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# ECO-EFFICIENCY MECHANISMS OF GREEN TECHNOLOGY ADOPTION IN TEXTILE INDUSTRY ENTERPRISES: A SYSTEMATIC LITERATURE REVIEW

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### Abstract

This study systematically reviews and bibliometrically maps the scholarly literature on eco-efficiency mechanisms associated with green technology adoption in the textile industry, identifying institutional barriers, theoretical frameworks, and conceptual solutions underpinning the sector's green transformation.

A systematic literature review (SLR) following PRISMA 2020 guidelines was conducted. Scopus and Web of Science databases were searched using targeted keyword combinations. From an initial pool of 701 records, 127 articles published between 2000 and 2024 were selected after rigorous screening. Bibliometric analysis including co-citation mapping, keyword co-occurrence, and thematic clustering was performed using VOSviewer. Thematic content analysis followed the Braun and Clarke (2006) framework.

**Keywords:** Eco-efficiency, green technology, textile industry, systematic literature review, bibliometric analysis, institutional theory, TOE framework, cleaner production, circular economy.

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### Introduction

The textile industry ranks among the oldest and most economically significant manufacturing sectors globally, employing over 300 million workers and generating annual revenues exceeding USD 1.7 trillion. However, its environmental footprint is disproportionately large. The industry accounts for approximately 20 percent of global industrial water pollution, 10 percent of global carbon emissions, and produces an estimated 92 million tonnes of textile waste annually (Niinimäki et al., 2020). These environmental pressures, amplified by the fast-fashion consumption model, have made the textile sector a primary target for green transformation initiatives.

The concept of eco-efficiency, originally proposed by Schaltegger and Sturm (1990) and formally adopted by the World Business Council for Sustainable Development (WBCSD, 1992), provides the theoretical foundation for reconciling economic competitiveness with environmental sustainability. Eco-efficiency denotes the delivery of competitively priced goods and services that satisfy human needs while progressively reducing ecological impacts and resource intensity throughout the life cycle. Huppes and Ishikawa (2005) distinguished four types of eco-efficiency — environmental intensity, environmental improvement cost, economic intensity, and environmental productivity — establishing a systematic measurement framework subsequently codified in ISO 14045:2012.

Green technology adoption in the textile industry encompasses a broad spectrum of innovations: waterless dyeing technologies (supercritical CO<sub>2</sub> dyeing), enzyme-based bio-processing, closed-loop water treatment systems, renewable energy integration, and Industry 4.0-enabled production optimization (Ozturk et al., 2016). Empirical studies have demonstrated that cleaner production technologies can reduce water consumption by 20-40 percent and energy consumption by 15-30 percent in textile manufacturing (Lin and Tan, 2017). Despite these documented benefits, adoption rates remain low, particularly in

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developing economies, suggesting the presence of significant institutional, organizational, and informational barriers.

The theoretical literature offers several lenses for understanding technology adoption patterns. DiMaggio and Powell's (1983) institutional theory identifies three isomorphic pressures — coercive, mimetic, and normative — that shape organizational behaviour. Tornatzky and Fleischer's (1990) Technology-Organization-Environment (TOE) framework analyses adoption decisions through technological, organizational, and environmental context dimensions. Rogers' (2003) Diffusion of Innovations theory explains how innovations spread through social systems via relative advantage, compatibility, complexity, trialability, and observability attributes. While each framework has been applied independently in various sustainability contexts, their integrated application to eco-efficiency in the textile sector remains underdeveloped.

The global textile market was valued at approximately USD 1.7 trillion in 2024 and is projected to reach USD 2.3 trillion by 2030. However, this economic growth comes at substantial environmental cost. According to the United Nations Environment Programme (UNEP, 2020), the textile industry is the second-largest consumer of water globally, uses approximately 25 percent of all chemicals produced worldwide, and is responsible for more greenhouse gas emissions than international aviation and maritime shipping combined. The environmental burden is further exacerbated by the industry's linear take-make-dispose production model, with less than 12 percent of textile materials being recycled globally (Ellen MacArthur Foundation, 2017). Addressing this ecological crisis requires a fundamental shift toward green technologies and eco-efficient production processes, yet the mechanisms facilitating or hindering this transition remain insufficiently understood.

Developing countries, which host the majority of global textile production capacity, face particularly acute challenges in adopting green technologies. Financial constraints, institutional weaknesses, and knowledge gaps create a

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complex web of barriers that resist simple policy interventions. The experience of countries such as Bangladesh, Vietnam, and Uzbekistan — where textile manufacturing constitutes a strategically important economic sector but environmental compliance infrastructure remains underdeveloped — underscores the need for context-sensitive theoretical frameworks capable of explaining adoption dynamics across diverse institutional settings. Moreover, the emergence of the European Union's Green Deal and its Strategy for Sustainable and Circular Textiles, together with increasingly stringent buyer-driven sustainability requirements, are creating unprecedented external pressures on developing-country manufacturers to adopt cleaner technologies, making the study of adoption mechanisms both timely and consequential.

