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Circularity in Colombia's Textile Industry: Practices and Business Models Through a Multiple-Case Study

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Caminante, no hay camino: se hace camino al andar

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Abstract

In Colombia, roughly 95% of textile waste is landfilled, incinerated, or otherwise mismanaged, with documented impacts on ecosystems and water bodies. Although environmental legislation has increasingly embraced the circular economy at the global level in recent years, the country still lacks a specific and effective policy for textile-waste management. This policy gap coexists with an industry in which microenterprises account for about 94.2% of firms, which pose challenges for implementing and scaling circular solutions.

Against this backdrop, *Circularity in Colombia's Textile Industry: Practices and Business Models Through a Multiple-Case Study* adopts an exploratory qualitative approach to ask: *How are circular economy practices being implemented across Colombia's textile industry, and which enabling factors and challenges influence the adoption and scaling of circular business models?* Drawing on semi-structured interviews with ten small companies that integrate circularity into their value propositions, within-case and cross-case analyses were conducted based on: (i) mapping circular practices by lifecycle stage (sourcing, design, production, distribution, and post-consumer), (ii) the 9R framework, and (iii) a Circular Business Model (CBM) typology: Circular suppliers, Product life extension, Sharing/Access, Resource Recovery, and Product-as-a-Service.

Findings show the prevalence of cycling strategies, centered on remanufacturing/upcycling and the use of surplus/deadstock, complemented by resource recovery where industrial alliances exist (e.g., re-spinning, panels, concrete, PP/PET inputs). Key enablers include reliable access to recovered inputs, partner networks, and flexible capacity via satellite workshops. Recurring challenges include material heterogeneity and labor intensity, capacity/infrastructure gaps, price sensitivity and higher costs of recycled inputs, a regulatory vacuum (absence of EPR), and logistics frictions. The social dimension was a critical finding that was briefly addressed: recyclers and workshop workers, often operating under informal conditions, whose fair inclusion emerges as a necessary condition for scaling circularity in the sector.

Resumen

En Colombia, cerca del 95% de los residuos textiles terminan en vertederos, se incinera o no se gestiona adecuadamente, con impactos sobre ecosistemas y cuerpos de agua. Aunque en los últimos años la legislación ambiental ha incorporado con mayor claridad el enfoque de economía circular a nivel global, en el país aún no existe una política específica y efectiva para la gestión de residuos textiles. Esta brecha convive con una industria en la que las microempresas representan aproximadamente el 94,2% del tejido empresarial, lo que plantea desafíos particulares para implementar y escalar soluciones circulares.

En este contexto, el estudio *Circularity in Colombia's Textile Industry: Practices and Business Models Through a Multiple-Case Study* adopta un enfoque cualitativo exploratorio para responder: *¿Cómo se implementan las prácticas de economía circular en la industria textil colombiana y cuáles son los factores habilitadores y los retos que influyen en su adopción y escalamiento?* Mediante entrevistas semiestructuradas a diez pequeñas empresas que integran la circularidad en su propuesta de valor, se realizó un análisis within-case y cross-case sustentado en: (i) el mapeo de prácticas circulares por etapa (diseño, producción, distribución y postconsumo); (ii) el marco 9R; y (iii) la tipología de Modelos de Negocio Circulares (CBM): Circular suppliers, Product life extension, Sharing/Access, Resource Recovery y Product-as-a-Service.

Los hallazgos evidencian la prevalencia de estrategias *cycling*, basadas en remanufactura/*upcycling* y aprovechamiento de excedentes (*deadstock*/saldos), complementadas por recuperación de recursos cuando existen alianzas industriales (hilatura, paneles, concreto, PP/PET). Entre los habilitadores destacan el acceso estable a insumos recuperados, las redes de socios y la capacidad flexible habilitada por talleres satélite. Los retos más frecuentes incluyen la heterogeneidad del material y la alta intensidad de mano de obra, brechas de capacidad/infraestructura, sensibilidad al precio y mayores costos de insumos reciclados, vacío regulatorio (ausencia de EPR/RAP) y fricciones logísticas. La dimensión social fue un hallazgo crítico que se abordó brevemente: recicladores y trabajadores de talleres, a menudo en condiciones de informalidad, su inclusión justa emerge como condición necesaria para escalar la circularidad en el sector.

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1. Introduction

The textile and apparel industry is a global economic sector, valued at approximately USD 2.4 trillion and employing around 75 million people across its value chain, making it the third-largest manufacturing industry worldwide (Gautam, 2024). Despite its economic significance, the textile industry is considered one of the most polluting and resource-intensive sectors globally (Salmi & Kaipia, 2022). Each year, at least 88.9 million tons of textile waste are generated, with approximately 87% of the material used in production lost without being recycled, ending up incinerated or in landfills (Jurado, 2019; Thomas et al., 2024). Textile manufacturing requires enormous amounts of non-renewable resources, consuming about 100 million tons of raw materials and 100 billion cubic meters of water annually, ranking it as the fourth-largest industry in terms of resource consumption worldwide (Oliveira Neto et al., 2024; Saccani et al., 2023). This situation is further exacerbated by the "fast fashion" model, which accelerates the production and consumption of short-lived garments, thereby increasing pollution and waste generation (Saccani et al., 2023).

The life cycle of textiles accounts for between 8% and 10% of global greenhouse gas (GHG) emissions (Klemm & Kaufman, 2024). It is estimated that over 100 million new garments are produced worldwide each year, of which approximately 92 million are mixed with other waste and end up incinerated, exported, or disposed of in landfills, exacerbating the environmental crisis (Ramírez-Escamilla et al., 2024). Globally, around 73% of garments are discarded after use, representing not only a significant loss of resources but also a missed economic opportunity (Valtere et al., 2023). By 2030, textile waste generation is projected to reach 148 million tons, an increase of 62% compared to 2015 (Koszewska, 2018; Schmutz & Som, 2022).

In Colombia, the situation reflects similar trends. Although the textile industry has historically been significant for the national economy, accounting for 8.2% of the industrial GDP and 21% of employment in the sector (Adarme-lópez et al., 2025; Gómez Ruiz, 2021), approximately 95% of textile waste ends up in landfills, incineration plants, open dumps, or water bodies due to inadequate management (Aguirre González, 2024). The highest

concentration of companies is found in Medellín, Bogotá, and Cali, with Antioquia and Bogotá responsible for 84% of total textile production (Congreso de la República de Colombia, 2023). This concentration contributes to the increase of pre-consumer waste, which, due to its volume and composition, requires specialized management for final disposal (Orozco Mazo, 2022).

The Colombian textile industry faces an additional challenge due to its high resource consumption; approximately 97% of the raw materials used are virgin, with 63% being synthetic fibers and 26% cotton (Orozco Mazo, 2022). Production processes demand significant amounts of water, energy, and labor, while dyes generate around 100 tons of effluents per year, polluting water bodies (Duque Montaña, 2023; Otero, 2023). For these reasons, the textile industry in Colombia is currently undergoing a critical transition phase toward sustainability and circularity (Adarme-lópez et al., 2025). In this context, it is essential to adopt more sustainable business models to promote economic development without compromising resources, fostering innovation, and reducing environmental impacts within the textile sector.

Sustainability seeks to balance environmental resilience, economic performance, and social inclusion to ensure the well-being of future generations. Recognized by international organizations such as the United Nations, it has become a central concept across multiple disciplines (Duić et al., 2015). Its three pillars (social, economic, and environmental) are interdependent and mutually reinforcing. The social pillar promotes inclusion, strengthens communities, and encourages responsible production and consumption. The economic pillar focuses on profitability, financial stability, and value creation through resource-efficient practices. The environmental pillar emphasizes ecological resilience, waste reduction, energy efficiency, and the use of sustainable materials. Practices such as remanufacturing, recycling, and reuse help minimize environmental impacts. Circular economy business models (CEBMs) provide tools to achieve these goals. They enhance resource efficiency, reduce waste, create economic value, and support social responsibility. Overall, CEBMs align business strategies with sustainability objectives, fostering more resilient and equitable systems (Hina et al., 2023).

Circular economy (CE) has emerged as a solution by aiming to eliminate the concept of "end-of-life" for products, prioritizing the reduction, reuse, recycling, and recovery of materials, thereby extending their useful life and minimizing negative environmental and economic impacts (Furferi et al., 2022; Klemm & Kaufman, 2024). However, the adoption of circular practices faces significant barriers, including limited recycling infrastructure, technological gaps, and a lack of integration within the value chain (Gómez Ruiz, 2021). At the international level, the European Union (EU) is at an early stage of transitioning toward a more circular industry, driving fundamental changes in the design, use, and disposal of products. To achieve this, Extended Producer Responsibility (EPR) and the "Closing the Loop" Action Plan have been implemented, aiming to transform production and consumption processes while prioritizing key sectors, such as textiles, to promote circular economy practices (Aguirre González, 2024; Gutiérrez & Pedraza, 2023).

In this context, the implementation of CE practices becomes a strategic necessity, driven by the environmental crisis, growing social and market awareness, and evidence from successful experiences. In Colombia, this challenge is particularly relevant in light of the legislative proposal presented for the first debate of Bill No. 218 of 2022, “Establishing a comprehensive management system for textile waste for large textile-producing or commercializing companies”, as well as the Sustainable Development Goals (SDGs) related to responsible production and consumption. Therefore, it is essential to evaluate sustainable and circular business models in Colombia. Analyzing how companies implement circular practices will provide valuable insights for public policies and business strategies aimed at promoting sustainability, resource efficiency, and the reduction of environmental impacts in the textile industry.

Despite the growing interest in the CE, the literature on its implementation in Colombia remains limited. Some studies have focused on describing circular strategies or specific company cases, but few have systematically examined how firms in the textile sector have integrated these models into their business, or how such practices contribute to their consolidation and scaling. This gap highlights the need for empirical evidence to better understand the implementation of circularity in specific contexts such as Colombia. Accordingly, this research adopts an exploratory qualitative approach to address the question:

How are circular economy practices being implemented across Colombia's textile industry, and which are the challenges and enabling factors that influence the adoption and scaling of circular business models in the textile industry?, the study uses semi-structured interviews with ten small Colombian companies that integrate circular practices as a core part of their business models. The aim is to identify patterns, strategies, and challenges in implementing CE practices, as well as the role of fashion brands in their adoption and development.

1.2. Objectives

1.2.1. General Objective

To identify the circular economy practices and business models present in the Colombian textile industry, and to analyze their characteristics, strategies, and challenges in order to support the transition toward a more sustainable sector.

1.2.2. Specific Objectives

- Describe the circular economy practices currently implemented by textile companies in Colombia across different lifecycle stages, including sourcing, design, production, distribution, and post-consumer end-of-life management.
- Categorize textile companies according to their business models to identify shared characteristics and patterns within the existing framework
- Describe the main challenges and enabling factors that influence the adoption and scaling of circular business models in the textile industry.
- Formulate strategic recommendations for strengthening the transition toward circularity in the Colombian textile sector, based on findings from both the case studies and sector-wide analysis.

2. Literature Review

2.1. Circular Economy (CE)

According to the European Parliament Research Service (2023), the CE is defined as a production and consumption model that includes sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible. The life cycle of items is hence extended, which means cutting waste as much as possible. When a product reaches the end of its life, recycling helps keep materials in the economy wherever possible. Further value can be created by repeatedly using these in a productive manner.

By extending the lifespan of goods, materials, and resources, CE is an economic model that aims to reduce waste and increase resource efficiency (Ellen Macarthur Foundation, 2015). In contrast to the conventional take-make-dispose linear economy, Akhimien et al. (2021) highlights that the CE helps close the loop (Figure 1), preventing resource depletion, placing emphasis on:

- Reuse, recycling, reduce.
- Extending product lifespans through repair and refurbishment.
- Improving efficiency in production and consumption.

