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# Adoption Of Circular Economy Principles In Small And Medium Enterprises (Smes): A Systematic Literature Review

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**KEYWORDS**

*Circular Economy (CE) , Small and Medium Enterprises (SMEs), Sustainable Business Models, CE Adoption Drivers and Barriers, Systematic Literature Review (SLR)*

**ABSTRACT**

Small and medium-sized enterprises (SMEs) are key actors in the shift toward a circular economy (CE), yet how they adopt CE principles remains inconsistently understood. This study systematically reviews 25 peer-reviewed publications from 2014 to 2024 indexed in Scopus, spanning disciplines such as Business, Environmental Science, Engineering, and Social Sciences. Using the TCCM (Theory–Context–Characteristics–Methodology) framework alongside bibliometric analysis via Biblioshiny and thematic synthesis, the review uncovers recurring CE practices—including eco-design, closed-loop systems, and digital performance tools—primarily within European manufacturing and agri-food sectors. While some studies adopt frameworks like the Resource-Based View or sustainability metrics, many lack explicit theoretical grounding. Key challenges identified include resource limitations, digital skill shortages, and regulatory uncertainty. This review highlights the need for more robust, theory- driven, and context-sensitive research, particularly across underrepresented sectors and regions. Its insights hold practical value for policymakers designing targeted CE interventions and for SMEs aiming to align innovation with sustainability goals..

## 1. INTRODUCTION

Shifting from linear to circular economic models has become essential for ensuring long-term sustainability in business. Central to this shift is the circular economy (CE), which emphasizes regenerative resource use by promoting reduction, reuse, and recycling to extend product life cycles and reduce environmental impact (Ghisellini et al., 2016; Kirchherr et al., 2018). Although large firms often dominate CE discourse, small and medium-sized enterprises (SMEs)—a vital component of most economies—face distinct challenges and opportunities in adopting CE practices (Rizos et al., 2016; Maman et al., 2024).

Despite often operating with limited financial, technological, and human capital, SMEs possess significant potential to drive environmental innovation due to their scale and flexibility (Caldera et al., 2019; Dey et al., 2020). Recent studies call for

tailored approaches that consider the unique internal capacities, external influences, and sector-specific factors shaping SME engagement with CE (Uwuigbe et al., 2021; Eleftheriadis & Anagnostopoulou, 2024). As global priorities shift toward sustainable consumption and production, understanding how SMEs implement CE is increasingly relevant for scholars, policymakers, and practitioners alike.

This systematic literature review (SLR) consolidates existing research on CE adoption in SMEs, identifying key practices, enabling technologies, and the barriers and drivers involved. It offers a critical overview of current knowledge, pinpoints research gaps, and provides guidance for advancing sustainable and resilient SME ecosystems. With following objective Systematically review and synthesize existing literature on how SMEs adopt CE principles.

Identify key drivers and barriers to CE adoption in SMEs.To Analyze theories and conceptual framework in studies related to CE adoption in SMEs. To Synthesize contextual factors and research characteristics influencing CE adoption in SMEs.

Following are the research questions : What are the main theories and conceptual frameworks used to explain the adoption of circular economy principles in SMEs? How do contextual factors (e.g., geography, industry sector, regulatory environment, and culture) influence the adoption of circular economy practices in SMEs? What research methodologies have been employed in studies on CE adoption in SMEs?, What gaps exist in the current literature on CE adoption in SMEs

**The Circular Economy: An Evolving Concept**

The circular economy (CE) marks a fundamental departure from the traditional linear model of production and consumption, which typically involves extracting resources, manufacturing goods, and discarding waste. Instead, CE promotes a restorative system that maximizes the utility and lifespan of materials, products, and resources (Kirchherr et al., 2017). Its core principles focus on eliminating waste, extending product use, and regenerating ecosystems (Ellen MacArthur Foundation, 2013). This model supports a closed-loop system where economic progress aligns with environmental responsibility.

CE's conceptual roots are interdisciplinary, drawing from cradle-to-cradle thinking (Braungart & McDonough, 2002), industrial ecology (Frosch & Gallopoulos, 1989), the performance economy (Stahel, 2006), and biomimicry (Benyus, 1997). These approaches share a focus on circular resource flows, system-wide efficiency, and design inspired by natural processes. CE encompasses more than recycling; it includes strategies like prolonging product life, optimizing inputs, and adopting innovative business models such as product-service systems (Bocken et al., 2016).

Operating at both macro and micro levels, CE influences policy frameworks, infrastructure planning, and firm-level operations. While increasingly featured in policy and corporate agendas, CE remains a dynamic and context-dependent concept, with diverse applications across industries and regions.

**Theoretical Lenses for Exploring CE Adoption in SMEs**

Various theoretical models have been used to examine how small and medium-sized enterprises (SMEs) engage with circular economy (CE) practices, each offering unique insights into the internal and external factors shaping adoption.The Resource-Based View (RBV) is commonly applied to assess how firm-specific assets—such as innovation capacity, environmental expertise, and leadership commitment—can support the adoption of circular strategies as a source of competitive advantage (Dey et al., 2022).