Three significant gaps persist in the current literature. First, no comprehensive bibliometric mapping of eco-efficiency research specifically within the textile sector exists. Second, the institutional barriers to green technology adoption in textile enterprises have not been systematically taxonomized. Third, an integrated conceptual framework combining institutional theory, the TOE framework, and diffusion theory to explain eco-efficiency mechanisms in textile manufacturing is lacking. This study addresses these gaps through a systematic literature review and bibliometric analysis of 127 articles published between 2000 and 2024, aiming to: (a) map the intellectual structure and thematic evolution of the field; (b) develop a comprehensive barriers taxonomy; and (c) propose an integrated multi-level conceptual framework with a five-stage adoption flowchart.

### Methodology

The study employed a systematic literature review (SLR) methodology following the PRISMA 2020 guidelines (Page et al., 2021). The SLR was complemented by bibliometric analysis to map the intellectual structure of the field quantitatively.

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Two leading academic databases — Scopus and Web of Science (WoS) — were searched using the following keyword combinations: ('green technology' OR 'cleaner production' OR 'eco-efficiency' OR 'sustainable manufacturing') AND ('textile' OR 'apparel' OR 'garment' OR 'fashion'). The search was restricted to English-language, peer-reviewed articles published between January 2000 and December 2024. Search queries were designed iteratively: broad initial queries were refined through preliminary screening to optimize recall and precision. The Boolean operators and truncation symbols were adapted to each database's syntax requirements.

Inclusion criteria comprised: (a) empirical or theoretical studies addressing green technology, eco-efficiency, or cleaner production in the textile sector; (b) peer-reviewed journal articles or review papers; and (c) studies published in English. Exclusion criteria included conference proceedings, editorials, book reviews, and studies focused exclusively on non-textile industries. The initial search yielded 701 records. After duplicate removal (124 records), title and abstract screening (577 to 279), and full-text assessment (279 to 127), a final sample of 127 articles was retained. Screening was conducted independently by two reviewers, with disagreements resolved through discussion (Cohen's kappa = 0.87).

Quality assessment was conducted using the Critical Appraisal Skills Programme (CASP) checklist and Joanna Briggs Institute (JBI) criteria. Each article was evaluated across 11 dimensions including research question clarity, methodological adequacy, data collection transparency, analytical rigour, and conclusion-evidence alignment. Articles scoring below 5 out of 11 were excluded from the synthesis. This quality assurance protocol ensures the internal validity and external reliability of the systematic review's findings.

VOSviewer software (van Eck and Waltman, 2010) was used for keyword co-occurrence analysis (minimum threshold: 5 occurrences, yielding 47 keywords), co-citation analysis (minimum 10 citations), and bibliographic coupling at the country and institution levels. The Louvain algorithm was applied for cluster

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detection (resolution = 1.0, minimum cluster size = 5). Fractional counting was used for normalization. Thematic content analysis followed Braun and Clarke's (2006) six-phase protocol: familiarization, initial coding, theme searching, theme reviewing, theme defining, and report writing. NVivo 14 assisted the coding process.

### Results

The 127 selected articles exhibit a clear growth trajectory across three periods. The foundational period (2000-2012) produced approximately 2-4 articles annually, dominated by cleaner production case studies in Turkish and Chinese textile mills (Ozturk et al., 2015). The growth period (2013-2019) saw annual output increase to 8-12 articles, driven by the UN Sustainable Development Goals, the circular economy paradigm, and growing consumer sustainability awareness. The acceleration period (2020-2024) witnessed exponential growth, with 15-25 articles annually. The COVID-19 pandemic's supply chain disruptions and the EU's Textile Strategy catalysed intensified research interest, particularly at the intersection of Industry 4.0 technologies and environmental sustainability. Articles combining digital transformation with eco-efficiency increased from 18 to 34 percent of annual output after 2020.

China leads national contributions with 23.6 percent of articles, reflecting its dominance in global textile manufacturing and substantial research investment. The United Kingdom (14.2%), Turkey (11.0%), and Germany (7.9%) follow, reflecting strong European research traditions in sustainable manufacturing. South and Southeast Asian nations — Bangladesh (7.1%), India (6.3%), and Vietnam (3.9%) — are increasingly active, consistent with their growing role as global textile production hubs. Notably, Central Asia, Latin America, and Africa collectively account for less than 2 percent of publications, representing a significant geographical gap. Co-authorship network analysis reveals that South Asian researchers collaborate predominantly within their region, with limited

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integration into European or Chinese collaboration networks — a pattern that may constrain knowledge transfer and research quality.