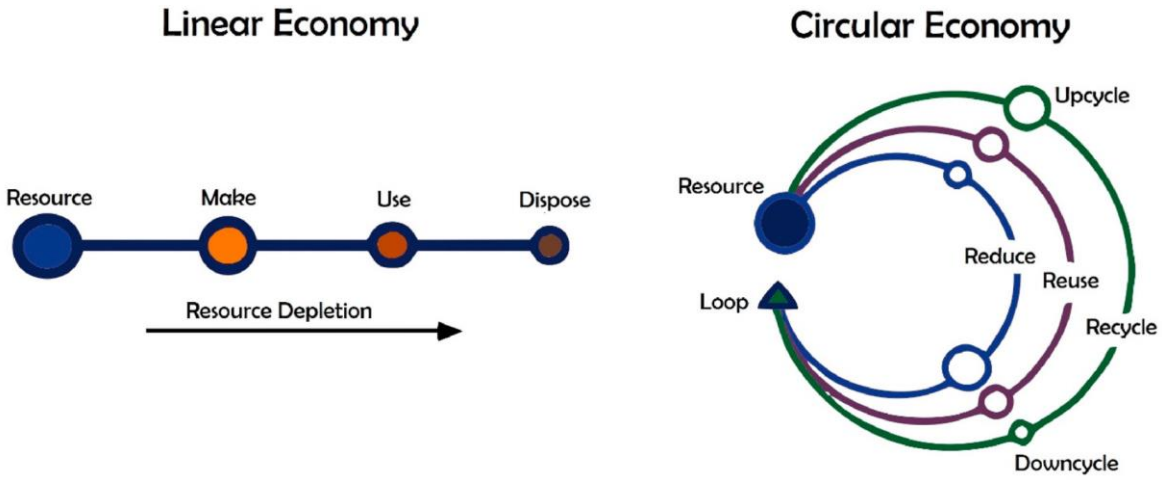

Figure 1. *Linear and circular economy* (Akhimien et al., 2021)

Similarly, CE employs the Narrowing the Loop strategy, which focuses on using fewer resources in the production and consumption of goods. This approach aims to increase resource efficiency and reduce the intensity of materials used, including metals, minerals, fuels, water, land, wood, fertile soil, clean air, and biodiversity. Its main objective is to reduce resource use from economic development. This is achieved through greater resource and material efficiency, technological innovation, and cleaner production processes (Domenech & Bahn-Walkowiak, 2019; Gerstmann, 2020). In addition, the Slowing the Loop strategy seeks to extend the lifespan of products, components, and materials as long as possible. By keeping products in use for longer periods, the need to manufacture new items decreases, thereby reducing the consumption of virgin resources and minimizing waste generation (Abdelmeguid et al., 2022; Jacometti, 2019).

Ghisellini et al. (2016) state that the reduction principle is essential to CE and that it seeks to reduce the amount of primary energy, raw materials, and waste input by increasing production and consumption efficiency (eco-efficiency), such as by introducing better technologies, lighter and more compact products, simpler packaging, more efficient household appliances, a simpler lifestyle, etc. In that order, CE aims to establish a framework that encourages the more effective use of natural resources. Its goal is to maintain the value of resources for as long as possible by reducing resource leakage through the closure, slowing down, or reducing material flows (Geissdoerfer et al., 2016). To do this, a number of crucial tactics are needed, including redesigning products to increase their recyclability, reusing materials, and extending their lifespan through repair or refurbishing (Geissdoerfer et al., 2016).

Several frameworks describe CE principles, but the most widely cited include the 9Rs Framework and the Butterfly Diagram. The first one is useful to describe a restorative system, designed to keep materials within the consumption loop for as long as possible, by implementing activities of refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, and recover (Gasulla Tortajada et al., 2024). The butterfly diagram is governed by three principles: the first is to preserve natural capital by managing finite resources and balancing the flow of renewable resources; the second focuses on optimizing resource yields by ensuring that products, components, and materials are circulated with maximum utility in

technical as in biological cycles; the las one is to enhance system effectiveness by identifying and eliminating negative externalities (Ellen Macarthur Foundation, 2015).

2.1.1. Importance of Circularity in the Textile Sector

The textile industry has historically been one of the most polluting due to its high consumption of natural resources, environmental impact, and large volumes of waste generated (Klemm & Kaufman, 2024). The current system, predominantly linear (take, make, dispose), depletes resources and causes significant environmental pollution (Koszewska, 2018). It is estimated that the textile sector is responsible for between 8% and 10% of global CO2 emissions, and approximately 20% of industrial water pollution is caused by the dyeing and treatment of textiles (Klemm & Kaufman, 2024). Additionally, more than 92 million tons of textile waste are generated annually, and it is projected that the total amount of waste could increase to 148 million tons by 2030 globally, representing a 62% increase since 2015. The majority of this waste ends up in landfills or is incinerated (Koszewska, 2018; Schmutz & Som, 2022).

Circularity has become of vital importance in the textile sector due to the significant environmental impacts of the industry and the urgent need for systemic transformation (Gautam, 2024). The traditional linear model has proven to be unsustainable, generating vast amounts of waste and pollution, depleting natural resources, and contributing to GHG emissions (Alonso-Muñoz et al., 2022; Thomas et al., 2024). The implementation of CE practices in the textile value chain could lead to an estimated reduction of 143 million tons of GHG emissions by 2030 (Klemm & Kaufman, 2024). All the above contribute to multiple United Nations Sustainable Development Goals (SDGs), including health and well-being, clean water, decent work, industry and innovation, responsible consumption and production, climate action, and life below water (Gautam, 2024; Valtere et al., 2023).

By implementing circular practices, the lifespan and value of materials are maximized through the promotion of reuse, repair, remanufacturing, and closed-loop recycling (Salvador et al., 2020). This allows for the recovery of value from waste, transforming it into new raw materials or products. As an example, Schmutz & Som (2022) estimate that 546 tons of fabric waste could be used to produce over 1.7 million t-shirts. Furthermore, circularity offers

strategic growth and profitability opportunities for companies by reducing reliance on non-renewable resources and waste disposal costs (Furferi et al., 2022; Salvador et al., 2020).

Circularity in the textile industry offers significant environmental, economic, and social benefits (Salvador et al., 2020). It helps reduce large amounts of textile waste that end up in landfills or are incinerated, minimizing associated environmental impacts, such as the release of methane and carbon dioxide into the atmosphere, and the leaching of pollutants into the soil (Valtere et al., 2023). Among its benefits, also promotes environmental sustainability by enabling the reuse of materials and energy (Gautam, 2024); decreases the need for the extraction of virgin resources, contributing to decoupling economic growth from the extraction of raw materials and their environmental harm (Klemm & Kaufman, 2024); and optimizes resources like water and energy in production processes (Furferi et al., 2022).

In terms of economic benefits, the implementation of circularity in the textile industry transforms what was traditionally considered an expense into a source of value and opportunities (Schmutz & Som, 2022). The CE allows textile waste to be viewed not as a cost, but as a resource for producing new textile products. This is achieved by exploiting the residual value of resources, for example, using PET bottles to produce clothing or carpets (Salvador et al., 2020). However, this implementation entails a series of challenges for businesses, consumers, and governments.

The implementation of circularity in the textile industry is driven by the urgent need to mitigate its significant environmental impact and the substantial economic and social opportunities it offers (Klemm & Kaufman, 2024). This model, which redefines waste as a resource, aims to maintain the value of materials at their highest level for as long as possible and minimize resource leakage (Salvador et al., 2020). The systemic transition is urgent, and the need for Global North societies to fundamentally transform how clothing is produced and consumed in the next decade has been emphasized (Thomas et al., 2024). Additionally, upcoming legislative changes in the European Union and the United States are likely to restrict or increase the cost of textile disposal. Several stakeholders have expressed the urgency of developing sustainable recycling solutions for post-consumer materials (Thomas et al., 2024). In this way, implementing circularity in the textile industry is becoming an increasingly critical necessity.

Regulatory pressure and strategic objectives will make the CE a necessity. The European Union has recognized the importance of this transition by establishing the textile sector as one of the seven key value chains prioritized for the CE (Valtere et al., 2023). Initiatives such as the European Green Deal provide a roadmap for industries to address environmental challenges (Dziubaniuk et al., 2024). More companies are acknowledging this challenge; renowned international consulting firms such as McKinsey, Deloitte Group, and BCG highlight the dynamic and competitive nature of the current fashion industry, characterized by abrupt changes and growing uncertainty (Gautam, 2024). Also companies like Inditex and Patagonia are actively exploring circularity policies as part of their corporate social responsibility strategies (Jurado, 2019).

Authors such as Dziubaniuk et al., (2024) and Jurado (2019) argue that new social and industry trends toward sustainable consumption are influencing the transition to CE, with increased public awareness and a shift in mindset from linear to circular. Circularity in the textile sector is not only a response to environmental pressures but also a strategic path for innovation, economic efficiency, the creation of new markets, and the enhancement of brand reputation. It transforms challenges into opportunities for long-term growth and sustainability (Salvador et al., 2020).

It is relevant to highlight the 9Rs framework adapted to the textile industry by Gasulla Tortajada et al. (2024), which addresses the CE and sustainability in the behavior of luxury fashion consumers. Figure 2 outlines how each R can be applied in the industry based on its approach. (Gasulla Tortajada et al., 2024; Klemm & Kaufman, 2024).

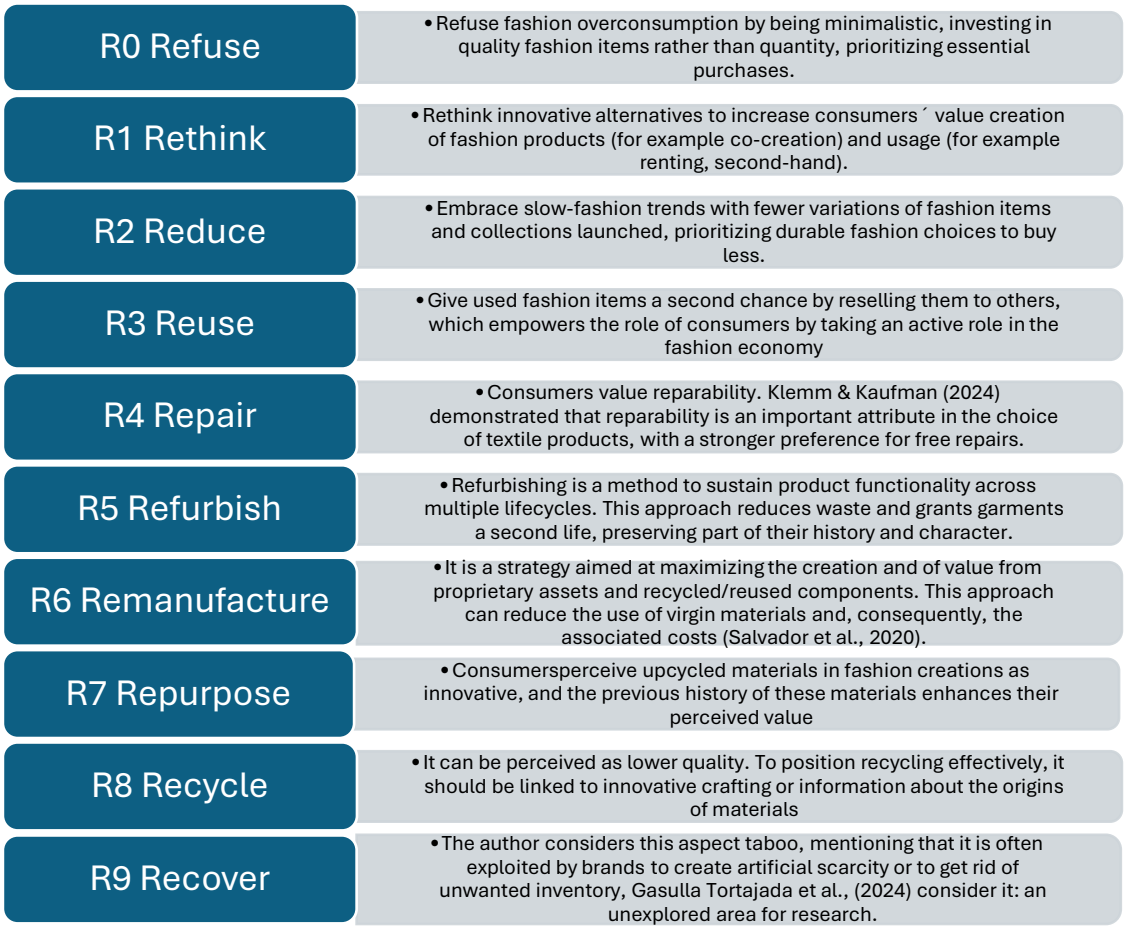

Figure 2*. 9R of circular economy in the textile industry* (Gasulla Tortajada et al., 2024)

2.1.2. Challenges and Barriers of circularity in the Textile Sector

The adoption of circularity in the textile industry is a complex process, essential for mitigating its significant environmental impact. However, it faces numerous challenges and barriers that hinder its implementation and scalability (Saccani et al., 2023). Despite the growing interest in sustainability and the CE, transitioning from a linear model to a circular one presents both internal and external obstacles for companies (Gautam, 2024; Saccani et al., 2023). These challenges vary depending on the company size, available infrastructure, consumer demand, and government policies (Salvador et al., 2020).

