined search criteria (Lieder & Rashid, 2016). This method typically involves searching multiple databases, with papers being analyzed and selected based on how effectively they address the research question. The systematic review in this study was chosen to establish a broad understanding of the current knowledge landscape regarding CE practices and their associated risks. By meticulously identifying, classifying, and synthesizing the vast array of existing research, the study ensures that it is grounded in a thorough analysis of existing data.

Narrative review: a narrative review employs a less formal approach to summarizing the body of literature. Less focus is placed on the rigorous search and selection of studies, and more emphasis is placed on providing a comprehensive overview of the existing research on the issue (Grant & Booth, 2009). This approach complements the systematic review by allowing for the inclusion of broader perspectives and interpretations that might not be captured in a strictly systematic approach.

To achieve a comprehensive understanding of the subject, the authors first retrieved a large number of relevant scholarly papers in English

from 2000 to 2023. Articles were sourced from various databases, including Scopus, which contains the most relevant and high-impact papers, and Web of Science, which includes a wider collection of indexed publications with high-impact conference proceedings (Gough et al., 2017). This combination of databases provides a complete picture of scientific progress in the sector.

A total of 150 articles were collected and reviewed for duplication, resulting in a preliminary list of 92 works. Following suggestions by Prendi et al. (2023), the authors meticulously screened abstracts and titles to refine their initial selection. This manual screening ensured that only publications directly relevant to the main topic — risks associated with the implementation of the CE in companies across different sectors — were included. The compliance check consisted of four sequential closed-ended questions:

1) Is the publication about the CE?

2) Is the role of the risk of the CE significant in the publication?

3) Is the publication about economic, political, technological, and environmental risks?

4) Is the publication about the types of risks?

Publications that did not meet these criteria were excluded, resulting in a final selection of 60 publications.

After content compliance, a quantitative assessment of the final selection's metadata was conducted. This included examining the number of publications, type (journal or conference paper), year of publication, total citations, the affiliation nation of the first author, and keywords. The analysis aimed to identify overarching trends in the last 20 years of publications concerning businesses implementing the CE.

Following this broad analysis, the authors shifted their focus to individual case studies, which allowed for an in-depth examination of specific instances of CE implementation. This shift from a broad to a narrow focus enabled the application of theoretical insights gained from the literature review to real-world examples, illustrating the practical challenges and nuances that could not be captured through a literature review alone. This methodological progression from general to specific strengthens the study's conclusions by validating the theoretical findings and offering practical insights into the application of CE principles in various contexts.

The study also references official European Central Bank reports, as well as books and articles authored by journalists, economists, and academics, to ensure a comprehensive perspective. Given that the risk of implementing a CE is a relatively new area of study, the research could also benefit from additional methodologies such as scoping reviews and meta-analyses, which offer broader and statistically grounded insights (Grant & Booth, 2009).

Finally, for evaluating the risks of implementing the CE in manufacturing there are potential alternatives such as scoping reviews, meta-analyses, and Delphi. Scoping reviews would aid in mapping the current research and identifying gaps, whilst meta-analyses might statistically synthesize data from quantitative studies to give more detailed insights into the effect of various risks. Furthermore, a Delphi study including experts from academia, business, and policy might lead to agreement on important risks and mitigation solutions. These methodologies would provide a more thorough and nuanced knowledge of the obstacles to implementing CE principles.

## 4. RESEARCH RESULTS

This section focuses on an extensive review of actual literature and case studies that shed light on the problems and real-world implementations of the CE in diverse industrial contexts. Through the examination of particular cases, including popular companies like Lucozade, McDonald's, and Volkswagen, this analysis seeks to close the gap between theoretical CE concepts and their observable effects in the industry. Every case study has been carefully selected based on how well it addresses the important risks — PESTE (that have been mentioned in previous discussions).

### 4.1. Insights gained from the literature review

The themes and conclusions of the 60 papers in the set revolve around identifying, analyzing, and proposing solutions for various risks associated with implementing CE practices across different sectors. These risks are categorized using the PESTE framework. Below is an integrated overview of the key themes and how "risk" fits into the picture according to the categories and conclusions.