The Journal of Cleaner Production dominates the publication landscape, accounting for 31.5 percent of selected articles. Sustainability (11.8%), Resources Conservation and Recycling (8.7%), and the International Journal of Production Economics (6.3%) follow. Co-citation analysis identifies Niinimäki et al. (2020) as the most frequently cited source (referenced in 41% of articles), followed by Öztürk et al. (2016) at 34 percent and Geissdoerfer et al. (2017) at 28 percent. This intellectual structure indicates that the field's knowledge base is organized around environmental impact reviews, technological solution documentation, and circular economy frameworks.

VOSviewer analysis identified five distinct thematic clusters, each representing a major research strand within the eco-efficiency and green technology domain in textiles.

### **Cluster 1: Cleaner production technologies (27.4%)**

The largest cluster centres on process-level technological interventions — wastewater treatment optimization, chemical substitution, energy efficiency improvements, and waste minimization. Key studies include Öztürk et al.'s (2016) comprehensive eco-efficiency assessment of Turkish textile mills and Khatri et al.'s (2015) review of reactive dye effluent reduction. This cluster exhibits the strongest linkage to Cluster 5 (circular economy), with a co-occurrence link strength of 847, suggesting that cleaner production and circularity are increasingly viewed as complementary strategies.

### **Cluster 2: Sustainable supply chain management (21.4%)**

This cluster addresses sustainability across the full textile value chain, encompassing supplier selection, green procurement, logistics optimization, and transparency mechanisms. Jia et al.'s (2020) systematic review of circular

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economy in textile and apparel supply chains is a foundational contribution. The cluster's strong linkage to Cluster 4 (institutional barriers, link strength = 623) underscores the importance of institutional factors in supply chain governance.

### **Cluster 3: Life-cycle assessment approaches (20.2%)**

Centred on environmental impact quantification methodologies, this cluster examines LCA applications to textile products, carbon and water footprinting, and environmental product declarations. Sandin and Peters' (2018) review of textile reuse and recycling environmental impacts is a key reference. The cluster highlights the methodological diversity and the persistent challenge of data standardization across the textile lifecycle.

### **Cluster 4: Institutional barriers to green adoption (16.7%)**

This cluster specifically addresses the factors impeding green technology adoption in textile enterprises, including regulatory deficiencies, financial constraints, knowledge gaps, and organizational resistance. Ikram (2025) and Nath, Eweje, and Sajjad (2025) are central contributions. The cluster provides the empirical foundation for the barriers taxonomy developed in this study.

### **Cluster 5: Circular economy integration (14.3%)**

The smallest but fastest-growing cluster examines the application of circular economy principles to the textile sector, including closed-loop recycling, product-as-a-service models, and industrial symbiosis. Chen et al.'s (2021) analysis of circular economy and sustainability in clothing and textile supply chains represents a key contribution.

The temporal dynamics of the publication corpus reveal several noteworthy inflection points. The 2015 adoption of the UN Sustainable Development Goals, particularly SDG 6 (Clean Water and Sanitation), SDG 9 (Industry, Innovation and Infrastructure), and SDG 12 (Responsible Consumption and Production),

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catalysed a marked increase in research linking textile manufacturing to broader sustainability agendas. Between 2020 and 2024, the COVID-19 pandemic disruption of global supply chains, combined with growing consumer demand for transparency and sustainability, accelerated research at the nexus of digital transformation and environmental performance. Studies combining Industry 4.0 technologies (IoT, artificial intelligence, digital twins) with eco-efficiency assessment increased from 18 to 34 percent of annual publications, signalling a significant thematic shift toward technology-mediated sustainability solutions. Author co-citation analysis provides further insight into the intellectual structure. The most highly co-cited author network centres on three foundational clusters: a cleaner production cluster anchored by Ozturk, Kitis, and Yetis, focusing on process-level environmental optimization in textile mills; a circular economy cluster anchored by Geissdoerfer, Bocken, and Hultink, emphasizing systemic business model transformation; and a sustainability assessment cluster anchored by Niinimaki, Peters, and Dahlbo, focusing on macro-level environmental impact quantification. The relative isolation of developing-country researchers from these core clusters represents a structural barrier to knowledge transfer and may partially explain the low adoption rates observed in peripheral economies. Inter-cluster linkage analysis yields particularly instructive findings. The strongest link (strength = 847) connects Cluster 1 (cleaner production) to Cluster 5 (circular economy), indicating that process-level technological interventions and systemic circularity strategies are increasingly understood as complementary approaches. The second-strongest link (strength = 623) connects Cluster 2 (supply chain management) to Cluster 4 (institutional barriers), confirming that supply chain governance is heavily shaped by institutional factors. The co-occurrence frequency of the terms circular economy, Industry 4.0, and digital transformation increased sharply after 2020, reflecting an emergent research stream at the intersection of digitalization and circularity.