Primarily, recycling technologies are either underdeveloped or nonexistent (Schmutz & Som 2022). Given the complexity of textile product compositions, which often include fiber blends and non-textile elements such as zippers or buttons, separating and recycling

them becomes both difficult and costly. This makes the classification of textile waste a complex and expensive process due to variability in fiber content, color, and the quality of post-consumer materials (Koszewska, 2018; Schmutz & Som, 2022).

Additionally, there is a low and variable amount of collected textile waste, making it difficult for recycling companies to plan their operations efficiently. As a result, only a small percentage of textiles are collected separately, with the majority ending up in landfills or incinerators (Coscieme et al., 2022; Saccani et al., 2023). In this area, reverse logistics is a challenge due to the globally dispersed production and consumption networks, which increase transportation costs and the carbon footprint. The lack of traceability for textile products hinders the tracking of materials throughout their lifecycle for recovery and recycling (Koszewska, 2018; Saccani et al., 2023). To address this, Silván-Ferrero et al. (2023) suggest that the digitalization of production chains as a way to improve traceability and control.

Regarding recycling methods, mechanical recycling reduces the quality of the fiber and often results in downcycling (use in lower-value products such as cleaning rags or insulation) (Saccani et al., 2023). This limits opportunities for multiple cycles of reuse and recycling due to the reduction in fiber length and quality. Furthermore, there is concern that recycling, especially mechanical recycling, could release toxic chemicals such as perfluoroalkyl substances (PFAS) and microplastics into the environment, as there are currently no large-scale processes to identify and remove these contaminants from post-consumer materials. While chemical recycling technologies are promising for maintaining fiber quality, they are still not used at an industrial scale and require further development (Thomas et al., 2024).

Recycling is often not economically viable; it is more expensive than incineration or the production of new products. For this reason, it is suggested that the average incineration cost can serve as a reference to make recycling competitive (Schmutz & Som, 2022). Additionally, because the prices of virgin fibers are low, it is challenging for recycled materials to compete in the market in terms of both price and quality (Fontell & Heikkilä, 2017; Schmutz & Som, 2022). Furthermore, the fast fashion model, with its low prices and

inferior quality, encourages the continuation of linear consumption (Fontell & Heikkilä, 2017).

The lack of a developed market and textile recyclers interested in textile waste is a significant barrier (Alonso-Muñoz et al., 2022). Uncertainty about the demand and consumer acceptance of circular products (which are often perceived as lower quality or more expensive) impacts their economic viability (Saccani et al., 2023). Additionally, the classification of textiles as *special waste* in certain regulations leads to additional certification costs and bureaucracy, making investment in this market a challenge, particularly for small businesses (Saccani et al., 2023). While Small and Medium-sized Enterprises (SMEs) have limited financial and human resources to invest in the transition to a CE (Alonso-Muñoz et al., 2022), large companies are hesitant to invest until technologies and costs are proven (Thomas et al., 2024).

Finally, another important point mentioned by Thomas et al. (2024) is the lack of clear incentives for individual companies to bear the financial burden of transitioning to a CE. The absence or insufficiency of clear and aligned legal frameworks and policies at the international scale represents a significant obstacle to the implementation of the CE in the textile industry (Saccani et al., 2023). For these reasons, Arnold et al. (2010) argue that the textile industry requires a systemic change supported by clear regulations, financial incentives, education, and greater collaboration among all stakeholders in the value chain.

2.2. Circular Business Models (CBM)

Circular Business Models (CBMs) are an innovative approach that aims to transform the way companies operate to achieve greater sustainability (N. M. P. Bocken et al., 2014). These models are design strategies and business models that seek to slow down, close, and narrow source loops (Geissdoerfer et al., 2016). Their main goal is to maintain products, components, and materials with the highest utility and value possible at all times, distinguishing between technical and biological cycles (Ellen Macarthur Foundation, 2015). CBMs are considered a type of sustainable business model (SBM) and are distinguished by integrating a triple bottom line approach (economic, environmental, and social) by

considering a wide range of stakeholder interests, including the environment and society (N. M. P. Bocken et al., 2014).

In general, a business model explains "how business is done" by outlining how a company proposes, generates, delivers, and collects value for itself, its clients, and other stakeholders (N. Bocken et al., 2019). The CBMs differ fundamentally from linear business models (LBMs), which are based on a "take-make-use-dispose" approach. LBMs assume that resources are abundantly available, easy to obtain, and cheap to discard, with their supply chains being linear, ending with the customer and often leading to large amounts of waste in landfills. In contrast, CBMs aim to promote a higher level of utility, preserving the economic and environmental value of products for as long as possible (Salvador et al., 2020).

Additionally, it is important to mention the difference between SBMs and CBMs. The first one, sustainability and SBMs, is a broader and more open concept, with a multitude of objectives that can vary depending on the stakeholders and interests. Its approach is holistic, aiming for a balanced integration of economic, environmental, and social dimensions. In contrast, CE and CBMs primarily focus on a more specific objective: a "closed loop" that ideally eliminates the input of resources and the leakage of waste and emissions from the system (Geissdoerfer et al., 2016). While it aims for environmental benefits (such as resource reduction and pollution), its primary benefit is directed towards the economic actors implementing it, with social gains often being implicit or secondary, and sometimes unclear in their integration (Geissdoerfer et al., 2016). The focus is often on resource efficiency and the creation of value from what was previously waste (Ellen Macarthur Foundation, 2015).

According to Bocken et al., (2019), a key component of business models is the concept of value. The main goal of CBMs is to maximize the value of resources for as long as possible, thereby reducing or delaying the excess of resources (Salvador et al., 2020).To preserve the embedded economic value for as long as possible, reduce environmental impacts, and deliver greater customer value, CBMs focus on slowing, closing, and narrowing resource loops (N. Bocken et al., 2019). CBMs have a clear purpose of creating a significant positive impact and/or significantly reducing negative impacts on the environment and/or society (N. M. P. Bocken et al., 2014). This is performed through changes in the way an

organization and its value network create, deliver, and capture value (N. M. P. Bocken et al., 2014). Key objectives include:

- Slowing down resource loops by promoting a long product lifespan and reuse (N. Bocken et al., 2019). This is reflected in design for remanufacturing, refurbishment, and recycling, as well as the "power of the inner circle," which aims to preserve the product's integrity and maximize its time in use (Ellen Macarthur Foundation, 2015).
- Closing resource loops by capturing the residual value of by-products or "waste" (N. Bocken et al., 2019). The idea is to eliminate the concept of waste by transforming its flow into useful inputs for other processes. This includes the "power of cascading use" to diversify reuse and the "power of pure inputs" to ensure material quality (Ellen Macarthur Foundation, 2015).
- Reducing (or narrowing) resource loops through product design and manufacturing efficiency (N. Bocken et al., 2019). This objective encompasses concepts such as "lean" manufacturing and maximizing material productivity and energy efficiency across the entire business (N. M. P. Bocken et al., 2014).
- To be restorative and regenerative by design. The recovery of materials and products is addressed not just at the end of usage, but also at the design stage. Companies must have fundamental capabilities in circular design to enable product reuse, recycling, and cascading (Ellen Macarthur Foundation, 2015).
- Promoting system effectiveness, identifying and eliminating negative externalities, such as air, water, and soil pollution, and the release of toxic substances (Ellen Macarthur Foundation, 2015).

CBMs incorporate principles of the CE as guides for their design. Bocken et al., (2019) and Salvador et al., (2020) identify:

- **Cycling**: focusing on recycling products or components within the system through reuse, remanufacturing, refurbishing, and recycling. An example is industrial symbiosis, where the by-products of one process are used as raw materials for another, to close resource loops.
- **Extending**: it involves prolonging the product's use phase through designs that are long-lasting and timeless, as well as through maintenance and repair. Patagonia

focuses on extending product lifespans through CE strategies by producing high-quality, functional, repairable, and technologically advanced items designed to last as long as possible (Jurado, 2019).

- **Intensifying**: This aims to intensify the use phase of a product through solutions such as the sharing economy. The strategy allows for new business models with stronger elements of service, such as Product-Service Systems (PSS), which can generate recurring revenue streams and a lower need for new product production.
- **Dematerializing**: providing the utility of a product without physical hardware, replacing it with service and software solutions. It can reduce the number of products manufactured while improving customer experience.

2.2.1. Circular Business Models in the Textile Sector

The textile industry faces considerable pressure to transition towards a CE (Salmi & Kaipia, 2022). Authors such as Fontell & Heikkilä (2017), Salmi & Kaipia (2022) and Schmutz & Som (2022) agree that the dominant LBM has doubled textile consumption and production over the past two decades, generating a large volume of waste and causing significant environmental impacts. In this context, CBMs are essential for mitigating these effects by treating waste as a resource and reducing reliance on virgin materials (Koszewska, 2018; Schmutz & Som, 2022). CBMs in the textile industry aim to:

- Use the minimum amount of resources for the longest possible time, extracting the maximum value throughout the process (Geissdoerfer et al., 2016).
- Close material loops, where products are reused for the same purpose, thereby optimizing resource efficiency and extending the product's lifespan (Geissdoerfer et al., 2016; Oliveira Neto et al., 2024).
- Reconcile resource efficiency with value creation, capitalizing on both the environmental and economic value inherent in products (Oliveira Neto et al., 2024; Salvador et al., 2020).
- Promote sustainable production and consumption practices, where factory waste can be transformed into a valuable input for another process (Oliveira Neto et al., 2024).

In the textile industry, various circular business models are being implemented by both global and local brands. Below are the most relevant models currently being applied in the sector:

Circular Suppliers. It represents a fundamental type of CBM in the textile industry, focused on optimizing resource use and reintroducing materials into the production cycle (Fontell & Heikkilä, 2017). It involves the provision of renewable energy, biologically sourced materials, or fully recyclable inputs to replace single-life cycle inputs (Fontell & Heikkilä, 2017). The goal is to reduce pressure on non-renewable resources, minimize waste, and decrease the environmental impact of production and consumption (Schmutz & Som, 2022). It allows a company to decouple its operations from the consumption of new resources by leveraging the economic value inherent in used products to create new offerings (Oliveira Neto et al., 2024).

The goal is to utilize inputs from circular paths, one way being the transformation of textile waste into raw materials to produce new textiles, thereby maximizing the value of materials for as long as possible. This includes the reuse of scraps and cuttings (pre-consumption) and the production of recycled fibers for spinning and use in other products (post-consumption) (Coscieme et al., 2022; Oliveira Neto et al., 2024). Examples found in the literature include the repurposing of used polyethylene terephthalate (PET) bottles to produce clothing or carpets (Salvador et al., 2020); Dziubaniuk et al. (2024) exemplifies how a Swedish company that specializes in mechanical recycling supplies raw materials to another company that performs chemical recycling, purchasing pre-classified textiles at the end of their useful life that cannot be mechanically recycled; and BIONIC transforms recycled plastics into innovative raw materials and high-performance textiles (Koszewska, 2018).