*Political risks.* Many papers emphasize that governmental decisions and policies can either facilitate or hinder the development and implementation of CE practices. A lack of supportive policies and coherent legal frameworks often leads to regulatory barriers, creating uncertainty for businesses. Weak enforcement results in noncompliance, and industry lobbyists can dilute legislation, hampering the transition to a CE. Varying recycling policies across countries further complicates efforts, making consistent regulatory frameworks essential for fostering a supportive environment for CE initiatives.

Inconsistent legislation and policy inconsistencies across regions create significant barriers to investment and innovation in CE practices. Political instability and lack of government support are recurrent themes, as these factors create uncertainty that undermines long-term planning and investment in sustainable practices.

*Economic risks.* The economic feasibility of CE practices is a recurring concern, especially the challenges related to securing adequate funding and financial incentives. High costs of sustainable materials, initial investments in new systems, and fluctuating market demand are prominent issues. Market dynamics and restrictive conditions can lead to financial instability, making symbiotic activities unsustainable and reducing the attractiveness of circular business models.

Competition with linear business models and products poses a significant barrier to the adoption of CE practices. Restrictive market circumstances, perceived risks, and uncertain returns on investment necessitate supportive policies and financial tools to encourage circular ventures. Organizations may invest in new resource management services but find themselves excluded from financial returns, undermining their long-term sustainability and competitiveness.

*Social risks.* Low levels of consumer awareness and acceptance of recycled products pose risks to the adoption and success of CE initiatives. There is often a preference for new or cheaper products over circular alternatives, and skepticism about product quality and safety can hinder market demand.

Marginalized groups may not benefit equally from CE initiatives, necessitating inclusive policies to ensure that CE practices are socially beneficial. Social risks also include internal organizational challenges such as mistrust, lack of communication, and resistance to change, which can impede the successful implementation of CE practices.

*Technological risks.* Numerous papers highlight the difficulties in incorporating novel solutions into existing systems. High development costs and a lack of expertise in handling waste materials are significant challenges. The uncertainty surrounding the viability of new technologies, coupled with the need for advanced technologies and infrastructure, creates barriers to efficient resource management and recycling.

Insufficient technology and infrastructure for implementing CE methods are common issues. Challenges in adopting and integrating sustainable technologies into existing supply chains are also prevalent, and effective marketing and consumer education are essential for building trust in circular products.

*Environmental risks.* The risk of greenwashing — where companies make misleading claims about the environmental benefits of their products — is a key concern. Unintended environmental impacts from CE practices, such as increased emissions from recycling processes, can undermine sustainability goals. It is crucial to ensure that circular practices do not inadvertently harm the environment.

Ineffective waste management practices and the potential environmental impacts of improper recycling are major themes. The extraction and processing of secondary raw materials can release toxic compounds if not properly managed. Strict regulations and new evaluation tools are necessary to align circular practices with sustainability goals and avoid unintended negative consequences.

Table 1 offers several strengths when presenting information on CE risks. Firstly, it provides a clear and structured overview of various risk types, such as PESTE, allowing for a comprehensive view of the subject matter. The table serves as a quick reference tool, enabling readers to identify specific risks and their corresponding authors with ease, thus showcasing the breadth of literature covered. Moreover, it facilitates comparative analysis by presenting different risks side-by-side, allowing readers to draw parallels and contrasts across multiple categories effectively.

However, the table format also has limitations. One notable drawback is its limited depth, as it often only provides a summary without detailed explanations. For complex topics like CE risks, additional context or examples are necessary to fully convey the nuances and implications of each risk. Additionally, if the table is too crowded or extends across multiple pages, it can become visually overwhelming and difficult to read, reducing its effectiveness. A table packed with dense and technical information can also overwhelm readers, making it challenging to extract key insights and understand the broader context (see Appendix).

## 4.2. PESTE "case studies"

Using case studies in this paper provides real-world examples that illustrate the complexities and practical implications of CE risks, enhancing the theoretical discussion with concrete, relatable evidence.