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Thematic content analysis identified four major categories of barriers to green technology adoption in textile enterprises. Financial barriers, reported in 73 percent of reviewed studies, encompass high initial investment requirements, uncertain return-on-investment timelines, limited access to green finance instruments, and the absence of dedicated credit mechanisms for environmental technology. Regulatory barriers (61%) include weak enforcement of environmental standards, legislative gaps, bureaucratic complexity, and inadequate incentive mechanisms. Informational barriers (58%) involve insufficient knowledge about available green technologies, shortage of trained technical personnel, and weak academia-industry collaboration. Organizational barriers (47%) comprise low management commitment, resistance to change, short-term profit orientation, and the absence of environmental strategy. The detailed taxonomy is presented in Table 1.

**Table 1. Taxonomy of barriers to green technology adoption in textile enterprises**

Barrier category	Key barriers	Prevalence	Key sources
<b>Financial barriers</b>	High initial investment; uncertain ROI; limited green credit access; absence of dedicated financial mechanisms for environmental technology	73%	Ikram (2025); Ozturk et al. (2016); Farrukh et al. (2024)
<b>Regulatory barriers</b>	Weak enforcement of environmental standards; legislative gaps; bureaucratic complexity; inadequate incentive mechanisms; cumbersome certification systems	61%	Nath et al. (2025); DiMaggio & Powell (1983); Farrukh et al. (2024)
<b>Informational barriers</b>	Insufficient knowledge of available green technologies; shortage of trained technical personnel; weak academia-industry collaboration; limited green technology market information	58%	Oliveira Neto et al. (2019); Jia et al. (2020)
<b>Organizational barriers</b>	Low management commitment; resistance to change; short-term profit orientation; absence of environmental strategy; weak internal communication	47%	Ikram (2025); Tornatzky & Fleischer (1990)

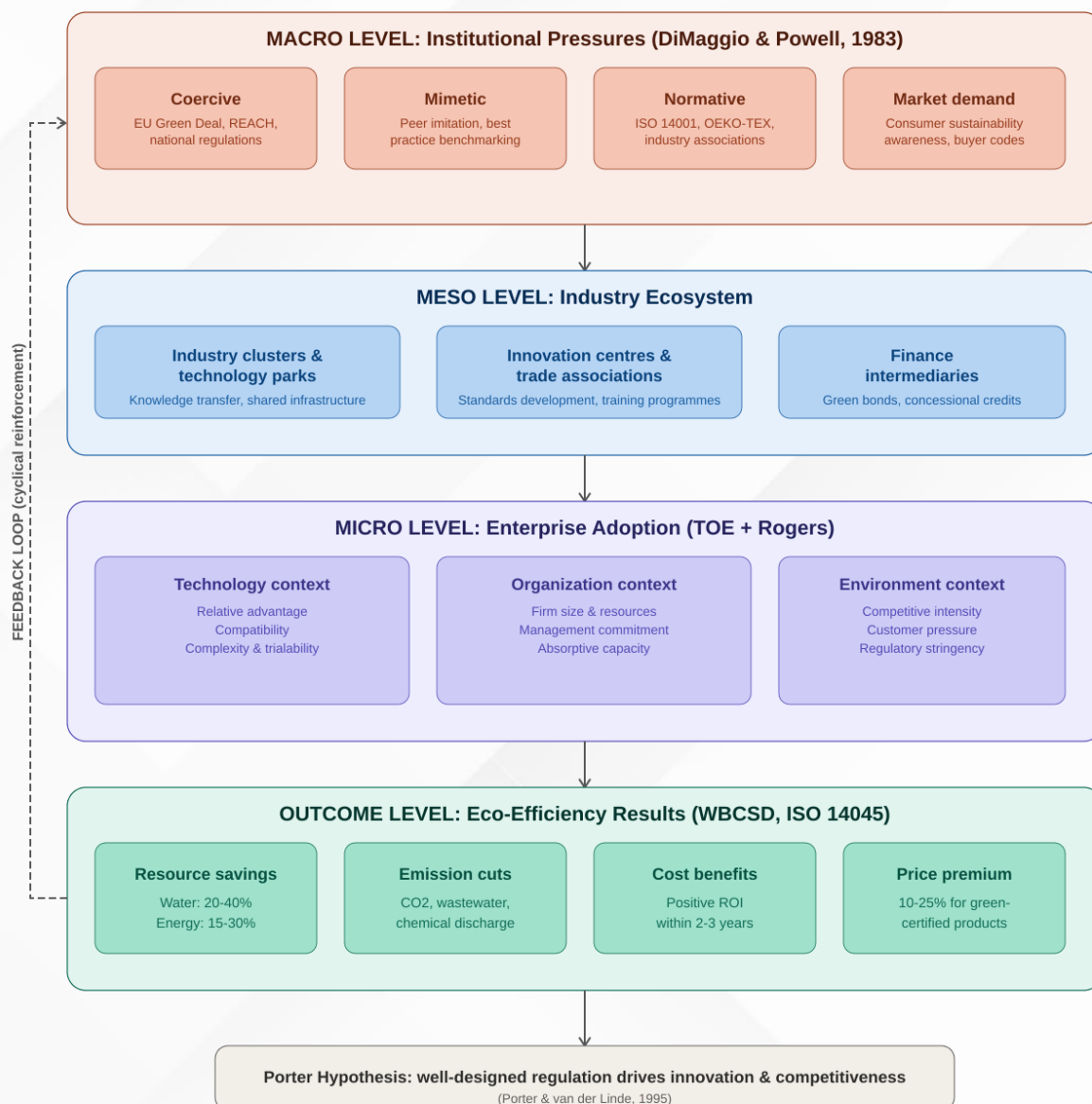
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**Figure 1. Integrated multi-level conceptual framework for green technology adoption in textile enterprises**