In contrast, Institutional Theory emphasizes external pressures—regulatory demands, societal expectations, and industry norms—as key drivers of organizational behavior. This perspective is especially relevant for SMEs that adapt to coercive, normative, or mimetic forces when implementing CE initiatives (Caldera et al., 2019).The Diffusion of Innovation Theory (Rogers, 2003) explores how innovations spread within social systems, highlighting the importance of communication channels and perceived innovation benefits in influencing CE uptake among SMEs.The Technology-Organization-Environment (TOE) Framework adds a multidimensional view by integrating technological readiness, internal capabilities, and environmental context—particularly useful for analyzing digital tools that facilitate CE (Eleftheriadis & Anagnostopoulou, 2024).

Emerging approaches such as Circular Business Model Innovation (CBMI) and the Triple Bottom Line (TBL) framework offer holistic views that link economic performance with environmental and social sustainability (Bocken et al., 2016).Together, these models enhance understanding of the complex factors guiding CE transitions in SMEs and inform strategies for researchers, practitioners, and policymakers.

**Empirical Insights into CE Practices in SMEs**

Over the last decade, empirical studies on circular economy (CE) adoption by small and medium-sized enterprises (SMEs) have expanded globally, with evidence from Europe, Asia, and Latin America documenting diverse practices such as eco-design, remanufacturing, reverse logistics, and circular supply chains (Dey et al., 2022; Caldera et al., 2019).CE adoption in SMEs is shaped by both internal and external influences. Internally, leadership commitment, employee participation,

environmental orientation, and innovation capabilities are key motivators (Pronti et al., 2024). Externally, drivers include policy frameworks, regulatory requirements, market demand, and supply chain pressure (Maman et al., 2024; Rizos et al., 2016), with additional support stemming from financial incentives and access to green funding.

Nonetheless, SMEs often encounter barriers such as limited resources, insufficient technical expertise, regulatory ambiguity, and doubts about financial returns (OECD, 2019; Uwuigbe et al., 2021). Cultural resistance and low consumer awareness can further hinder adoption in certain regions.Adopted circular business models include leasing, sharing systems, and hybrid models combining reuse with digital services. Tools like life cycle assessments, carbon footprint calculators, and digital platforms enhance implementation (Eleftheriadis & Anagnostopoulou, 2024).

Collaborative innovation—via partnerships with universities, larger firms, or industry clusters—has proven effective. Studies suggest SMEs benefit significantly from targeted training, knowledge-sharing networks, and industry-specific guidance (McDougall et al., 2022). altogether, the literature reflects increasing momentum but also highlights persistent structural and contextual obstacles, reinforcing the need for customized support strategies and enabling policy environments.

### Contextual Determinants of CE Adoption in SMEs

The uptake of circular economy (CE) practices by small and medium-sized enterprises (SMEs) is shaped by a range of contextual influences that affect organizational strategies, decision- making, and operational implementation. These factors include geography, industry sector, regulatory conditions, and cultural norms, all of which can either facilitate or obstruct CE integration.

Regional and Geographic Disparities: Adoption levels differ across regions, with Northern and Western European SMEs—such as those in Germany, the Netherlands, and the UK— demonstrating higher engagement due to stronger regulatory frameworks, greater environmental awareness, and better-developed green infrastructure (Hoffmann & Marticke, 2024; Dey et al., 2022). In contrast, enterprises in Southern and Eastern Europe often encounter structural limitations linked to weaker institutional support and lower public investment. Cultural and Institutional Influences: National values, institutional trust, and organizational culture also mediate CE adoption. While some contexts show strong societal alignment with sustainability, others struggle with low awareness or resistance to behavioral change (Maman et al., 2024).

Industry-Specific Influences: CE implementation varies widely by sector. Manufacturing and agri-food businesses tend to emphasize resource recovery, waste valorization, and reverse logistics. In contrast, service-oriented and creative sectors lean toward digital and shared-use models. The fashion industry, notably, is exploring blockchain-based transparency and rental platforms (McDougall et al., 2022; Huynh, 2022).Policy and Regulatory Environment: Policies such as extended producer responsibility, tax benefits, green procurement mandates, and environmental standards play a pivotal role in advancing CE. Yet, inconsistent enforcement and fragmented regulation can dilute their impact (Manta et al., 2024; Rizos et al., 2016).

## 2. METHODOLOGY

This systematic literature review (SLR) examined how small and medium-sized enterprises (SMEs) adopt circular economy (CE) principles. Following established protocols for transparency and academic rigor (Page et al., 2021), the process involved eligibility screening, structured data extraction, and a blend of bibliometric and thematic analysis using Biblioshiny and manual coding techniques.

### Eligibility Criteria

The review included English-language sources published between 2014 and 2024 that were peer-reviewed and in final publication stage. Eligible documents were journal articles, book chapters, and conference contributions focusing explicitly on SMEs and CE adoption, including empirical and conceptual studies. Exclusions comprised preprints, editorials, and studies lacking SME or CE relevance.

### Information Sources

Scopus served as the sole database due to its multidisciplinary coverage and metadata reliability. Preliminary testing showed that using additional sources introduced high redundancy, especially for open-access works.