### *4.2.1. Case study 1*

The recyclable plastic bottles from Lucozade required a redesign because their label confused waste sorting machinery. This emphasizes how crucial it is to make sure products are made with their end-of-life processing in mind, as this is now a pressing need rather than just a "nice to have" (Morris, 2018). A major risk is insufficient design for products that are nearing the end of their life, which can harm a company's reputation.

The case of Lucozade's recyclable plastic bottles is a concrete example of how design for end-of-life processing is critical in a CE. Products that are not made with recycling in mind might not work with the current waste sorting and recycling systems, which would force otherwise recyclable goods into landfills.

The situation of Lucozade's recyclable bottles and the issue with their labels confusing waste sorting machinery, several areas of risk are affected, each in distinct ways. Encouraging recyclable bottles is mostly done for environmental reasons. However, these bottles serve no use if they are missorted and dumped in landfills rather than recycled; this increases resource waste and pollution to the environment.

Sales may decline as a result of consumers losing faith in the brand's sustainability claims, which would have an impact on Lucozade's bottom line.

Better technological solutions are needed for waste management systems if the technology is unable to identify and appropriately sort recyclable bottles because of the label design.

Customer loyalty and brand credibility may be lost if the public believes that Lucozade is dishonest or ineffectual in its efforts to be sustainable.

Out of these, the environmental and economic risks are typically the most affected. The aim of sustainability initiatives is directly at odds with the environmental impact, and there can be serious financial repercussions from missing environmental targets, which can have an influence on both short-term expenses and long-term brand value.

### *4.2.2. Case study 2*

Paper straws that McDonald's introduced in 2019 turned out not to be recyclable. This was a prime example of a corporate behemoth feigning to solve a problem, in this case, plastic pollution, without actually taking any action, aside from the dubious practice of felling trees to make throwaway straws (https://thesustainableagency.com/blog/greenwashing-examples/).

McDonald's paper straws are an example of "greenwashing", in which firms promote themselves as ecologically friendly while making minimal efforts toward sustainability. In this example, the conversion from plastic to paper straws was meant to minimize plastic waste, but problems arose when the paper straws were not recyclable, raising concerns about the true environmental impact of the change.

This example brings to light a larger problem related to the idea of a CE, which tries to do away with waste and endless resource use. Three guiding concepts underpin this strategy: eliminating waste and pollution via design, preserving materials and goods through use, and regenerating natural systems.

In this context, greenwashing can impact various sectors differently, and the degree to which

each sector is affected depends on several factors, such as loss of public trust in regulatory frameworks or political leaders who endorsed such initiatives. For the company, the immediate risk is a potential loss of consumer trust, leading to a decline in sales and possibly stock value. If the public perception shifts negatively, leading to boycotts and a damaged reputation that can take years to recover from. The tangible outcome of greenwashing — in this case, non-recyclable waste contributing to pollution — has a direct and lasting impact on the environment.

Since environmental risk directly affects ecosystems and public health in measurable ways, it might be considered the most affected risk. The other risks are more indirect and can change in magnitude based on how the people and government respond. However, because environmental risks can result in irreversible damage, they usually pose the greatest long-term risk.

### *4.2.3. Case study 3*

Volkswagen fell under considerable scrutiny for manipulating emissions testing results to make their cars seem greener than they actually were. One of the best examples of purposeful disinformation in corporate sustainability communication is this case (Vollero, 2022).

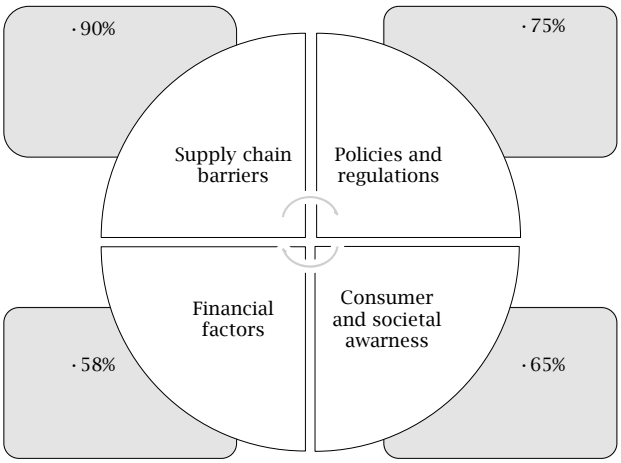
It was discovered that software installed in diesel-powered vehicles by Volkswagen, one of the biggest automakers in the world, could identify when the vehicles were being tested for pollutants. The program would turn on the vehicles' whole emissions control systems during these tests in order to comply with regulations. Nevertheless, the software would disable some of these protections once the cars were on the road and operating normally, causing them to spew up to 40 times the amount of nitrogen oxides that were permitted by United States environmental regulations.