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### Discussion

The findings, interpreted through DiMaggio and Powell's (1983) institutional theory, reveal that all three isomorphic mechanisms operate in the textile sector's green transformation. Coercive isomorphism manifests through regulatory pressures — EU environmental directives, REACH chemical regulations, and importing countries' compliance requirements compel textile manufacturers to adopt cleaner technologies. Mimetic isomorphism operates as firms imitate the successful environmental practices of industry leaders, particularly when facing uncertainty about which technologies to adopt. Normative isomorphism is driven by industry associations, professional standards bodies (ISO, OEKO-TEX), and sustainability certification systems. Studies indicate that firms with ISO 14001 certification are 2.3 times more likely to adopt green technologies (Nath et al., 2025), confirming the powerful role of normative institutional pressures in shaping adoption behaviour.

The Technology-Organization-Environment framework provides a complementary lens. In the technological context, relative advantage and compatibility emerge as primary adoption determinants — technologies that demonstrably reduce costs while maintaining product quality receive the strongest uptake. In the organizational context, firm size, management commitment, and absorptive capacity are critical: larger firms with dedicated R&D functions adopt green technologies at significantly higher rates than SMEs. In the environmental context, customer pressure, competitive intensity, and regulatory stringency form the external push factors. The interaction between these three contexts determines the adoption decision, with the environmental context often serving as the primary trigger that activates evaluation of technological and organizational readiness.

Rogers' (2003) framework illuminates the diffusion dynamics of green technologies in textiles. Trialability emerges as a particularly important attribute, because the high capital costs and process disruption risks associated with full-

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scale adoption make pilot projects the preferred adoption pathway. Observable success cases — documented through industry publications, trade fairs, and best-practice databases — significantly accelerate diffusion by reducing perceived risk. The study identifies a typical adopter trajectory: innovators (3-5% of firms) adopt based on regulatory compliance or export market requirements; early adopters (10-15%) follow upon observing documented benefits; and the early majority (25-35%) adopt when industry-standard support infrastructure (training, maintenance, financing) becomes available.

Synthesizing the three theoretical perspectives, this study proposes a multi-level conceptual framework operating across four analytical levels. At the macro level, external institutional pressures — regulatory requirements, international standards, market demand for sustainable products, and civil society activism — create the impetus for green transformation. These pressures are mediated at the meso level by industry ecosystems — clusters, technology parks, industry associations, and innovation centres — that translate macro-level pressures into accessible resources and knowledge. At the micro level, individual enterprises evaluate their technological readiness, organizational capacity, and financial resources through the TOE lens and make adoption decisions influenced by Rogers' innovation attributes. The outcome level captures the eco-efficiency results — resource savings, emission reductions, cost benefits, and competitive advantages — which generate feedback loops that reinforce or modify the institutional environment. This cyclical feedback mechanism distinguishes the framework from linear adoption models.