This business model brings multiple environmental benefits by reducing pressure on non-renewable resources, allowing a company to decouple its operations from the consumption of new resources by leveraging the economic value inherent in used products (Jurado, 2019). Similarly, it minimizes waste and pollution by transforming waste into raw materials, eliminating or reducing resource leakage, and decreasing

the amount of waste that ends up in landfills or is incinerated (Salvador et al., 2020). All the above contribute to the reduction of CO2 emissions and the consumption of energy and water, thus lowering the environmental impact (Fontell & Heikkilä, 2017).

Product Life Extension. It is based on designing products that are inherently durable and long-lasting. This involves using high-quality materials, robust assembly methods, and timeless designs that resist wear and avoid rapid obsolescence due to changing fashion trends. To achieve this, there are design strategies for durability and longevity, such as manufacturing classic, long-lasting products using high-quality fibers and fabrics that withstand frequent use and washing, and even incorporating post-sales services and maintenance strategies (Coscieme et al., 2022; Salvador et al., 2020).

Another strategy to extend product lifespan is through Take-back schemes. Brands or retailers facilitate the return of used garments for resale, recycling, or upcycling (Geissdoerfer et al., 2016; Jurado, 2019). This business model significantly reduces the generation of textile waste and its accumulation in landfills (Gautam, 2024), minimizes the consumption of natural resources, and creates new business opportunities and revenue streams (Jurado, 2019). Many companies are exploring or implementing PLE models:

- Patagonia, an example of slow fashion, focuses on producing durable, functional, and easy-to-repair garments. Its "Worn Wear" platform facilitates the buying and selling of second-hand clothing, extending the lifecycle of its products (Jurado, 2019).
- Zara, although primarily following a "fast fashion" model, as a subset of their activities has implemented garment take-back programs ("Closing the Loop") and has explored partnerships to use recycled textiles in its collections (Gautam, 2024).
- Manteco, an Italian company, applies the "Manteco System" for the production of regenerated wool fabrics and uses the "Manteco Aging Process" to test and ensure the durability of its prototypes (Furferi et al., 2022).

Sharing / Access. CBMs based on access involve offering the function or use of a product rather than its ownership (Coscieme et al., 2022). This is achieved through

various modalities such as rental, leasing, exchange, or pay-per-use models. By doing so, companies retain ownership of the product, which encourages them to design more durable and repairable products. The aim is for products to be in continuous use, maximizing the energy and materials embedded in them (Jurado, 2019). This model aims to reduce resource consumption by increasing the utilization rate of existing textile products (Coscieme et al., 2022).

Authors such as Salvador et al. (2020), Salmi & Kaipia (2022) and Oliveira Neto et al. (2024) suggest Access-Based Models (Product-Service Systems or PSS), where instead of selling ownership, the function or use of the product is offered through rental, leasing, or pay-per-use models (such as clothing libraries or subscriptions). These models encourage producers to design more durable products since profitability comes from the function rather than the sale. The company is responsible for managing the entire product lifecycle, including maintenance, repair, laundry, and disposal at the end of its useful life (Coscieme et al., 2022). A notable example is the rental of workwear uniforms. For instance, the Lindström Group offers workwear rental services, assuming responsibility for the ecological footprint and responsible disposal, designing textiles to be easy to repair and durable, and recycling garments from one user to another until they are no longer usable (Fontell & Heikkilä, 2017).

Rental and Leasing allow consumers to access garments for a specified period, which is common for special occasion clothing (such as wedding or dinner dresses) or even baby clothes. These models typically charge a periodic fee or pay-per-use. On the other hand, Sharing includes more informal models like wardrobe-sharing (Coscieme et al., 2022). For this business model, Salmi & Kaipia (2022) argue that the integration of digitalization is crucial. This can include more flexible and user-friendly rental and sharing platforms, product tracking technologies (such as RFID chips), and digital services for textile cleaning, sanitization, or even virtual wardrobes.

Resource Recovery: This strategy transforms what was once considered waste into a valuable resource for the production of new textile products or for other value chains (Salvador et al., 2020). The main goal is to redirect as much post-consumer textile material as possible back into reuse or recycling cycles, rather than being

incinerated or sent to landfills (Fontell & Heikkilä, 2017). The value capture in this case is primarily related to minimizing material acquisition costs and generating additional revenue from products/materials at the end of their useful life (Geissdoerfer et al., 2016).

This business model involves collecting, sorting, and cutting textile waste into fibers, which are then reprocessed using mechanical, thermal, or chemical methods (Dziubaniuk et al., 2024). Recycling systems can be either open-loop (where the waste is processed and used in another value chain, such as construction) or closed-loop (where the waste is processed and used within the same value chain, such as in the textile industry). Often, textile products are made from mixed materials, and recycling technology for these materials is not yet fully developed. This makes recycling less common than incineration for textile waste (Schmutz & Som, 2022).

It is important to address Industrial Symbiosis at this point, which involves using the residual by-products of one process as raw materials for another, either within the same facilities or between different organizations. Notable examples include the industrial symbiosis complex in Kalundborg, Denmark, which has demonstrated both environmental and economic gains by creating a local network where waste from one sector (such as steam from a power plant, dust, gases, or sludge) is transformed into inputs for other companies (Salvador et al., 2020).

As an example of this strategy, Pure Waste Textiles is a Finnish company that produces 100% recycled yarns, fabrics, and garments in India, using pre-consumption textile waste as raw material. Additionally, VTT Technical Research Centre of Finland Ltd leads research projects such as the "Relooping Fashion Initiative" and has developed cellulose carbamate (CCA)-based cotton recycling technologies, promoting the production of new fibers from textile waste (Fontell & Heikkilä, 2017). This resource recovery is essential for the textile industry's transition to a CE offering a path toward sustainability and new business opportunities. However, its full implementation requires overcoming significant technological, economic, and systemic barriers (Salmi & Kaipia, 2022).

2.3. Legislation and Policy Framework for Circular Economy

Environmental laws and policy frameworks provide the regulatory foundation to address environmental issues and require organizations to adopt sustainable operations. These legal frameworks establish specific obligations for companies, such as reducing emissions, improving waste management, and designing products with environmental considerations. They can also encourage sustainable practices through fiscal incentives, green certification programs, and subsidies for eco-friendly technologies (Daramola et al., 2024).

2.3.1. Global Legislation: The European Union Policy Framework

Primarily, the European Union has established itself as an international benchmark in environmental policy, making its regulatory framework particularly relevant when analyzing the transition toward a CE. As highlighted by Jacometti (2019), one of the most significant reforms was introduced in 2018 with the amendment of the Waste Framework Directive, which, for the first time, required member states to implement a separate collection system for textile waste, with a compliance deadline of January 1, 2025. This measure is part of a broader strategy aimed at preventing improper treatment that relegates materials to the lower levels of the waste hierarchy, increasing preparation rates for reuse and recycling, promoting high-quality recycling, and encouraging the use of reliable secondary raw materials. In the specific case of textiles, this provision is crucial to ensure that garments are properly collected and managed, thereby preserving their value through reuse or recycling.

The European Commission has shown a strong commitment to substantially improving resource efficiency within the European economy and facilitating the transition to a CE (Domenech & Bahn-Walkowiak, 2019). This commitment was further reinforced with the introduction of the "Roadmap to a Resource-Efficient Europe" (2011) and the "Circular Economy Action Plan" (2015) (Domenech & Bahn-Walkowiak, 2019).

By 2020, the European Commission presented the New Circular Economy Action Plan (CEAP) as one of the main pillars of the European Green Deal (EGD). This plan aims to ensure the implementation of the regulatory framework, maximize the business opportunities arising from the transition, and minimize burdens and obstacles for individuals and

companies (Spani, 2020). CEAP focuses on initiatives across the entire material life cycle, from product design to sustainable consumption. Key actions include:

- Sustainable products are the norm in the EU.
- Empowering customers and public buyers.
- Focusing on resource-intensive sectors with high circularity potential, such as electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, food, water, and nutrients.
- Reduce waste.
- Ensuring that circularity benefits people, communities, and cities.
- Leading global initiative in CE.

The textile sector is explicitly identified in the 2020 CEAP as one of the key sectors with high circularity potential and intensive resource use. To achieve the goal of making sustainable products the standard in the EU, CEAP proposes a legislative initiative on sustainable product policy. This initiative will complement the scope of the 2009 Ecodesign Directive, which so far has only addressed energy-related aspects (Spani, 2020). The new initiative will prioritize product groups, including textiles, for the introduction of mandatory requirements. Ecodesign requirements aim to promote repairability, durability, and recyclability of products from the design stage (Domenech & Bahn-Walkowiak, 2019). By doing so, the initiative seeks to enhance resource efficiency and circularity across the product life cycle.

Similarly, Extended Producer Responsibility (EPR) is a key legal instrument for the CE (Daramola et al., 2024). Within the CEAP framework, EPR plays a crucial role by encouraging companies to consider end-of-life implications of their products during the design phase (Daramola et al., 2024; Kyriakopoulos, 2021). According to Domenech & Bahn-Walkowiak (2019) EPR has a dual purpose:

- Internalization of environmental externalities: It requires producers to assume the environmental costs associated with managing their products at the end of their life, shifting responsibility from local authorities to manufacturers.

- Promotion of sustainable products and waste management: It drives the operational implementation of management schemes that follow the waste hierarchy (prevention, reuse, recycling, recovery, and disposal) and encourages eco-design.

Kyriakopoulos (2021) highlights that EPR schemes promote separate waste collection, help achieve municipal and packaging recycling targets, prevent the disposal of collected waste in landfills, and encourage producers to design more sustainable products. Additionally, EU member states are being encouraged to adjust EPR scheme fees based on product durability, repairability, reusability, and the presence of hazardous substances. Regarding their application to textiles, in July 2023 the European Commission proposed implementing EPR for textiles through an amendment to the Waste Framework Directive. This initiative forms part of the EU Circular Economy Action Plan and the EU Strategy for Sustainable and Circular Textiles (Vuori, 2023).

At the same time, addressing the release of microplastics or microfibers requires careful product design, which plays a key role in minimizing their emission, for instance, through the development of new materials and fabric constructions (Gerstmann, 2020). The European Commission plans to adopt measures to reduce microplastic pollution as part of its EU Strategy for Sustainable and Circular Textiles (Abrahamsson, 2022). It is also crucial to implement effective solutions to capture microfibers when their release is unavoidable, particularly during washing. This may involve financing the removal of micro-contaminants from wastewater, for example, by expanding cost coverage under EPR schemes (Gerstmann, 2020).

The EU Waste Framework Directive (WFD) requires Member States to implement separate collection systems for textile waste by 1 January 2025 at the latest (Carvalho et al., 2025). Stricter recycling targets have also been established, including 70% of municipal waste and 80% of packaging waste to be recycled by 2030, along with the near elimination of landfill disposal by the same year (Domenech & Bahn-Walkowiak, 2019). Once again, EPR serves as a key policy tool to ensure that producers take responsibility for the collection, sorting, and recirculation of the products they place on the market (Ellen Macarthur Foundation, 2024).

France and the Netherlands have implemented national EPR systems for textiles since 2007 and 2023, respectively, and more recently, Hungary adopted an EPR policy for textiles in July 2023 (Ellen Macarthur Foundation, 2024). France's experience, through its organization Re_fashion (formerly EcoTLC), has shown that EPR can significantly improve selective collection rates, while also providing financial support for sorting, research and development, and communication campaigns. Furthermore, France has set new collection targets of 60% by 2028 and recycling/reuse targets of 70% by 2024 and 80% by 2027. The country has also introduced a "repair bonus" to incentivize the repair of clothing and footwear, funded through producer EPR fees (Brown & Börkey, 2024). This demonstrates how government-led requirements can effectively drive the management of textile waste.