These cars' actual emissions were much higher than what was stated, which led to pollution and other negative effects on the environment, especially on-air quality.

### *4.2.4. Case study 4*

Within the CIR4Life European Union (EU)-funded project, was conducted a study on 41 companies, of which 31 operate in the electrical and electronic e-equipment (EEE) sector and 10 in the agri-food sector. Regarding the representativeness in the sample of different circular processes, 15 companies were involved in collection or sorting activities, 14 in refurbishment or remanufacturing, 12 in circular design and production, 11 in reuse, eight in repair, seven in product-as-service or leasing models and six in recycling. Supply chain barriers were experienced by an overwhelming majority (90%) of the companies interviewed. Closely following were policies and regulations, which more than 75% of the companies found to engender some form of challenge to their circular activities. More than half of the companies also mentioned consumer and societal awareness (65%) and finance or economic factors (58%) as barriers. The least mentioned barrier categories were technology and company organization, followed by other factors (Rizos et al., 2021).

**Figure 1**. Circular economy barriers in companies




*Source: Authors' elaboration.*

Supply chains and politics appear to be the most affected, given their high mention rates respectively, 90% of companies experiencing significant barriers in supply chain and political and regulatory challenges were significant, with over 75% of companies citing policies and regulations as barriers. Challenges in supply chains can include logistics, the availability of suitable and sustainable materials, and coordination among various stakeholders. Challenges in politics and regulations could be due to inadequate, inconsistent, or overly stringent regulations that do not align well with current business practices or technological capabilities, making compliance difficult and costly.

### *4.2.5. Case study 5*

In 2022, H&M faced allegations of greenwashing over its conscious choice line, misrepresenting the environmental benefits of its products through the high sustainability profile. For example, a product labeled as using 20% less water actually used 20% more, which H&M blamed on a technical error (Shendruk, 2022). This incident eroded consumer confidence in sustainability claims, fueling skepticism toward companies' environmental commitments (Kaner, 2021). The case primarily impacted environmental

and social risks, damaging H&M's credibility, while also triggering potential long-term political and economic risks due to regulatory scrutiny and loss of consumer trust.

In the table below there is a summary of the risks that are affected during the study of the above case studies according to the PESTE framework.

**Table 1**. Analysis of risks according to the PESTE framework

| *Case study* | *Political risks* | *Economic risks* | *Social risks* | *Technological risks* | *Environmental risks* |
|---|---|---|---|---|---|
| 1. Lucozade recyclable plastic bottles | Potential regulatory changes to waste sorting and recycling requirements | Loss of consumer trust leads to decreased sales and profitability | Negative public perception and loss of consumer confidence in the brand's sustainability efforts | Need for advanced sorting technology to handle complex packaging materials | Increased landfill waste due to improper sorting, contradicting environmental sustainability claims |
| 2. McDonald's non-recyclable paper straws (greenwashing) | Risk of stricter regulations on environmental claims and greenwashing | Financial penalties or loss of market share due to perceived dishonesty in sustainability claims | Erosion of public trust and brand reputation, leading to consumer skepticism | Technological limitations in recycling infrastructure to handle new materials | Continued environmental degradation due to non-recyclable waste, undermining sustainability goals |
| 3. Volkswagen Dieselgate | Legal consequences and regulatory fines due to emissions cheating | Significant financial losses from fines, lawsuits, and decreased sales | Loss of public trust and damage to corporate reputation, with long-term impacts on brand loyalty | Need for technological innovation to ensure compliance with environmental standards | Increased air pollution and environmental damage due to higher-than-reported emissions |
| 4. CIR4Life EU-funded project on circular processes | Challenges in aligning national policies with EU CE goals | Economic barriers related to financing circular initiatives and managing supply chain logistics | Varying levels of societal awareness and acceptance of CE practices | Need for technological advancements in recycling, remanufacturing, and circular design processes | Potential environmental benefits if circular processes are successfully implemented, but risks if barriers prevent effective adoption |
| 5. H&M conscious choice line (greenwashing) | Risk of increased scrutiny and regulation on environmental claims and marketing | Financial impacts due to loss of consumer trust and potential legal actions for misleading claims | The decline in consumer confidence and trust in sustainability claims affects brand loyalty | Technological issues related to accurate environmental impact measurement and reporting | Misrepresentation of environmental impact undermines genuine sustainability efforts and contributes to continued ecological harm |