### Search Strategy

The search, conducted in March 2025, targeted five subject areas: Business, Environmental Science, Social Sciences, Engineering, and Computer Science. Using Boolean logic, the search string combined terms like “circular economy,” “SMEs,” “adoption,” and “sustainability performance.” The search was restricted to documents **pub**lished between 2014 and 2024, written in English, and marked as final publication stage**.** The following keywords and Boolean operators were

used:
( TITLE-ABS-KEY ( "circular economy" OR "CE principles" OR "resource efficiency" OR "waste reduction" OR "closed-loop systems" ) AND TITLE-ABS-KEY ( "small and medium enterprises" OR "SMEs" OR "small businesses" OR "micro enterprises" ) AND TITLE-ABS- KEY ( "adoption" OR "implementation" OR "transition" OR "integration" OR "uptake" ) AND TITLE-ABS-KEY ( "barriers" OR "drivers" OR "enablers" OR "motivators" OR "challenges"
) AND TITLE-ABS-KEY ( "sustainability performance" OR "environmental impact" OR "economic benefit" OR "business model innovation" ) ) AND PUBYEAR > 2013 AND PUBYEAR < 2025
This search strategy retrieved 31 documents. After removing duplicates and screening for eligibility, 25 studies were selected for final inclusion.

**Selection Process**
Screening followed PRISMA 2020 guidelines. Titles and abstracts were initially reviewed for relevance. Full texts were then assessed by two independent reviewers, with a third consulted in case of disagreement. Documents were evaluated for thematic alignment and methodological soundness.

**Data Collection**
A structured extraction process captured key outcomes across five dimensions:

- CE practices (e.g., business models, operational strategies)
- Internal/external adoption factors (e.g., leadership, regulation)
- Technological enablers (e.g., IoT, blockchain)
- Environmental, economic, and social impacts
  Incomplete data were supplemented through contextual interpretation when necessary.

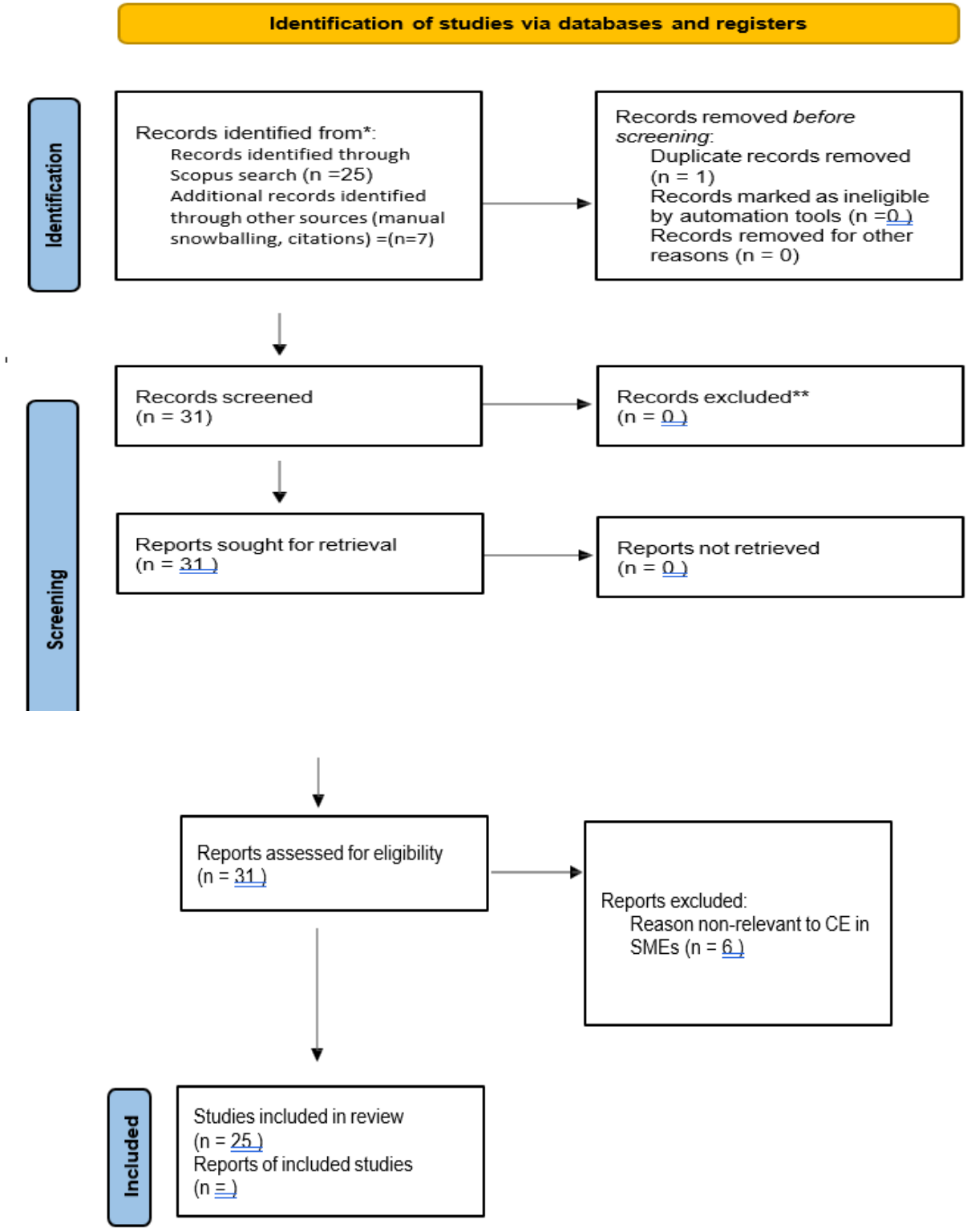
**Bias Assessment**
A formal risk-of-bias tool was not applied due to methodological heterogeneity. Instead, each study was assessed narratively based on clarity of aims, methodological transparency, and analytic validity. Low-quality or thematically misaligned studies were excluded during review.