Due to the dramatic increase in second-hand clothing imports in some regions, such as Ghana (140.5% between 2000 and 2021), without a corresponding growth in waste management infrastructure, textiles are often incinerated, destroyed, or dumped (Ellen Macarthur Foundation, 2024), EU waste shipment regulations will provide clearer guidance on the criteria for determining whether used garments are considered waste. It is crucial to establish strict legal standards and guidelines for used clothing shipments to ensure that only intact products intended for reuse are exported, rather than waste (Brown & Börkey, 2024). Although producer responsibility has traditionally ended at the point of export, there is growing interest in extending EPR beyond jurisdictional borders to financially support collection, sorting, reuse, and recycling activities in importing countries (Brown & Börkey, 2024).

Similarly, the proposed Digital Product Passport (DPP) is part of the European Commission's 2020 CEAP. By centralizing detailed information for each product, from its production stage to end-of-life management, the DPP serves as a key tool to promote sustainability and facilitate the adoption of circular practices within the textile industry. Its integration with reporting requirements under EPR schemes enables increased efficiency for both manufacturers and regulatory authorities, encouraging higher levels of compliance (Legardeur & Ospital, 2024). In this context, implementing a DPP in the textile sector would involve creating a unique digital identity for each garment, providing a verifiable record of its journey throughout the entire value chain. In line with this perspective, Legardeur &

Ospital (2024) emphasize the need for a gradual approach, supported by public policy instruments aligned with the European Union Strategy for Sustainable and Circular Textiles.

The implementation of the DPP and EPR brings significant challenges and opportunities for brands and supply chains, aiming to promote a CE in the textile industry. Brands are required to comply with EPR, taking responsibility for the entire lifecycle of textile products, from design and manufacturing to end-of-life management (Abrahamsson, 2022). European Union regulations, such as the Green Deal and the Strategy for Sustainable Textiles, are expected to drive the adoption of circular practices (Farrukh & Sajjad, 2024), This requires companies to design products with extended lifespans, manufacture them for reuse, and produce them from safe, recycled, or renewable materials. Early adoption of these circular practices can provide competitive advantages, including a stronger brand image, increased stakeholder trust, and access to emerging markets (Abrahamsson, 2022).

2.3.2. Legislation in Emerging Markets: Colombian case.

In recent years, environmental legislation and policy in Colombia have begun to address the CE more explicitly. Table 1 presents the most relevant legislative and policy events in the country related to environmental management and the transition towards a CE, with a particular focus on the textile sector.

Table 1. *Colombian regulations for the transition to a circular economy, adapted from* Duque Montaña (2023)

Policy	Description
National Policy for the Integrated Management of Solid Waste, CONPES 3874 (2016)	Manage solid waste in an integrated manner, applying tools that optimize its use, with the aim of transitioning toward a circular economy.
Green Growth Policy, CONPES 3934 (2018)	Promote economic growth by considering sustainability actions, such as the preservation, restoration, and use of natural resources, and enhancing sector productivity.
Sustainable Production and Consumption Policy	Guidance toward sustainable and competitive production, with a focus on conservation, responsible consumption of natural resources, and pollution reduction.

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Recently, the National Circular Economy Strategy (2019) has guided Colombia's development model under the principle of "produce while conserving and conserve while producing" *("producir conservando y conservar produciendo")*. This strategy, aligned with international policies, agreements, and protocols ratified by the country, aims to promote efficient use of natural resources, mitigate ecosystem impacts, and extend the life cycle of products and materials (Duque Montaña, 2023). Within the recent legislative framework, Decree 2598 of 2022 partially modified the customs tariff for imported garments, establishing a 40% duty with the purpose of stimulating Colombia's fashion industry, enhancing its competitiveness, and promoting domestic production, with particular emphasis on generating employment for women in the sector (Duque Montaña, 2023).

Colombia is making progress in regulations and certifications to promote a more sustainable textile industry, as evidenced by the recently submitted Bill for a Textile Waste Management System *(Proyecto de Ley para un Sistema de Gestión de Residuos Textiles)* presented to the House of Representatives *(Camara de Representantes)*. This initiative establishes obligations for large textile-producing and marketing companies to mitigate the environmental impacts of the sector, promote CE practices, reduce water footprint, decrease the burden on landfills, and contribute to climate change mitigation (Congreso de la República de Colombia, 2023). This legislation is grounded in the country's international commitments; in 2015, within the framework of the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), Colombia pledged to reduce its greenhouse gas emissions projected for 2030 by 20%. Effective management of textile waste can contribute to achieving this target. To achieve this goal, the bill defines responsibilities for three key actors:

- **Large companies:** responsibly manage textile waste; implement educational and awareness campaigns; accept product returns from consumers free of charge; design strategies for efficient treatment or reincorporation into new products; and report these operations to the Ministry of Environment *(Ministerio de Ambiente)* and the Ministry of Housing *(Ministerio de Vivienda)*.
- **Users/consumers:** deliver textile waste to designated collection points and assume the associated social responsibility.

- **National government:** establish incentives for the utilization and valorization of waste; ensure access to information; promote innovation and technological development; and foster markets for recycled and second-hand textiles.

At the local level, Bogotá and Medellín, Colombia's two main cities, have promoted initiatives aimed at fostering circularity in the textile industry. In Bogotá, the Circular Fashion Network, in collaboration with the Bogotá Chamber of Commerce *(Camara de Comercio)* and FENALCO (National Federation of Merchants), seeks to reduce sectoral waste and pollution through training programs, the strengthening of circular economy models, material utilization, and the promotion of competitiveness and green growth. Meanwhile, Medellín has implemented public policies targeting SMEs, improving production processes and consolidating coordination platforms such as Colombiamoda and Colombiatex. Additionally, Empresas Varias de Medellín (Emvarias) (organization responsible for providing public sanitation services in Medellin) has developed textile valorization strategies, including partnerships with managers such as Fibretex and with organizations and foundations for the sorting and commercialization of materials, complemented by training programs aimed at companies and sector operators (Orozco Mazo, 2022).

These local initiatives reflect a broader framework of global and national commitments. Driven by Colombia's accession to the OECD in 2018 and the COP21 targets to reduce greenhouse gas emissions by 20% by 2030, the adoption of waste management and circular economy policies has gained increasing relevance (Congreso de la República de Colombia, 2023). However, to consolidate this transition, the government must establish economic and tax incentives, as well as clear regulatory frameworks that guide responsible and sustainable production; otherwise, the integration of circular models will continue to face barriers, despite being a strategic necessity for the textile sector (Cuartas Galvis, 2018).

2.4.Adoption of Circular Practices in Colombia's Textile Sector

The adoption of circular practices in Colombia's textile industry has become a strategic and urgent necessity, given the magnitude of environmental challenges and the sector's need to enhance competitiveness (Cuartas Galvis, 2018). Although Colombia is still at an early stage in implementing sustainable models, characterized by fragmented and heterogeneous

progress, significant advances and a growing environmental awareness are evident in the industry (Adarme-lópez et al., 2025). This interest is further supported by emerging generations of consumers, who increasingly demand responsible and sustainable options (Cuartas Galvis, 2018), as well as by a more stringent political and regulatory framework, reflected in instruments such as the National Circular Economy Strategy (ENEC), Draft Law No. 218 of 2022, and Decree 2598 of 2022, among others.

At the same time, the second-hand market and innovative business models have shown notable growth in Colombia. In Bogotá, for instance, this market has increased by 32 %, with platforms such as Gotrendier facilitating clothing resale (Adarme-lópez et al., 2025). Ventures like Kambia and ClosetUp aim to transform the perception of second-hand clothing, promoting its consumption as a sustainable alternative (Otero, 2023). Similarly, practices such as upcycling, design for durability and repair, and made-to-order production have gained traction, emerging as relevant circular strategies in the country (Duque Montaña, 2023; Otero, 2023).

Moreover, several companies have actively integrated circularity into their production processes, serving as key examples of innovation and leadership in Colombia's textile sector. La Fayette, for instance, uses biodegradable fibers such as organic cotton and bamboo, incorporating innovative recycling processes in approximately 40 % of its production, which demonstrates the feasibility of large-scale integration of sustainable materials; Also Fabricato has developed the "Hilos Renovados" program, integrating 30 % recycled material, highlighting the potential for traditional textile manufacturers to transition toward circular production models(Adarme-lópez et al., 2025). Otero (2023) mentions examples as Madre Tierra, which manufactures textiles from recycled PET and recovered cotton, representing an important case of environmental responsibility by transforming post-consumer waste into high-value products; Enka and Riochevi, which transform post-consumer PET and textile waste into new fibers and materials, collectively contributing to closing material loops and strengthening the CE in Colombia. These companies are crucial not only because they reduce environmental impact, but also because they serve as benchmarks for other firms, demonstrating practical strategies for integrating sustainability and circularity into the textile value chain.

According to Aguirre González (2024), Colombian companies have begun to implement various reverse logistics and CE practices, albeit at an early stage. Among the strategies adopted are direct reuse, where returned products can be used again after limited cleaning or repair without being reincorporated into the production process; repair, which restores the functionality of returned items; and refurbishment, which returns a product to its original condition, often through the addition of new components. Additionally, recycling is applied to transform waste into new fibers or materials, while reduction aims to minimize resource consumption, material use, and waste generation. Finally, reverse logistics has become a key tool for managing both pre-consumer waste, such as production leftovers, and post-consumer waste. These practices complement the CBMs described in Section 2.2.1. and reflect a growing interest in closing material loops, optimizing resources, and generating added value by integrating sustainability throughout Colombia's textile value chain.

Nevertheless, significant challenges remain for the implementation of circular practices in Colombia. The infrastructure and technological adoption for recycling and reusing textile materials are insufficient; in fact, the three existing textile recycling plants operate at less than 20% of their capacity. The sector also faces low technological development and outdated machinery (Adarme-lópez et al., 2025). Additionally, approximately 60% of raw materials are imported, which increases costs and hinders the local production of lower-impact textiles. These challenges are compounded by smuggling and under-invoicing, factors that erode competitiveness and particularly affect the textile industry, which is considered one of the most impacted by technical smuggling (Cuartas Galvis, 2018).

These limitations are compounded by the high financial and technological costs associated with transitioning to sustainable models (Duque Montaña, 2023) and the geographic concentration of supply, 92% of facilities are located in Bogotá, Medellín, and Cali, leaving other regions without coverage. Furthermore, the limited coordination between informal recyclers, SMEs, and large companies restricts the circulation of materials (Adarme-lópez et al., 2025). Finally, sociocultural barriers persist, products made from recovered materials are perceived as lower in quality and more expensive, and taboos surrounding second-hand clothing remain (Aguirre González, 2024; Otero, 2023).

SMEs and entrepreneurial ventures, which constitute most of the sector, face significant challenges in financing, access to technology, and scalability; however, they often lead experimentation with sustainable materials and fashion models. Complementarily, consumers are key actors, as their purchasing decisions can steer the market toward lower-impact products. Therefore, it is essential to strengthen education on environmental footprint, traceability, and the benefits of circular fashion (Adarme-lópez et al., 2025; Otero, 2023).

2.5.Key Insights and Gaps in the Literature:

Circularity has become a strategic necessity for companies in the textile sector. The literature review shows that CE principles and CBMs provide a robust framework to promote sustainability in industry, enabling firms to address urgent environmental challenges, capitalize on economic opportunities, meet social demands, and comply with increasingly strict regulatory frameworks, thus ensuring long-term viability and success. In the European Union, instruments such as the European Green Deal and Circularity Strategies for Textile Products set ambitious goals for prevention, reuse, and recycling, requiring the redesign of products, processes, and business models (VELA-MICOULAUD & ENCISO-SANTOCILDES, 2022).

However, the literature also highlights that the fashion industry is characterized by long and complex global supply chains and a lack of transparency, which hinders the implementation of large-scale structural changes (Ellen Macarthur Foundation, 2015). While the CE offers a promising pathway toward a more sustainable industry with multiple benefits, its adoption requires overcoming entrenched inertia, addressing systemic complexities, and developing new infrastructure and regulatory frameworks that actively support this transformation.

Reviewed studies emphasize the importance of CBMs as they provide a sustainable and more efficient alternative to the traditional linear model, which has become unsustainable due to resource depletion and massive waste generation. Their relevance spans environmental, economic, and social dimensions, significantly contributing to competitiveness and long-term sustainability, especially in high-impact industries such as textiles (Gómez Ruiz, 2021). It is important for this research to distinguish between CBMs

and circular practices. While a company may adopt one or multiple circular practices without deriving direct economic value, CBM integrates these practices at the core of its operations, generating tangible economic benefits while reinforcing environmental and social outcomes.