Building on the integrated framework, a five-stage conceptual flowchart depicting the green technology adoption logic chain is proposed (Table 2). Stage 1 (External Pressure Recognition) involves monitoring regulatory developments, market trends, and stakeholder expectations — grounded in institutional theory's isomorphic mechanisms. Stage 2 (Internal Capability Assessment) entails evaluating technological readiness, financial resources, human capital, and

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organizational culture — corresponding to the TOE framework's three contexts. Stage 3 (Decision-Making) encompasses technology selection, cost-benefit analysis, risk assessment, and pilot project planning — informed by Rogers' innovation attributes. Stage 4 (Implementation) covers pilot execution, workforce training, technology adaptation, and monitoring system deployment. Stage 5 (Eco-Efficiency Outcome Evaluation) involves KPI monitoring, LCA assessment, ROI analysis, and feedback loop activation — returning information to Stage 1 to begin a new cycle. The cyclical nature of this process reflects the continuous improvement philosophy inherent in eco-efficiency.

The cyclical feedback mechanism embedded in the multi-level framework merits further elaboration. Unlike linear adoption models that treat technology implementation as a terminal event, the proposed framework conceptualizes adoption as an iterative process. Eco-efficiency outcomes, whether positive or negative, are continuously fed back to the macro-institutional and meso-industry levels. Positive outcomes generate demonstration effects that reduce mimetic uncertainty for potential adopters, strengthen normative expectations within industry associations, and may even influence coercive regulatory standards upward. Negative outcomes, conversely, may reinforce organizational inertia and financial risk perceptions, decelerating diffusion. This bidirectional feedback structure implies that early adoption successes, particularly those documented transparently through industry publications and best-practice databases, can generate a positive self-reinforcing cycle, while early failures can create a vicious cycle of risk aversion. Policy interventions should therefore prioritize de-risking mechanisms for early adopters, such as pilot project subsidies, technical assistance, and risk-sharing instruments, to initiate the positive feedback loop.

The circular economy paradigm offers a complementary lens for interpreting the findings. The Ellen MacArthur Foundation (2017) butterfly diagram distinguishes between biological cycles (for natural fibres such as cotton, wool, and silk) and technical cycles, each requiring distinct recovery strategies. The

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reviewed literature suggests that currently only 12 percent of textile materials are recycled, and the vast majority involves downcycling into lower-value products rather than closed-loop fibre-to-fibre recycling. Achieving the circular economy vision for textiles requires not merely incremental cleaner production improvements but fundamental redesign of products, business models, and reverse logistics systems, a transformation that the proposed five-stage flowchart can support by integrating circularity criteria into Stage 3 (Decision-Making) and Stage 5 (Outcome Evaluation).

The barriers taxonomy, interpreted through Porter and van der Linde's (1995) hypothesis, suggests that well-designed environmental regulation can stimulate innovation rather than merely imposing costs. Evidence from the reviewed literature indicates that textile enterprises adopting cleaner production technologies achieve average resource savings of 15-22 percent within three years (Ozturk et al., 2016), while green-certified textile products command price premiums of 10-25 percent. These findings support the 'strong' version of the Porter Hypothesis, suggesting that environmental policy can drive competitive advantage. Policy recommendations include: establishing dedicated green finance instruments to address financial barriers; strengthening enforcement mechanisms and simplifying certification procedures to address regulatory barriers; creating technology transfer platforms and industry-academia partnerships to address informational barriers; and developing green leadership training programmes to address organizational barriers.

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**Table 2. Five-stage conceptual flowchart of green technology adoption**

Stage	Process	Key activities	Theoretical basis
1	External pressure recognition	Monitor regulatory developments; assess market trends; evaluate stakeholder expectations; track international standards	Institutional theory (DiMaggio & Powell, 1983): coercive, mimetic, normative isomorphism
2	Internal capability assessment	Evaluate technological readiness; analyze financial resources; assess human capital capacity; diagnose organizational culture	TOE framework (Tornatzky & Fleischer, 1990): technological, organizational, environmental contexts
3	Decision-making	Technology selection; cost-benefit analysis; risk assessment; implementation strategy design; pilot project planning	Rogers (2003): innovation-decision process; relative advantage, compatibility, trialability evaluation
4	Implementation	Pilot execution; workforce training; technology adaptation; monitoring system deployment; continuous improvement cycle launch	TOE: organizational context; Rogers: re-invention and implementation
5	Eco-efficiency outcome evaluation	KPI monitoring (resource savings, emission reductions); LCA assessment; ROI analysis; eco-efficiency index calculation; feedback loop to Stage 1	WBCSD (1992): eco-efficiency principles; ISO 14045; Huppes & Ishikawa (2005)