## 5. CONCLUSION

This study has explored the complexities and risks associated with the implementation of CE practices across various industries, utilizing the PESTE framework to assess PESTE risks. The findings indicate that while CE offers significant potential for promoting sustainable development, the path to its full adoption is fraught with challenges.

Inconsistent legislation, unclear regulatory frameworks, and lack of government support have emerged as significant barriers to CE adoption. These factors lead to uncertainty and hinder investments, especially in industries that are heavily regulated or reliant on international trade. The high initial costs of adopting CE practices, coupled with fluctuating market demand and competition from linear business models, create financial risks. Without substantial government incentives or private-sector investment, many circular initiatives may struggle to be economically viable, especially in developing regions. Trust issues between stakeholders within the CE ecosystem, consumer skepticism towards recycled or refurbished products, and social inclusivity challenges are common. The unequal distribution of benefits from CE projects, particularly among marginalized groups, remains a concern that needs to be addressed. The development and deployment of cutting-edge technologies required for circular processes face challenges such as high R&D costs, technical uncertainty, and difficulties in integrating new systems into existing infrastructure. Additionally, consumer acceptance of these technologies is often slow due to concerns over quality and safety. While the CE aims to reduce waste and improve resource efficiency, there are risks of unintended environmental consequences, such as emissions from recycling processes or improper handling of secondary raw materials. Greenwashing practices further complicate environmental efforts, undermining genuine sustainability initiatives.

The study emphasizes the need for a comprehensive risk management framework to mitigate these challenges. Effective policies that harmonize regulations across regions, financial tools to incentivize CE projects, and technological innovation that ensures safe and sustainable practices are all critical for advancing CE. Furthermore, fostering trust and transparency among all stakeholders is essential to ensuring collaboration and the widespread adoption of circular practices. Companies must also address greenwashing, ensuring that their sustainability claims are genuine to maintain consumer trust.

This research has certain limitations that should be acknowledged. First, it relies heavily on literature and case studies, without direct empirical data collection from companies actively implementing CE practices. The findings are based on secondary data, and there is a lack of real-time external viewpoints. Additionally, the study focuses mainly on developed economies, which may limit the applicability of the conclusions to emerging markets, where economic, regulatory, and social conditions differ significantly.

Future research should gather empirical data through interviews and surveys across industries to better understand the practical challenges of implementing CE practices. A mixed-methods

approach combining qualitative and quantitative data will offer a comprehensive view of CE obstacles and successes. Additionally, studying the effects of greenwashing on consumer behavior and developing advanced tools to assess environmental risks will enhance CE progress.

In conclusion, while the CE offers solutions to environmental and economic challenges, addressing PESTE risks is crucial. Collaboration among stakeholders is essential for building a more sustainable and resilient economic model.