**Effect Measures**
Given the varied methodologies, statistical effect sizes were not uniformly available. Where present, quantitative results (e.g., resource savings) were noted. The primary synthesis relied on qualitative comparison.

**Synthesis**
Findings were analyzed using a hybrid approach:

- The TCCM framework (Theory–Context–Characteristics–Methodology) structured the review (Paul & Rosado-Serrano, 2019).
- Thematic coding identified patterns across CE strategies, drivers, and outcomes.
- Bibliometric analysis via Biblioshiny (Aria & Cuccurullo, 2017) mapped publication trends, citation patterns, and thematic clusters.

Due to design heterogeneity, meta-analysis was not feasible. Instead, the review emphasized conceptual integration and cross-study pattern recognition.




Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.
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## 3. RESULTS

**Figure 4.1: Annual Scientific Production**

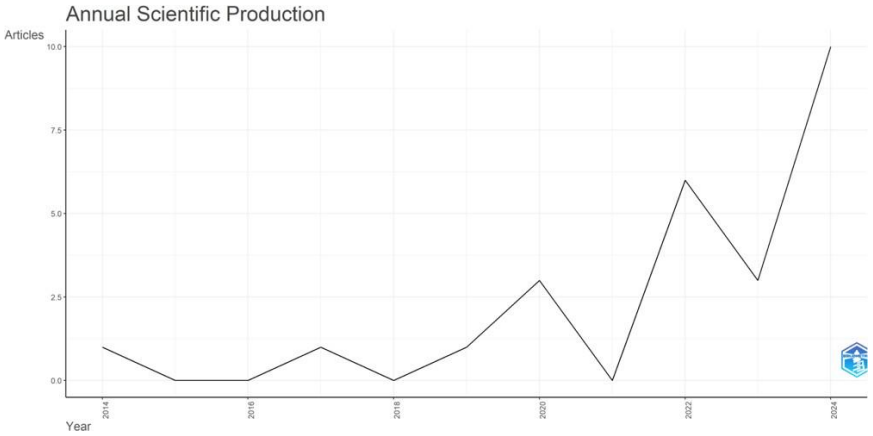


Figure 4.1 shows Annual Scientific Output. Research on circular economy (CE) adoption in small and medium-sized enterprises (SMEs) has gained momentum over the past decade. Between 2014 and 2018, scholarly activity in this area was minimal, with some years showing no recorded publications—reflecting limited academic attention to the topic during its early development.

A notable surge began in 2019, with publication volume accelerating significantly from 2020 onward. This growth aligns with global policy shifts promoting sustainability, such as the European Union's Circular Economy Action Plan and the United Nations Sustainable Development Goals. A pronounced peak occurred in 2024, when ten articles were published, despite a brief decline in 2023The sharp rise in recent years highlights the increasing relevance of CE in the SME context and the urgency of addressing associated sustainability challenges. This upward trend underscores the importance of this review and reinforces the call for more robust theoretical frameworks and empirical studies to guide future research.

**Figure 4.2: keyword co-occurrence network map**


Figure 4.2 illustrates a co-occurrence network map generated through bibliometric analysis, offering a visual overview of the dominant themes in circular economy (CE) research within small and medium-sized enterprises (SMEs). The map highlights three key thematic clusters. The green cluster focuses on environmental and operational dimensions, where terms like "circular economy," "environmental impact," "waste management," and "carbon emissions" frequently co-appear—reflecting studies concerned with resource efficiency and emission reduction in SMEs.

The red cluster emphasizes strategic and regulatory integration, featuring keywords such as "sustainable development," "environmental management," "manufacture," and "supply chains." This indicates a research stream examining how CE practices align with broader sustainability goals and policy imperatives. A smaller blue cluster reflects methodological trends, linking "supply chain management" with "qualitative analysis," suggesting increased reliance on case-based and exploratory methods.

Prominent terms like "small and medium-sized enterprise" and "sustainable development," shown in larger font, underscore their centrality in the field. Notably, strong linkages such as "circular economy" with "environmental impact," and "sustainable development" with "small and medium-sized enterprise," demonstrate the conceptual cohesion between ecological goals and SME strategy within CE literature. Strong connections between "circular economy" ↔

"environmental impact" and "sustainable development" ↔ "small and medium-sized enterprise" show how closely these concepts are integrated in the literature.

**Figure 4.3 Conceptual Structure: Multiple Correspondence Analysis (MCA)**

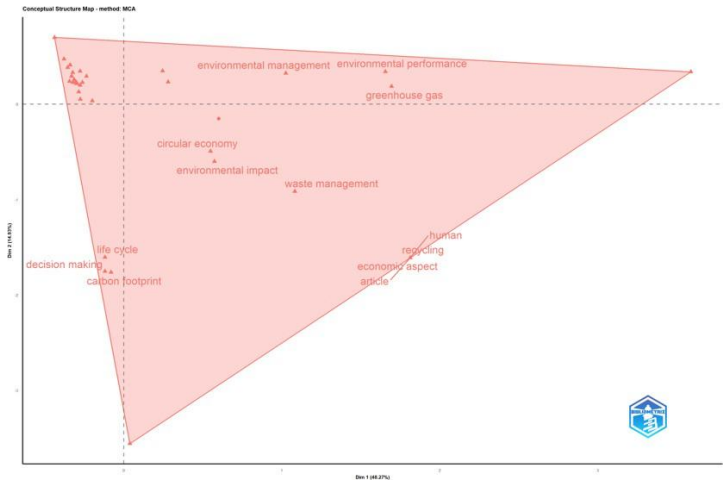


Figure 4.3 shows Conceptual Structure via Multiple Correspondence Analysis (MCA). It uncovers the underlying thematic dimensions shaping the literature on circular economy (CE) adoption in SMEs. This two-dimensional factorial plot groups co-occurring keywords, offering a visual interpretation of conceptual proximities and structural associations within the field.