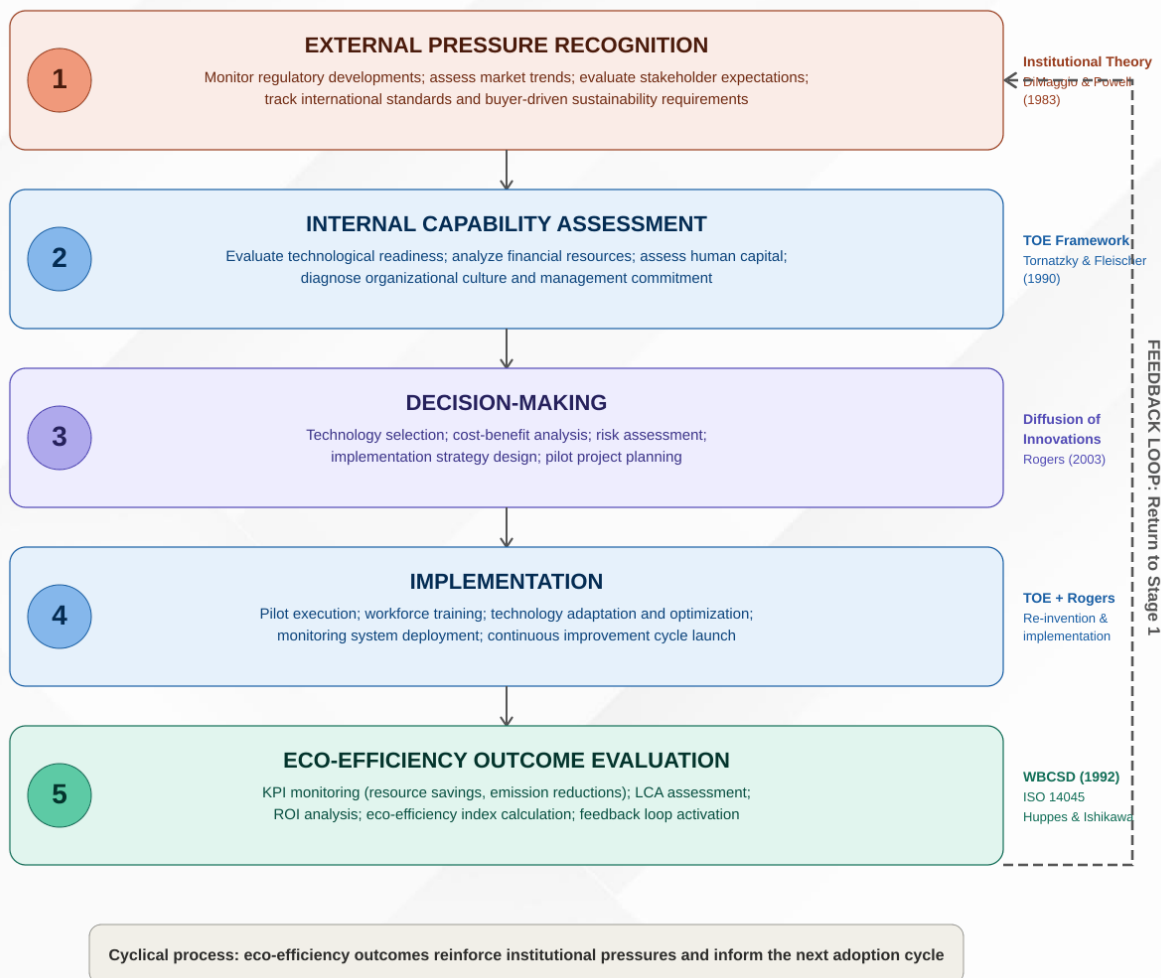
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**Figure 2. Five-stage conceptual flowchart of green technology adoption**

### Conclusion

This study has systematically reviewed and bibliometrically mapped the scholarly literature on eco-efficiency mechanisms of green technology adoption in the textile industry, analyzing 127 articles published between 2000 and 2024. The principal findings are as follows.

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First, bibliometric analysis reveals a rapidly growing field organized around five thematic clusters, with cleaner production technologies (27.4%) and sustainable supply chain management (21.4%) as the dominant research streams. Publication output has accelerated dramatically since 2020, driven by the EU Textile Strategy and the convergence of Industry 4.0 with sustainability research. China, the UK, and Turkey lead national contributions, while Central Asia, Africa, and Latin America remain severely underrepresented.

Second, the barriers taxonomy identifies financial constraints (73%), regulatory gaps (61%), informational asymmetries (58%), and organizational inertia (47%) as the four principal impediment categories. These barriers interact synergistically: financial constraints prevent technology acquisition; informational gaps prevent awareness of available solutions; regulatory weakness removes the external pressure for adoption; and organizational inertia resists change even when external conditions are favourable.