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## APPENDIX. RISKS OF A CIRCULAR ECONOMY

| *PESTE* | *Risks* | *Authors* |
|---|---|---|
| Political | The decision-making authority of the government becomes an obstacle to the development and application of CE practices. | Velenturf et al. (2018), Vollero (2022) |
| | Lack of laws and regulations. | Velenturf et al. (2018) |
| | | Rizos et al. (2015), Vollero (2022), Constantinos et al. (2010), Charef et al. (2021) |
| | Related to regulatory frameworks, lack of government support, and policy inconsistencies. | Mehmood et al. (2021), De Gárate Pérez (2024) |
| | Ineffective local government involvement, inadequate regulations, poor resource distribution, and limited collaboration among stakeholders, hinder the effective implementation of CE practices. | Dagilienė et al. (2021) |
| Economic | Lack of access to financial resources, not being able to finance new projects or partnerships. | Aid et al. (2017) |
| | Competition (including with non-circular products/processes). | Rizos et al. (2021) |
| | Restrictive market circumstances. | Aid et al. (2017), AlMashaqbeh and Munive-Hernandez (2023) |
| | Fluctuations in resource prices and market demand can impact the financial viability of circular business models. | AlMashaqbeh and Munive-Hernandez (2023) |
| | Organizations invest in new resource management services but are excluded from the financial returns, which can undermine their long-term sustainability and competitiveness. | Aid et al. (2017), Rahman and Marjerison (2020) |
| | There is a risk that CE implementation may not be economically viable if it neglects comprehensive economic sustainability. | Bjørnbet et al. (2021) |
| | High costs and lack of financial incentives to support CE practices. | Charef et al. (2021) |
| | | Johns et al. (2022) |
| | | Amato (2022), Masi et al. (2017), Okogwu et al. (2023), Awino and Apitz (2023) |
| | Mistrust of shared goals and unequal distribution of investment returns. | Aid et al. (2017) |
| | Different impacts on social groups, inclusivity, and equity. | Schroeder et al. (2019) |
| | Lack of consumer awareness and acceptance of recycled products may hinder the adoption of circular practices. | AlMashaqbeh and Munive-Hernandez (2023) |
| | The narrow focus on environmental aspects can lead to the neglect of social dimensions, risking the development of solutions that are not socially beneficial. | Bjørnbet et al. (2021) |
| | Resistance to change and lack of awareness among stakeholders. | Charef et al. (2021) |
| | | Amato (2022), Rizos et al. (2021) |
| | | Johns et al. (2022) |
| | Limited public awareness, weak stakeholder participation, and reliance on informal economies pose significant challenges. | Awino and Apitz (2023) |
| Technological | Difficulty in smoothly incorporating novel solutions into pre-existing systems. | AlMashaqbeh and Munive-Hernandez (2023) |
| | Harmful items may reach the market. | Bilitewski (2012), AlMashaqbeh and Munive-Hernandez (2023) |
| | High costs and uncertainty in developing new technologies. | AlMashaqbeh and Munive-Hernandez (2023) |
| | Consumer acceptance and market demand for circular products. | Linder and Williander (2017), Reike et al. (2018) |
| | Insufficient technology and infrastructure for implementing circular methods. | Johns et al. (2022) |
| | Need for advanced technologies and infrastructure for efficient resource management and recycling. | Amato (2022), Velenturf et al. (2018) |
| | | Awino and Apitz (2023) |
| | Challenges in adopting and integrating new sustainable technologies into existing supply chains. | Okogwu et al. (2023) |
| Environmental | Shifting pollution rather than eliminating it (greenwashing). | Bilitewski, 2012, AlMashaqbeh and Munive-Hernandez (2023) |
| | Unintended environmental impacts from circular practices. | Zink and Geyer (2017), Asogwa et al. (2022) |
| | Unintended environmental consequences, such as increased emissions from recycling processes, can undermine sustainability goals. | AlMashaqbeh and Munive-Hernandez (2023), Murrja et al. (2023) |
| | CE practices in manufacturing are often focused only on environmental sustainability, potentially overlooking broader environmental impacts. | Bjørnbet et al. (2021) |
| | Ineffective waste management practices leading to environmental degradation. | Charef et al. (2021) |
| | Potential environmental impacts of improper recycling and resource management. | Amato (2022), Okogwu et al. (2023) |
| | Ineffective management of waste trading and improper disposal practices impact global environmental sustainability. | Awino and Apitz (2023) |

*Source: Authors' elaboration.*