Existing studies in the Colombian textile sector have addressed circularity, including some case analyses aimed at evaluating the competitiveness of circular models compared to the traditional linear model. However, most of these studies have focused solely on circular strategies without delving into the underlying business models. This represents a significant gap, as failing to examine the business models limits understanding of their potential for replication or scaling. Without studying the underlying business models, only a superficial level of circularity is visible, leaving the structure that enables these practices to be sustainable, scalable, and replicable largely unexplored. Building on this gap, the present study aims to provide empirical evidence through an exploratory approach, analyzing how small textile companies in Colombia implement circular practices and the role of these practices within their business models. This approach seeks to identify patterns, strategies, and challenges that complement existing literature, contributing to a deeper understanding of the consolidation and scaling of circular economy practices in the Colombian context.

3. Methodology

To address the research question "*How are circular economy practices being implemented across Colombia's textile industry, and which are the challenges and enabling factors that influence the adoption and scaling of circular business models in the textile industry?"*, this study employed a qualitative and exploratory methodology, using a multiple-case study design with purposive sampling. Data were collected through semi-structured interviews with 10 small textile companies operating in Colombia. The main objectives were to identify the circular practices and business models applied by these companies and to examine the challenges and enabling factors influencing the implementation of circular practices within the Colombian context. Data analysis combined both inductive and deductive approaches, allowing the identification of emerging patterns from the interviews while also comparing the findings with existing theoretical frameworks on circular economy and business models.

3.1. Research Design

To understand how textile companies in Colombia implement circular practices and the role that fashion brands play in their adoption and consolidation, this study was conducted using a qualitative approach. This approach allows for exploring organizations' perceptions, experiences, and strategies that cannot be adequately captured through quantitative methods (Saunders et al., 2003). Furthermore, since many companies were start-ups in the circular textile industry without quantitative indicators and given the limited availability of government and NGO data, a quantitative approach was not feasible. Anyway, conducting a qualitative study enables a deeper understanding of the context of circularity in Colombia by facilitating open communication with the companies to uncover the reasons behind their decisions. It also allows theory or explanations to emerge directly from the events and circumstances observed, ensuring a close alignment between the social reality of participants and the emerging theoretical insights (Saunders et al., 2003).

Moreover, knowledge about implementing CBMs in the Colombian textile industry is still limited and fragmented, despite the existence of various circular fashion initiatives (Quintero Castro, 2022). In this context, this research adopts an exploratory approach, as few empirical works have examined how circular models are implemented within the Colombian

textile sector. The exploratory nature of the research enables the identification of patterns, challenges, and opportunities while providing strategic recommendations. This approach is flexible and adaptable, allowing the research direction to evolve as new data and insights are obtained, as suggested by Saunders et al. (2003) while initially broad and dispersed, the approach becomes progressively more focused as the study advances, facilitating a comprehensive understanding of the context and allowing theory or explanations to emerge directly from the observed events and circumstances.

It should be noted that this research is empirical, based on information collected through semi-structured interviews with the managers responsible for sustainable and circular practices in each company. This approach, grounded in observation and direct experience for data collection and analysis (Saunders et al., 2003), allows to capture direct evidence regarding the adoption of circular strategies, ensuring that the findings are firmly anchored in the reality of the industry. The study is designed as a multiple case study, focusing on 10 Colombian textile companies selected for implementing circular practices and, in most cases, for operating under CBMs. Considering similar studies on CE in the textile sector (Kurkela, 2020; Petänen et al., 2024; Salmi & Kaipia, 2022; Wójcik-Karpacz et al., 2023), comparable methodological strategies have been applied, supporting the validity and relevance of this approach and providing a reliable and robust framework for analysis.

3.2. Sampling Strategy

The study uses a multiple case study approach with purposive sampling, as this enables the selection of companies that best help answer the research question and achieve the objectives. As Saunders et al. (2003) mention, this type of sampling is suitable for small samples, such as in case study research. This purposive sampling approach is appropriate for qualitative studies, as it allows for selecting relevant and representative cases for the research, without the need to represent the entire population of textile companies in Colombia. The selected companies were small and medium-sized (according to the European Comission (2020) definition), which facilitates a detailed analysis of how SMEs with limited resources have successfully implemented circular practices in a sector that has traditionally been linear. The following parameters were used to select the firms included in the sample:

- Implementation of circular practices, whether in sourcing, design, production, distribution, or post-consumption.
- Official participation in the Colombian textile sector (registered brand recognized by the Chamber of Commerce (*Camara de Comercio*).
- Availability and willingness to participate in semi-structured interviews.

A total of 33 companies were initially contacted through various sources; however, due to companies' availability, the study focused on 10 companies that met the established requirements. These 10 small Colombian firms actively implement circular practices in their operations, and for most, a CBM forms a core part of their strategy. This design enables a comparison of the experiences and strategies adopted by these companies, the identification of common barriers and enablers, and the formulation of recommendations applicable to the Colombian textile industry. 10 companies agreed to participate in the study through criterion (purposive) sampling, defined a priori as recommended by Suri (2011), targeting small Colombian textile firms that are actively implementing circular practices, in order to ensure a valid representation of companies meeting the inclusion criteria. The selected companies were identified through social media, academic recommendations, and referrals from companies in the sector already implementing sustainability and CE practices. All identified companies were contacted and invited to participate in the study, and Table 2 provides a detailed description of the cases and companies included in the research.

Table 2. *Case studies summary*

Company Name	Principal activities	Location	Num. Empl.	Est. Year	Web page	Data type	Data source
Aquelarre	Upcycling	Bogotá D.C, Medellín	<10	2023	Instagram Web page	Primary and Secondary	Interview with the CEOs and the company website and social media
BeeUnique	Second-hand as principal activity	Bogotá D.C	<10	2022	Instagram Web page	Primary and Secondary	Interview with the CEO and the company website and social media
Codes	Upcycling	Medellin	<10	2021	Instagram Web page	Primary	Interview with the CEO and the company website and social media
Luca denim	Upcycling	Medellin	<10	2024	Instagram	Primary and Secondary	Interview with the founder and CMO, company reports and company website, and social media
Mar de gea	Beachwear with recycled materials	Palmira	<10	2021	Instagram	Primary and Secondary	Interview with CEO and the company website and social media
Muysa moda sostenible	Textile recycling products and workshop	Bogotá D.C	<10	2021	Instagram Web page	Primary and Secondary	Interview with CEO and company website and social media
New for you	Upcycling	Medellin	11-50	2022	Instagram Web page	Primary and Secondary	Interview with the founders and company website and social media

Table 2. *(Continue)*

Company Name	Principal activities	Location	Num. Empl.	Est. Year	Web page	Data type	Data source
Rediestilo	Upcycling and restauration services	Villavicencio	<10	2019	Instagram	Primary	Interview with CEO
SLOW	Utilization of textile waste, upcycling, resource	Medellín	<10	2018	Instagram Web page	Primary and Secondary	Interview with CEO, company reports and company website and social media
X2 Underwear	Men underwear with recycled materials	Medellín	11-50	2013	Instagram Web page	Primary	Interview with the CEOs

3.3. Data Collection Methods

Semi-structured interviews were conducted to explore key aspects, including the integration of circularity within the business model, materials management, the creation of economic, environmental, and social value, the challenges encountered, performance indicators, and future sustainability prospects. In addition to the interviews, secondary data was collected from the companies' official websites, social media platforms, and other relevant online resources or materials provided by the company. This information facilitated an understanding of whether circularity was central to the business model, in other words, whether value was generated through circular practices.

The companies were primarily contacted via social media channels such as email, Instagram, or WhatsApp, where the research objectives were explained. The companies Slow and X2underwear were contacted through an academic third party. In total, 10 semi-structured interviews were conducted, with the interview format varying based on the organizational context and the progression of the conversation (Saunders et al., 2003). The interviews lasted an average of 30 minutes, with the shortest lasting 26 minutes and the longest extending to one hour, allowing for in-depth conversations on topics of interest. The interviews covered key topics, including the company's activities and position in the value chain, the CE practices and strategies implemented, the motivations, challenges, and benefits of circularity, the impact of circularity on the value proposition and customer relationships, and the internal and external factors that support its implementation.

This semi-structured interview approach allowed for a natural flow of dialogue, with questions being omitted if already addressed during the conversation. The first part of the interview focused on understanding the company and the interviewee, including the company's background, the practices implemented, and the history behind their circularity efforts. The second part aimed to deep into the company's experience with circularity, exploring challenges, benefits, and enabling circular practices. Additionally, discussions covered the state of the country's textile industry in terms of circularity, to gather insights from industry professionals. The main questions that serve as the basis for the interviews are presented in Table 3:

Table 3. *Semi-structured interview questions outline*

Section	Question
General information	Could you briefly describe the main activities of your brand, its position in the textile value chain, size, and key markets?
Circularity and sustainability	What circular practices has your brand implemented in its second-hand business? Are these practices a central part of your business model?
	When did your brand start adopting circular practices, and what motivated this transition?
	How do you monitor the progress and impact of your circular practices? (KPIs, tools, or certifications)
	What are your company's long-term sustainability goals? Are you planning to implement new initiatives or technologies to further improve your environmental or social impact?
	Do you think anything is needed at the national level to scale the circular economy in the textile industry? Why?
	Is there anything else you would like to add, or any specific aspect we should know to better understand your company's sustainable or circular potential?
Circularity and sustainability business specifics	What types of textile products do you sell, and where do they come from?
	What do you do with clothing that cannot be sold? Do you have any policies for managing waste or damaged garments?
Challenges and enabling factors	What environmental, economic, or social benefits have you observed so far?
	What are the main obstacles you have faced (technical, financial, cultural, supply chain, customer-related)?
	What internal factors or external collaborations (government, NGOs, suppliers) have helped you advance in circularity?

3.4. Data analysis

To streamline the processing of qualitative data analysis, audio recordings were first transcribed using TurboScribe, an AI-driven platform designed for automated transcription and content analysis. For the translation of the interviews from Spanish to English, ChatGPT, an AI-powered language model, was used to provide precise and contextually appropriate translations.

To analyze the data, this study adopts a combined inductive and deductive approach, following the definitions proposed by Saunders et al. (2003). The inductive approach allows for the identification of emerging patterns directly from the data collected from the

companies. Accordingly, a table was created summarizing the most significant and descriptive statements about the practices currently implemented by textile companies in Colombia, including sourcing, design, production, distribution, and post-consumer strategies, thus fulfilling the first research objective.

Conversely, the deductive approach enables the comparison of these findings with existing literature and theoretical frameworks on CE and business models. For this purpose, a table was developed in the first part of the results section to classify the CBMs identified in the literature, providing a basis to categorize the business models of the companies analyzed. Following the inductive approach, the main challenges and enabling factors influencing the adoption and scaling of circular strategies in the textile industry were described based on the information gathered during the interviews, considering the experiences of the participating companies. Finally, considering the evidence collected from both the literature and the interviews, recommendations are presented to strengthen the transition toward circularity in the Colombian textile sector.

3.5. Ethical consideration

In this study, several factors were carefully considered, including the duration of the interviews, the depth of the conversation, and the direct interaction with participants. Given these conditions, ethical considerations, particularly regarding privacy, were treated as a critical aspect. Ensuring the confidentiality of the collected data guarantees respect for individual privacy and allows participants to engage freely without any form of pressure. All interviews were audio-recorded with the explicit consent of each participant to ensure accuracy and completeness and were subsequently fully transcribed for detailed analysis. The data collection process strictly adhered to fundamental ethical research principles, including the protection of privacy and informed consent. Since the participants were legally established companies, rather than private individuals, special attention was given to the handling, storage, and use of company-provided information. None of the companies requested anonymity; therefore, the company names are disclosed throughout the study, while maintaining professional discretion in the presentation and discussion of their operational and strategic details.