The first dimension (Dim 1), explaining 48.27% of the variance, traces a continuum from environmentally driven and operational themes to economically oriented and stakeholder- related issues. Terms like “decision making,” “life cycle,” “carbon footprint,” and “circular economy,” located on the left, emphasize assessment tools and managerial strategies tied to CE implementation. Shifting rightward, keywords such as “human,” “recycling,” and “economic aspect” reflect a pivot toward socio-economic impacts and practical application.

The second axis (Dim 2), accounting for 24.93% of the variance, distinguishes between conceptual or policy-focused research and implementation-centered approaches. The upper section, populated by terms like “environmental performance,” “greenhouse gas,” and “environmental management,” points to studies grounded in metrics, policy, and sustainability standards. Meanwhile, the lower half, with keywords such as “recycling” and “economic aspect,” aligns more closely with the operational realities SMEs face.

Positioned near the origin, core concepts like “circular economy,” “waste management,” and “environmental impact” serve as integrative anchors, linking firm-level strategies with policy and performance discussions across both dimensions.

## 4.3 TCCM Framework

**Table 4.3.1 Theories Referenced in Circular Economy Adoption Studies**

| *Theory/Framework* | *Number of Studies* | *Studies* |
|---|---|---|
| Life Cycle Assessment (LCA) | 2 | Eleftheriadis (2024); Dantas (2022) |
| Resource-Based View (RBV) | 2 | Dey (2022); McDougall (2022) |
| Grounded Theory | 1 | Carreira (2024) |
| Institutional Theory | 1 | Caldera (2019) |
| Triple Bottom Line | 1 | Lindgren (2024) |

| | | |
|---|---|---|
| Entrepreneurial Orientation | 1 | Hoffmann (2024) |
| Market Orientation | 1 | Hoffmann (2024) |
| Circular Business Model Innovation | 1 | Lindgren (2024) |
| Environmental Dynamism | 1 | Arsawan (2024) |
| Green Human Resource Management | 1 | Arsawan (2024) |
| Circular Transition Indicators (CTI) | 1 | Dantas (2022) |
| Waste Hierarchy Index (WHI) | 1 | Dantas (2022) |
| Ecological Innovation | 1 | Herrero-Luna (2022) |
| Innovation Adoption Theory | 1 | Pronti (2024) |
| 5th Wave Theory | 1 | Mohammadian (2022) |
| Lifecycle Costing | 1 | Manta (2024) |
| Innovative Public Procurement (IPP) | 1 | Manta (2024) |
| SaaS Marketplace Framework | 1 | Franke (2024) |
| Multilevel Modeling with Sustainability Indicators | 1 | Maman (2024) |
| Grounded in Sustainability and Logistics Theory | 1 | Chen (2024) |
| Eco-Efficiency Framework | 1 | Özbuğday (2020) |

Source: Data compiled from the included studies by the author.

Table 4.3.1 shows the theoretical underpinnings in CE Adoption Studies. Theoretical approaches to circular economy (CE) adoption in SMEs reveal a mix of diversity and inconsistency. Notably, the Life Cycle Assessment (LCA) and Resource-Based View (RBV) frameworks were each applied in two studies, reflecting interest in connecting environmental assessment with internal resource efficiency (Eleftheriadis, 2024; Dey, 2022). Other studies employed emerging and context-specific models, such as Circular Business Model Innovation (Lindgren, 2024) and Green Human Resource Management (Arsawan, 2024), which emphasize integrating sustainability with organizational competencies and workforce practices.

Broader conceptual frameworks—including the Triple Bottom Line, Institutional Theory, and Grounded Theory—also featured in some studies, offering varied perspectives on how firms adapt to circular strategies amid distinct organizational and external pressures. However, a significant portion of the literature—nine studies—lacked any explicit theoretical grounding, relying instead on descriptive or empirical observation.

This theoretical gap points to a broader challenge: the absence of consistent conceptual frameworks limits explanatory depth and hinders cross-study comparisons. Future research would benefit from more rigorous theory integration to support a coherent understanding of CE adoption pathways in SMEs.