Third, the integrated multi-level conceptual framework — combining institutional theory, the TOE framework, and Rogers' Diffusion of Innovations — provides a comprehensive theoretical apparatus for understanding the macro-to-micro dynamics of green technology adoption. The accompanying five-stage flowchart operationalizes this framework as a practical decision-support tool, emphasizing the cyclical feedback mechanism that distinguishes genuine eco-efficiency transformation from one-off technology investments.

From a methodological perspective, the study demonstrates the value of combining bibliometric analysis with thematic content analysis in a systematic review. The bibliometric approach provides quantitative, reproducible mapping of the field's intellectual structure, while the thematic analysis enables deeper qualitative engagement with the substantive content of individual studies. This mixed-method SLR design is particularly appropriate for theoretically rich, interdisciplinary fields where both the structure of scholarly communication and the substance of theoretical arguments require examination. Future reviews in

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adjacent domains, such as green technology adoption in the construction or food processing industries, could productively employ a similar methodological combination.

The study contributes to the literature by providing the first comprehensive bibliometric mapping of eco-efficiency research specifically in the textile sector, by systematically taxonomizing adoption barriers, and by developing an integrated theoretical framework that bridges the gap between institutional analysis and firm-level decision-making. For practitioners, the framework offers actionable guidance for designing adoption strategies; for policymakers, the barriers taxonomy identifies priority intervention points; for researchers, the identified geographical and thematic gaps provide a clear agenda for future investigation.

### References

1. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
2. Chen, X., Memon, H. A., Wang, Y., Marriam, I., & Tebyetekerwa, M. (2021). Circular economy and sustainability of the clothing and textile industry. *Materials Circular Economy*, 3, 12.
3. DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(2), 147-160.
4. Ellen MacArthur Foundation. (2017). *A New Textiles Economy: Redesigning Fashion's Future*. Ellen MacArthur Foundation.
5. Farrukh, A., Mathrani, S., & Taskin, N. (2024). Investigating the theoretical constructs of a green lean six sigma approach towards environmental sustainability. *Sustainability*, 12(19), 8247.

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6. Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The circular economy - A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757-768.
7. Huppes, G., & Ishikawa, M. (2005). Eco-efficiency and its terminology. *Journal of Industrial Ecology*, 9(4), 43-46.
8. Ikram, M. (2025). Exploring the developments and research trends of environment management accounting. *Environment, Development and Sustainability*, 27, 1-35.
9. ISO. (2012). ISO 14045:2012 - Environmental management - Eco-efficiency assessment of product systems. International Organization for Standardization.
10. Jia, F., Yin, S., Chen, L., & Chen, X. (2020). The circular economy in the textile and apparel industry: A systematic literature review. *Journal of Cleaner Production*, 259, 120728.
11. Khatri, A., Peerzada, M. H., Mohsin, M., & White, M. (2015). A review on developments in dyeing cotton fabrics with reactive dyes for reducing effluent pollution. *Journal of Cleaner Production*, 87, 50-57.
12. Lin, B., & Tan, R. (2017). Ecological total-factor energy efficiency of China's energy intensive industries. *Ecological Indicators*, 73, 284-292.
13. Nath, S. D., Eweje, G., & Sajjad, A. (2025). Barriers and enablers of sustainable supply chain management in the garment industry. In *Responsible Business in a Changing World* (pp. 225-249). Springer.
14. Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews Earth & Environment*, 1(4), 189-200.
15. Oliveira Neto, G. C., et al. (2019). Cleaner production in the textile industry and its relationship to sustainable development goals. *Journal of Cleaner Production*, 228, 1514-1525.

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16. Ozturk, E., et al. (2016). Sustainable textile production: Cleaner production assessment/eco-efficiency analysis study in a textile mill. *Journal of Cleaner Production*, 138, 248-263.
17. Ozturk, E., et al. (2015). Evaluation of integrated pollution prevention control in a textile fiber production and dyeing mill. *Journal of Cleaner Production*, 88, 116-124.
18. Page, M. J., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71.
19. Porter, M. E., & van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, 9(4), 97-118.
20. Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). Free Press.
21. Sandin, G., & Peters, G. M. (2018). Environmental impact of textile reuse and recycling - A review. *Journal of Cleaner Production*, 184, 353-365.
22. Schaltegger, S., & Sturm, A. (1990). *Okologische Rationalitat. Die Unternehmung*, 44(4), 273-290.
23. Scott, W. R. (2001). *Institutions and Organizations* (2nd ed.). Sage.
24. Tornatzky, L. G., & Fleischer, M. (1990). *The Processes of Technological Innovation*. Lexington Books.
25. Van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523-538.
26. WBCSD. (1992). *Eco-Efficient Leadership for Improved Economic and Environmental Performance*. World Business Council for Sustainable Development.