4. Results

This chapter is divided into four sections. Section 4.1 presents the within-case analysis, describing each company and summarizing the findings from each case throughout the study. Section 4.2 illustrates how the 10 selected companies implement circular economy practices. In Section 4.3, their business models are classified and analyzed. Finally, Section 4.4 focuses on the factors that enable or hinder the implementation of these practices within the Colombian context.

4.1. Within-case analysis

This section provides a description of the ten companies included in this study, highlighting the key findings and insights provided by the interviews that contribute to the research.

4.1.1. Aquelarre

Aquelarre is a small upcycling venture selling micro-collections via e-commerce and two multi-brand partners. Their value proposition is focused on unique garments and input-led designs from existing garments. Upcycling design is guided by material availability, where curated donations and deadstock set the foundation for every release. Production focuses on remanufacturing shirts, pants, and jeans, with a recent extension to B2B remanufacturing of corporate production surplus. Remnants are repurposed into functional components (e.g., collars, sleeves). The distribution model consists of small drops aligned with curated lots, resulting in low inventory levels. Sales occur through multi-brand partners, where turnover tends to be slower in Bogotá and more consistent in Medellín. Post-consumer practices include the intake of secondhand garments via donations and sourcing from wardrobes, wholesale depots, and local marketplaces. A formal take-back mechanism after sale has not been implemented. This is enabled by a satellite workshop (a small, decentralized unit that informally produces garments for a main brand, focusing only on manufacturing, not design or sales) and a network of allies (e.g., Slow, wardrobes, wholesale depots, and local marketplaces), which support rigorous pre-selection to raise input suitability. Scalability remains constrained by input heterogeneity, labor intensity (unsewing, cutting, adjusting), difficulties in size standardization, and higher input costs when working with surplus; the

team also stresses the need to educate consumers about the value embedded in the transformation. Overall, the model achieves high textile recovery and strong differentiation through unique designs, at the cost of reduced production speed.

Figure 3. *Photographs of upcycling products* (AQUELARRE, 2025)

4.1.2. BeeUnique

BeeUnique centers its model on rigorous curation of second-hand clothing, complemented by garment restoration and textile recycling, with a "solve-your-closet" value proposition (resell, repair, or recycle). Sells via e-commerce and one multi-brand physical point, where it also hosts occasional clothing-swap events. It also operates as a collection hub aggregating industrial-scale volumes from individuals and from seamstresses/small designers. Its circular practices unfold across the chain: at the design stage it applies a triage rule: sell if usable, repair if damaged, and recycle if irreparable; while defining upcycling paths (e.g., channeling denim residues into new products); in production it executes mending and full upcycling to return materials to use; in distribution it places curated pieces through e-commerce and the multi-brand outlet to keep items circulating; and on the post-consumer side it operates a collection hub that aggregates large volumes from individuals and small designers, routing irreparable textiles to Corporación de la Mujer (shredding and heat processing into new textiles) and mixed streams of at least 500 kg to Sistema Verde (conversion into recycled charcoal), and it has already delivered ~300 kg of denim residues to entrepreneurs for external upcycling while running basic sewing workshops to promote repair. This portfolio is enabled by partnerships with specialized waste managers, multi-source intake (donations, wardrobes, seamstress leftovers), and community engagement

through workshops/swaps. However, limited financing and time constrain the scaling of these services. Overall, BeeUnique functions as a local circular node that captures textiles, restores and upcycles what can be saved, and channels residuals to industrial processors, integrating reuse, repair, and recycling within a coherent business model.

4.1.3. Codes

CODES integrates the upcycling of textile waste and second-hand apparel with the reuse and recycling of electronic discards (e.g., headphone cables, computer chips, CDs, USBs), enabled by partnerships with Ecom (digital solutions) and Recupera Co (textile waste management). Its portfolio runs in two modalities: a B2B export stream where, although each piece is unique, products can resemble one another and be classified by typology; and a B2C stream oriented to fairs and a physical store. A rental service exists but, due to logistical constraints, is offered selectively to artists and influencers. Production is executed through a network of external workshops (printing, sewing, and other operations) engaged as needed. Inventory is actively reworked, unsold items are transformed again, reflecting a principle of ongoing iteration ("the transformation never stops"). Business growth has been supported by the Chamber of Commerce and advisory entities, yet financing limitations continue to restrict the firm's ability to scale within the industry, and logistical constraints limit rental to select users.

4.1.4. Luca denim

Luca Denim is an upcycling studio (small scale) that converts surplus/leftover denim into new products. Inputs come mainly from denim, the founder collected over several years while employed at a company, now complemented by surplus fabrics from small local firms. Sales and engagement run through a custom lab (it works as a creative hub and a point of sale) and participation in local fairs (Anti Tattoo, Feria Claq). The brand operates a "custom lab" that serves as a creative center to co-design with artists, point of sale, and open community space for co-creation, training, and textile transformation, maintaining ties with educational institutions for technical instruction. Production emphasizes creativity with material efficiency, using systematic cut optimization and converting offcuts into ancillary products (e.g., keychains, decorative dolls). Enablers of growth include women-led workshops and allied small jean businesses for production, documented logs and joint

production records, localized alliances, and seed-capital awards (Concurso Capital Semilla) offering funding and advisory support. However, potential barriers remain, such as small-scale capacity and reliance on external workshops, which can limit throughput and standardization. In fact, Luca Denim follows a collaboration-driven upcycling model distinguished by creative co-design, documented processes, and high denim utilization; scaling likely depends on expanding production capacity while preserving material efficiency and community focus.

4.1.5. Mar de gea

Mar de Gea develops themed collections that spotlight Colombian territories through their prints (e.g., sugarcane, Antioquia's flower carriers "silleteros"). The brand works with recovered materials (cassava starch, sugarcane bagasse, and bottles/caps) and converts swimsuit offcuts into hair scrunchies; a recent alliance enables eyewear made from recycled polypropylene. Produces in-house; cutting is outsourced when fair/event logistics require it, and printing is always outsourced. Main channels include fashion fairs and a new physical presence at Tienda Sokalo (Guatapé), which supports low on-hand inventory and a slow-fashion cadence. Beyond sourcing and production, the founder drives beach-recycling initiatives, funding cleanups and children-focused awareness activities in Bahía Málaga. Growth has been backed by sugar mills in Valle del Cauca, which both inspire collections and provide financial support, visibility, and event participation; the firm has also received seed capital and other national/international awards; and alliances enabling polypropylene (PP) recycled eyewear. Early expansion was difficult; initial channels (small towns, local/campesino fairs) did not match the target audience, but once the audience was identified and the brand entered fashion fairs, traction and recognition improved. Additionally, operational dependence on outsourced cutting/printing adds coordination and lead-time risks during events. Overall, the brand advances into a territory-inspired, slow-fashion model that integrates recovered inputs and community recovery/education. Distinctiveness comes from thematic design and material innovation (bagasse, PP, bottle/cap plastics); bottlenecks lie in channel fit (now corrected) and reliance on outsourced processes for event-driven production.

4.1.6. Muysa moda sostenible

Muysa is a small-scale B2B uniform maker whose traditional line, made-to-order uniforms for corporate clients, remains the core of its business and primary revenue stream. Alongside this, the firm operates a sustainability line that delivers hands-on workshops, advisory services, and corporate souvenirs, all centered on textile recycling and giving materials a "second story." Internally, Muysa pursues low-impact production by prioritizing undyed textiles and more natural fibers, and by segregating process scraps that a partner converts into recycled yarn. As a post-consumer strategy, the company collects back uniforms it has sold and channels them into thermoacoustic panels, while providing training and advisory help to client firms to embed repair, reuse, and recycle in their operations. This integrated approach is supported by an R&D focus on undyed/natural inputs; however, scaling is constrained by technical and financial barriers: producing new goods directly from waste would require recycling technologies and a plant that the firm cannot yet afford, and by limited client willingness to pay the added costs of recycling. Even so, Muysa has launched uniform collection routes, converted internal scraps into yarn, introduced a portfolio of circular services, and advanced practical learning on low-impact inputs, all while maintaining its conventional uniform line.

4.1.7. New for you

New For You designs and produces garments from surplus fabrics sourced from allied companies and other local firms, aiming to avoid economic and environmental costs by valorizing existing materials. Design is input-led, collections are built from what is available, with denim as the flagship product, while production is executed through a women-led satellite workshop that enables flexible, small-batch manufacturing. Commercially, the brand sells via e-commerce and city fairs, and its inventory policy rejects discount-driven sell-through; when pieces remain in stock for long periods, collections are gifted to followers rather than marked down, in line with their stance against promoting consumption. This approach is enabled by alliances that secure surplus inputs, a women-led workshop that supports agile, limited-run execution, and a channel mix suited to short releases. However, the philosophy of constrained scale (micro-batches and no discounts) can limit revenue growth; gifting residual stock preserves circular intent but forgoes sales; and reliance on

surplus availability may constrain planning. Overall, the model combines input-driven design, women-led satellite production, and micro-batch releases to transform surplus textiles into marketable pieces while purposefully restraining growth and demand stimulation.

4.1.8. Rediestilo

RediEstilo is a small, service-oriented studio in Villavicencio that focuses on custom upcycling and personalized advisory, operating locally because clients supply the inputs (their own garments), and shipping often exceeds labor costs, making remote work viable only when several items are sent together. At the practice level, the studio provides one-to-one guidance to define feasible redesigns from client pieces, executes alterations/repair and creative transformations to extend life, and valorizes offcuts into hair scrunchies; distribution is appointment-based rather than scale-oriented retail, and post-consumer capture occurs directly as clients bring unwanted garments for redesign. This model is enabled by steady client-provided feedstock, a bespoke advisory capability for condition-based redesign, and local craft execution suited to small, custom jobs. However, high logistics costs, viability limited to multi-garment batches, and no intent to scale constrain revenue growth and reach. Even so, RediEstilo systematically extends garment lifetimes through repair/redesign, reduces waste by converting offcuts into scrunchies, and delivers localized impact through tailored services, distinguished by its bespoke advisory and offcut reuse, with bottlenecks rooted in logistics, economics, and an intentionally non-scaling stance.

4.1.9. Slow

SLOW is a multi-channel circular venture that combines resale (online and physical), wholesale bundles of second-hand to other firms, and textile-valorization services for companies and consumers; its value proposition is to capture, classify, and transform textile waste into new products and verified routes. In practice, the firm upcycles textile waste into accessories (pencil cases, fanny packs, tote bags, customized garments, coasters) and also mechanically shreds textiles to produce inputs for concrete and furniture solutions (EC2/EBR2 claddings, custom decorative blocks, floors, tables, countertops), while on the distribution/use side it operates second-hand resale and closed-loop B2B deliveries in which bespoke products are made from each client's own waste. Post-consumer recovery is supported by a collection network (five containers in Medellín and one in Bogotá), direct

curation for corporate streams (logo/label removal, donation or recycling) with textile-utilization certificates (kg), and fiber-based sorting (e.g., cotton to re-spinning; mixed fibers to panels). This portfolio is enabled by a network of designers, artisans, and technical partners (concrete/furniture), a container rental service where they collect used garments at different locations and offer their allies transportation and certification of these containers, and ecosystem building through the *Convergencia Socialista* podcast that connects communities, companies, government, and academia. However, scale-up is limited by capacity shortfalls across the sector (not all volumes can be processed), high capex for machinery to run full waste-management systems, and a regulatory vacuum (a 2022 bill was archived, leaving no binding EPR/fees) that weakens incentives for end-of-life financing. Even so, SLOW reports an operational network of six containers, issuance of kg-based certificates, implementation of closed-loop deliveries that return products to the same client, and diversified B2B outputs with documented fiber routing. Overall, it advances a system-oriented model that closes loops across reuse, upcycling, and industrial symbiosis; distinctiveness lies in containerized capture, kg-level assurance, and concrete/furniture valorization, while bottlenecks remain sectoral capacity, capital intensity, and absent EPR signals.