**Table 4.3.2** *Contextual Settings of Circular Economy Adoption Studies*

| Context | Number of Studies | Studies |
|---|---|---|
| UK | 4 | Dey (2020); Dey (2022); McDougall (2022); Howard (2014) |
| Textile industry SMEs (Europe) | 5 | Franke (2024); Maman (2024); Manta (2024); Lindgren (2024); Herrero-Luna (2022) |
| SMEs (general/global) | 3 | Arsawan (2024); Huynh (2022); Multiple authors (2017) |
| Fashion industry (global) | 3 | Ramos (2023); Huynh (2022); Multiple authors (2020) |
| Greece (general and SME-specific) | 3 | Dey (2022); Eleftheriadis (2024) |
| French SMEs (general and textile) | 2 | Dey (2022); Hrouga (2023) |
| Micro-firms in Emilia-Romagna, Italy | 2 | Pronti (2024) |
| Brazil (hospitality sector SME) | 1 | Dantas (2022) |
| Australia | 1 | Caldera (2019) |
| India (manufacturing MSMEs) | 1 | Kaswan (2023) |
| Germany (SMEs) | 1 | Hoffmann (2024) |
| Portugal (SMEs) | 1 | Carreira (2024) |
| Turkey (SMEs) | 1 | Özbuğday (2020) |
| China (SMEs) | 1 | Chen (2024) |
| Hybrid SMEs (post-COVID, global) | 1 | Mohammadian (2022) |
| Developing countries | 1 | Arsawan (2024) |

Source: Data compiled from the included studies by the author.

Table 4.3.2 shows Geographic and Sectoral Contexts in CE Research. The contextual distribution of studies demonstrates both thematic richness and regional concentration. The United Kingdom emerges as a leading setting for CE-focused SME research, with four studies conducted within its institutional and regulatory landscape (Dey, 2020; McDougall, 2022). The European textile sector is also prominently featured, underscoring its significance as a high- impact industry requiring circular interventions (Franke, 2024; Manta, 2024). A range of other countries—such as Greece, France, Germany, Portugal, Turkey, and China—also appear, though often represented by one or two studies each. Cross-sectoral and global perspectives, particularly in the fashion industry, contribute to understanding how CE dynamics operate across diverse industrial contexts. Interestingly, some studies focus on hybrid SMEs and post- pandemic transitions, reflecting a shift toward understanding resilience and innovation in turbulent environments. However, studies from developing economies remain limited, particularly outside Asia and Latin America. This imbalance suggests that broader geographic representation is essential to capturing the full spectrum of CE implementation challenges and opportunities in SMEs worldwide.

Table 4.3.3 CE Characteristics Explored in the Studies

| Theme | Number of Studies | Studies |
|---|---|---|
| CE Business Models and Innovation | 1 | Arsawan I.W.E. et al. (2024) |
| Digital Tools and Technologies | 4 | Franke M. et al. (2024); Huynh P.H. et al. (2022); Lindgren P. et al. (2024); Multiple authors (conference proceedings) et al. (2020) |
| Drivers and Barriers to CE | 2 | Caldera H.T.S. et al. (2019); Carreira R.J. et al. (2024) |
| Eco-Design and Lifecycle Approaches | 5 | Dey P.K. et al. (2022); Eleftheriadis I. et al. (2024); Hrouga M. et al. (2023); Maman A. et al. (2024); Multiple authors (conference volume) et al. (2017) |
| Organizational Culture and Capabilities | 3 | Hoffmann A. et al. (2024); Mohammadian H.D. et al. (2022); Pronti A. et al. (2024) |
| Other CE Characteristics | 1 | Howard M.J. et al. (2014) |
| Sustainability Outcomes | 2 | Dey P.K. et al. (2020); Kaswan M.S. et al. (2023) |
| Sustainable Supply Chain Practices | 3 | Chen Y. et al. (2024); Manta O. et al. (2024); McDougall N. et al. (2022) |
| Waste Management and Resource Efficiency | 4 | Dantas T.E.T. et al. (2022); Herrero-Luna S. et al. (2022); Ramos L. et al. (2023); Özbuğday F.C. et al. (2020) |

Source: Data compiled from the included studies by the author.

Table 4.3.3 shows the characteristics of CE practices identified. Thematic analysis of CE characteristics reveals several dominant areas of focus. Eco-design and lifecycle-based practices are the most commonly explored, appearing in five studies and highlighting the centrality of design-stage decisions in reducing environmental impact (Dey, 2022; Eleftheriadis, 2024). Digital tools and technological enablers—including platforms, traceability solutions, and automation—are another focal point, reflecting the increasing integration of CE with Industry 4.0 technologies (Franke, 2024; Huynh, 2022). Research has also emphasized waste management and resource efficiency, suggesting a continued commitment to foundational sustainability practices. Other themes include supply chain sustainability, organizational culture, and business model innovation, each representing strategic dimensions through which SMEs engage with circularity.

However, it is evident that many studies tend to isolate individual aspects of CE rather than addressing them holistically. This trend points to a lack of integrated approaches capable of linking design, operations, and outcomes within comprehensive CE adoption models—a gap that future research must address.

**Table 4.3.4 :** ***Methodologies Used in CE Adoption Studies in SMEs***

| Methodology | Number of Studies | Studies (APA in-text citation) |
|---|---|---|
| Survey-based analysis | 5 | Chen (2024); Hoffmann (2024); Pronti (2024); Dey (2020); Arsawan (2024) |
| Mixed methods (e.g., survey, interviews, case studies) | 2 | Dey (2020); Dey (2022) |
| Conceptual and theoretical analysis | 4 | Kaswan (2023); Mohammadian (2022); Franke (2024); Lindgren (2024) |
| Systematic literature review | 2 | Herrero-Luna (2022); Ramos (2023) |
| Scenario and technical assessment | 2 | Dantas (2022); Howard (2014) |
| Grounded theory and qualitative interviews | 2 | Caldera (2019); Carreira (2024); McDougall (2022) |
| Structural equation modeling | 1 | Arsawan (2024) |
| Document and content analysis | 2 | Manta (2024); Özbuğday (2020) |
| Case study-based approaches | 4 | Eleftheriadis (2024); Lindgren (2024); Huynh (2022); Hrouga (2023) |
| Multilevel and regression analysis | 2 | Maman (2024); Hoffmann (2024) |
| Eurobarometer/descriptive secondary data analysis | 1 | Özbuğday (2020) |

Source: Data compiled from the included studies by the author.

Table 4.3.4 shows Methodological Approaches in CE Studies on SMEs. The methodological choices across the reviewed studies reflect a diverse but somewhat fragmented research landscape. Survey-based studies are most prevalent, often used to capture attitudes, behaviors, and practices related to CE among SME stakeholders (Chen, 2024; Hoffmann, 2024). A number of studies adopt mixed-methods designs, combining quantitative and qualitative techniques to provide a more nuanced understanding (Dey, 2020; Dey, 2022). Several works are conceptual or theoretical in nature, reflecting an ongoing effort to frame CE within evolving scholarly paradigms (Lindgren, 2024; Mohammadian, 2022). Case study approaches are used extensively, particularly in studies focused on specific sectors or technological applications (Huynh, 2022; Eleftheriadis, 2024). While this methodological plurality allows for depth and context-specific insights, it also presents challenges in terms of comparability and replication. Moreover, the limited use of longitudinal designs, experimental methods, or large-scale datasets restricts the generalizability of findings. Strengthening methodological rigor through more consistent research designs, larger samples, and cross-regional comparative studies would significantly advance the field.

### 4.4. Thematic analysis

**Table 4.4.1 Key Themes of Circular Economy Practices Adopted by SMEs**

| Theme | Description | No. of Studies |
|---|---|---|
| Recycling and Waste Reduction | Practices focused on reusing materials, reducing waste generation, and promoting recycling systems. | 2 |
| Eco-Design and Sustainable Product Development | Designing products to minimize environmental impacts throughout their lifecycle. | 2 |
| Green Logistics and Reverse Logistics | Implementing environmentally friendly logistics and reverse flows for resource recovery. | 2 |
| CE Field Actions (Take, Make, Use, Recover) | Comprehensive application of CE principles across product and process life cycles. | 2 |

Source: Data compiled from the included studies by the author.

Table 4.4.1 in Thematic analysis reveals four key patterns in CE practices adopted by SMEs. The most prevalent theme—recycling and waste reduction—reflects a foundational emphasison easily implementable sustainability measures. Themes such as eco-design and green logistics illustrate more strategic efforts, where circularity is embedded within product development and supply chain operations. A broader category, CE field actions, captures comprehensive, system-level initiatives spanning the full product lifecycle. Together, these themes suggest an evolving approach among SMEs—progressing from basic environmental practices toward more integrated, design-driven circular models.

**Table 4.4.2. Technological Enablers of Circular Economy Adoption in SMEs**

| Theme | Description | Number o Studies |
|---|---|---|
| Digital Tools and Platforms | Technologies such as Software-as-a-Service (SaaS), digital marketplaces, and traceability platforms enabling CE implementation. | 3 |
| Lifecycle and Carbon Footprint Tools | Use of Life Cycle Assessment (LCA) and carbon footprint calculators to support sustainability-based decision-making. | 3 |
| Artificial Intelligence and Analytics | AI-driven tools for process optimization, inventory control, waste reduction, and modeling consumer behavior. | 2 |
| Smart Sensors and Emerging Technologies | Integration of sensors, 5G/6G technologies, and automation for environmental monitoring and circular compliance. | 2 |

Source: Data compiled from the included studies by the author.

Table 4.4.2 in This thematic analysis highlights the growing integration of technological innovations in facilitating CE practices among SMEs. Digital tools and lifecycle-based assessments are the most commonly used, suggesting a reliance on scalable platforms and quantitative evaluation tools. Additionally, AI technologies and smart sensors are emerging as cutting-edge enablers, supporting real-time decision-making, automation, and transparency in circular business models. These tools are pivotal in overcoming information asymmetry and operational inefficiencies that traditionally hinder CE adoption in smaller enterprises.

**Table 4.4.3 Outcomes of Circular Economy Adoption in SMEs**

| Theme | Description | Number of Studies |
|---|---|---|
| Environmental Performance | Reduction in emissions, improved waste management, better resource efficiency, and overall lower environmental impact. | 4 |
| Economic and Operational Efficiency | Cost savings, and improvements in production, supply chain, and distribution efficiency through CE strategies. | 3 |
| Social and Organizational Impact | Positive changes in workforce behavior, stakeholder engagement, and cultivation of sustainability-oriented business culture. | 2 |
| Integrated Triple Bottom Line Outcomes | Simultaneous achievement of environmental, economic, and social goals through holistic and strategic CE implementation. | 2 |

Source: Data compiled from the included studies by the author.

The adoption of circular economy (CE) practices in SMEs shown in Table 4.4.3 yields benefits across environmental, economic, and social dimensions. Environmental improvements— particularly in reducing emissions and waste—are the most consistently reported outcomes. Economic advantages, including cost savings and enhanced operational efficiency, are also frequently highlighted. In addition, CE initiatives often foster organizational change, encouraging collaboration and embedding sustainability into company culture. A growing subset of studies reports integrated outcomes aligned with the triple bottom line framework, reflecting a more holistic understanding of sustainability within the SME context

## 4. DISCUSSION

This review provides an integrated understanding of how circular economy (CE) principles are adopted within small and medium-sized enterprises (SMEs), synthesizing insights from bibliometric trends, theoretical frameworks (TCCM), and thematic patterns. The bibliometric analysis highlights a growing academic interest post-2020, with 2024 marking the highest publication volume, reflecting a broader institutional and policy-driven push toward sustainability (Hrouga & Michel, 2023; Manta & Mansi, 2024).

The TCCM framework reveals substantial heterogeneity in theoretical application. While models such as the Resource-Based View (Dey, 2022), Circular Business Model Innovation (Lindgren, 2024), and Green HRM (Arsawan et al., 2024) offer promising lenses, a significant proportion of studies lack explicit theoretical grounding. This inconsistency hampers comparative analysis and points to the need for greater conceptual alignment across studies. Contextually, European SMEs dominate the research landscape, particularly in manufacturing and agri-food sectors (Pronti et al., 2024; Herrero-Luna et al., 2022), while geographical underrepresentation remains a critical gap.

Thematic analysis identified four dominant CE practice areas: recycling and waste reduction, eco-design, green logistics, and holistic lifecycle strategies. These themes reflect a maturity trajectory—from operational sustainability to systemic integration. CE outcomes most

frequently involve environmental benefits, followed by economic gains and, to a lesser extent, organizational and social improvements. Emerging integrative approaches increasingly reference the triple bottom line, signalling a broader shift in SME sustainability paradigms (Eleftheriadis & Anagnostopoulou, 2024).

**Limitations of the Evidence**

Despite the breadth of literature reviewed, several limitations were evident in the primary studies. Most were concentrated in high-income regions, particularly Western Europe, limiting the generalizability of findings to SMEs in developing economies. Sample sizes and sectoral coverage also varied widely, with many studies relying on small, non-random samples. Methodologically, the dominance of qualitative and exploratory designs limits the ability to generalize findings or measure impact consistently across contexts.

**Limitations of the Review Process**

This review also faces methodological constraints. Relying exclusively on the Scopus database, while ensuring quality and consistency, may have led to the exclusion of relevant grey literature or works indexed elsewhere. Publication bias is a potential concern, as studies reporting positive CE outcomes are more likely to be published. The application of the TCCM framework, although useful for structuring synthesis, proved challenging in studies with vague theoretical or methodological articulation. Similarly, while thematic analysis enabled the identification of recurring CE practices, its reliance on subjective interpretation introduces potential coder bias.

**Implications for Practice, Policy, and Future Research**

The findings offer several implications. For practitioners, the evidence underscores that CE adoption can yield both ecological and economic value, particularly when supported by internal leadership and external institutional incentives. Digital technologies—such as lifecycle assessment tools, carbon calculators, and blockchain—are critical enablers of this transition (Eleftheriadis & Anagnostopoulou, 2024).Policymakers should recognize that effective CE uptake among SMEs depends not only on regulatory mandates but also on targeted support measures. These may include tax incentives, sector-specific guidelines, digital training, and access to green finance. The review also highlights the need for harmonized policy enforcement and support tailored to SMEs' size, sector, and regional context. Evidence on the role of policy mechanisms and technological capabilities in supporting CE adoption is currently fragmented. There is a pressing need for integrated models that bridge regulatory frameworks with technological infrastructure. Such frameworks would enable more coordinated and scalable support for SMEs, fostering alignment between public policy objectives and the digital tools necessary to operationalize circular practices. Future research should pursue longitudinal and cross-country studies to better capture the dynamics and impacts of CE adoption over time. There is also a need for greater theoretical rigor and comparative studies that test the applicability of CE models across sectors and cultural contexts. Research examining how consumer perceptions, preferences, and demand influence SMEs' adoption of circular economy (CE) practices remains limited. This gap hinders a full understanding of market-driven enablers or barriers to CE implementation. Deeper insights into consumer behavior could identify key drivers—such as awareness campaigns or tailored marketing—that may enhance adoption rates and align CE strategies with evolving market expectations. Exploring digital innovation’s role in accelerating circular transitions in underrepresented regions offers a particularly promising avenue.

## 5. CONCLUSION

This review offers a comprehensive synthesis of how circular economy (CE) principles are adopted within small and medium enterprises (SMEs), drawing on insights from theoretical foundations, contextual dynamics, organizational characteristics, and methodological approaches. It highlights an evolving research landscape, with increasing interest in CE practices that range from basic waste reduction to integrated lifecycle strategies. While frameworks like the Resource-Based View and Circular Business Model Innovation have informed some studies, many lack a robust theoretical grounding, limiting generalizability.

Several critical research gaps persist, including the absence of sector-specific models, minimal use of longitudinal or cross-regional designs, and scarce attention to consumer behavior as a driver of CE adoption. Moreover, fragmented insights on policy and technology call for unified frameworks that better support SMEs in operationalizing CE.

This study advances the field by clarifying key adoption patterns and offering a structured foundation for future inquiry. For practitioners and policymakers, the findings underscore the need for tailored support mechanisms, digital tools, and policy alignment. Researchers are encouraged to build on these insights with more rigorous, theory-driven, and context-sensitive studies that bridge strategy, innovation, and sustainability in the SME sector

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