4.1.10. X2 Underwear

X2 Underwear is an apparel brand with a traditional assortment (underwear, outerwear, swimwear, socks) that sells mainly via e-commerce and social channels, complemented by a physical store in Sabaneta (Antioquia), and whose value proposition is enhanced by an eco-friendly underwear line. In practice, the brand incorporates recycled PET fiber into its printed boxers (approximately 3 plastic bottles per boxer) and performs in-house printing and cutting, with processes reported as non-water-polluting. Portfolio-wise, historical collections were ~60% recycled, whereas the latest mix shifted to 40% recycled and 60% conventional due to input costs and customer price sensitivity. This configuration is enabled by multi-supplier sourcing of recycled fibers to secure inputs, in-house printing/cutting capabilities, and an omnichannel presence that places both conventional and eco lines. However, financial constraints (driven by higher costs of recycled inputs and limited willingness to pay), alongside perceived weak public support for SME sustainability transitions, cap the recycled share. Even so, the company has maintained its eco line while preserving sales through a

mixed portfolio, absorbing the incremental costs of recycled collections rather than passing them on to customers, and gaining operational learning on sourcing and low-impact processing. Overall, this is a pragmatic circular approach within a traditional model: recycled-PET integration differentiates the brand, but premium input costs and price sensitivity limit scale, making cost absorption and a balanced portfolio the current strategy to manage these bottlenecks.

4.2. Circular Economy Practices Implemented by the Companies

In this section, circular practices are examined and identified across the companies included in the research. First, the concrete strategies are detailed at each value-chain stage (Sourcing, Design, Production, Use, and Post-consumer), highlighting common patterns and case-specific nuances (Table 4). Then, a cross-case is presented and diagnosed using the 9R hierarchy (R0-Refuse to R8-Recycle). Providing a comparable view of the breadth and depth of circularity across cases and setting up the synthesis that follows.

Table 4 presents the strategies identified in each company, organized into five areas: sourcing, design, production, use, and post-consumer. Sourcing covers how inputs are obtained and prepared before design (agreements for deadstock or surplus, donation/collection networks, supplier selection, and basic intake specifications by fiber or condition). Design refers to planning and configuration prior to manufacturing, including input-driven design, pattern standardization, design for disassembly, and planned offcut use. Production comprises the transformation processes used to deliver the final product or outcome (repair/alteration, remanufacturing/upcycling, mechanical shredding, low-impact finishing, small-batch execution, and quality control). Use captures how products are put into and kept in use, including resale channels and access models (such as swaps and selective rental), made-to-order releases, micro-batches, inventory and pricing policies, and consumer education that supports continued use. Finally, post-consumer encompasses practices aimed at closing the material loop by collecting and transforming items that would otherwise be discarded; a practice is classified as post-consumer whenever a product destined for disposal is recovered and reprocessed, regardless of whether it originates from the company itself or from external sources.

Table 4. *Circular practices in the Colombian textile sector: selected cases*

Company	Areas				
	Sourcing	**Design**	**Production**	**Use/Distribution**	**Post-consumer**
Aquelarre	▪ Intake of used garments via donations to reintroduce materials into the production cycle. ▪ Active sourcing in wardrobes, depots and marketplaces to recover post-consumer textiles. ▪ Channeling post-commercial brand surplus into remanufacturing workflows.	▪ Input-driven design from donations and curated deadstock to reuse existing materials. ▪ Modular/patchwork composition to maximize use of offcuts. ▪ Curatorial criteria to exclude non-recoverable items and salvage usable parts (waste reduction).	▪ Low level of production and inventory ▪ Remanufacturing shirts, pants, and jeans into new garments. ▪ B2B remanufacturing corporate surplus stocks. ▪ Disassembly (unsewing/cutting) and reassembly aimed at life extension. ▪ Valorization of remnants into functional components (collars, sleeves, reinforcements). ▪ Fiber-specific process routing (cotton vs. polyester) to minimize scrap and enable effective reuse.	▪ Micro-collection drops aligned with curated lots to prevent overproduction and excess inventory.	

Table 4. *(Continue)*

Company	Areas				
	Sourcing	**Design**	**Production**	**Use/Distribution**	**Post-consumer**
BeeUnique	▪ Curates second-hand garments as the core input, applying a triage rule: resell if usable, repair if damaged, recycle if irreparable.		▪ Restoration/repair (mending, alterations) to return garments to use.	▪ Occasional clothing-swap events to keep garments in circulation. ▪ Runs basic sewing workshops to promote user-side repair and life extension.	▪ Operates a textile collection hub for industrial-scale volumes from individuals and from seamstresses and small designers. ▪ Sends irreparable and damaged textiles to Corporación de la Mujer for shredding and heat processing into new textiles. ▪ Routes mixed materials (shoes, bags, faux leather, heavily soiled/stained items) in ≥500 kg lots to Sistema Verde for conversion into recycled charcoal.

Table 4. *(Continue)*

Company	Areas				
	Sourcing	**Design**	**Production**	**Use/Distribution**	**Post-consumer**
BeeUnique					▪ Supplies denim residues (300 kg) to entrepreneurs for external upcycling
Codes	▪ Partner-enabled recycling routes: collaborations with Recupera Co for textile-waste management and Ecom for reuse/recycling of electronic discards. ▪ Internal closed-loop practice: unsold/long-inventory items are systematically re-transformed instead of being discarded.	▪ Input-driven design using second-hand apparel and textile waste as core materials. ▪ Integration/reuse of e-waste elements (headphone cables, computer chips, CDs, USBs) as materials/components in products. ▪ Design-for-iteration: every piece can be re-worked if it remains in inventory	▪ Upcycling or remanufacturing second-hand garments into new products. ▪ Incorporation of selected e-waste components during reconstruction to replace virgin trims/decor. ▪ Continuous rework of slow-moving items into new designs to avoid disposal.	▪ Selective rental service (artists/influencers) as an access-based model extending use without ownership.	.

Table 4. *(Continue)*

Company	Areas				
	Sourcing	**Design**	**Production**	**Use/Distribution**	**Post-consumer**
Codes		▪ Typology-based design families for the B2B export line (unique pieces that resemble each other by category), enabling repeatable silhouettes without new			
Luca denim	▪ Raw materials include fabric offcuts and remnants accumulated by the founder over the years, as well as surplus fabrics acquired from partner brands disposing of excess stock.	▪ Input-driven design using leftover/surplus denim. ▪ Remnant utilization: offcuts deliberately designed into secondary products (e.g., keychains, decorative dolls) ▪ Co-design with artists to	▪ Upcycling or remanufacturing of surplus denim into new garments ▪ On-demand, small-batch execution Systematic valorization of offcuts into accessories/ancillary items to approach near-zero textile waste.		

Table 4. *(Continue)*

Company	Areas				
	Sourcing	**Design**	**Production**	**Use/Distribution**	**Post-consumer**
Luca denim		repurpose denim into new aesthetics without virgin fabric.			
Mar de gea	▪ Material selection based on recovered inputs: cassava starch, sugarcane bagasse, and plastics from bottles and caps.	▪ Accessory line from recycled polypropylene (PP) via a new alliance (eyewear).	▪ Remanufacturing recovered materials into garments and accessories. ▪ Systematic offcut valorization: convert swimsuit fabric remnants into hair scrunchies. ▪ Manufacture of PP-recycled eyewear through partner capabilities (replacing virgin plastics).	▪ Slow-fashion stocking at Tienda Sokalo (Guatapé): very low on-hand inventory to prevent overproduction and dead stock.	

Table 4. *(Continue)*

Company	Areas				
	Sourcing	**Design**	**Production**	**Use/Distribution**	**Post-consumer**
Muysa moda sostenible	▪ Material policy: prioritize undyed textiles and more natural fibers to lower chemical inputs and enable later recycling.	▪ Development of corporate souvenirs made from recycled textiles as a circular product line.	▪ Collecting internal textile offcuts and sending them to a partner that converts them into recycled yarn. ▪ Upcycling fabrication of corporate souvenirs from reclaimed textiles.	▪ Service-based circular offering to B2B clients: hands-on workshops and advisories that teach repair or reuse and embed circular practices.	▪ Uniform take-back garments previously sold to clients. ▪ channel post-consumer uniforms into thermoacoustic panels. ▪ Reuse of institutional uniforms via dedicated projects that rework them into new products.
New For You	▪ Raw materials include fabric offcuts and remnants accumulated by the founder over the years, as well as surplus fabrics acquired from partner brands disposing of excess stock.	▪ Input-driven design based on surplus (deadstock) fabrics purchased from allied.	▪ Small-batch manufacturing via a women-led satellite workshop; batch cap 15–25 units per style to prevent overproduction.	▪ Gift slow-moving stock to followers to keep garments in circulation and avoid disposal or price cut which promotes consumption.	▪

Table 4. *(Continue)*

Company	Areas				
	Sourcing	**Design**	**Production**	**Use/Distribution**	**Post-consumer**
Rediestilo	▪ Direct intake of unwanted client garments as inputs.	▪ Personalized advisory to define feasible redesigns from client-supplied garments.	▪ Repair and alteration to return garments to use. ▪ Upcycling (creative transformation) of the same client garments. ▪ Offcut valorization into hair scrunchies to avoid textile		▪ Life-extension via redesign/repair rather than disposal.
Slow	▪ Operates collection containers in Medellín (five) and Bogotá (one) to receive textiles from individuals.	▪ Develop client-waste B2B products (furniture or concrete: EC2/EBR2 claddings, decorative blocks, coasters). ▪ Accessories and custom garments made 100% from textile waste	▪ Curation and sorting by quality, category, and fiber. ▪ De-branding (logo/label removal) to enable compliant donation. ▪ Upcycling textile waste into finished products.	▪ B2B: Direct management of textile residues through curatorship and issuing certificates of textile utilization.	▪ SLOW leases collection containers to partner brands so they can collect used clothing on-site. SLOW then picks up the filled containers, performs the textile handling (sorting, de-branding if needed, donation or

Table 4. *(Continue)*

Company	Areas				
	Sourcing	**Design**	**Production**	**Use/Distribution**	**Post-consumer**
Slow		(pencil cases, fanny packs, tote bags, art pieces).	▪ Mechanical shredding of textiles to produce raw input for concrete or furniture. ▪ Traceability and utilization certificates (kg) for processed lots. ▪ B2B: Transformation of textile residues into products for the company using the same materials.		and finally issues a certificate to the partner with the kilograms processed and the routing (e.g., donation vs. recycling).
X2 Underwear	▪ Recycled PET fiber integration in the underwear line (≈3 bottles per boxer).		▪ In-house printing and cutting are reported as non-water-polluting processes.		

In the Design area, upcycling is a core business strategy for Aquelarre, CODES, Luca Denim, Muysa, New For You, RediEstilo, and SLOW, transforming old garments and fabric scraps into new products with added value. Especially, Luca Denim utilizes internal offcuts to design small, innovative items (e.g., keychains or decorative pieces), thereby increasing material efficiency. A common and distinctive practice is the utilization of deadstock and surplus materials. Many textile firms purchase fabric lots larger than needed as a risk buffer; the unused portion often sits in inventory and is later discarded. Therefore, in the sourcing area, New For You addresses this gap by purchasing surplus lots and transforming them into new denim pieces, creating value for both parties; Luca Denim also purchases surplus and repurposes cutting leftovers; Aquelarre works with companies' excess inventory to give it a second life. In the case of Mar de Gea, cassava starch and sugarcane bagasse are incorporated as recovered inputs in its textile threads. Muysa prioritizes raw materials that are undyed and predominantly natural fibers to reduce chemical inputs and enable later recycling.

For the production practices, local production with low inventory is evident in Aquelarre, Luca Denim, Mar de Gea, and New For You, helping to prevent overproduction. Muysa and RediEstilo apply made-to-order production, starting work only after client requests. Direct reuse and take-back are concentrated in SLOW and BeeUnique, which collect textiles from companies, designers, and consumers and channel them to resale or dedicated management programs. BeeUnique and RediEstilo provide repair and mending to restore garments with minor defects (e.g., missing buttons, small tears, undone seams), returning items to their original value and extending their life. Muysa and X2 Underwear implement low-impact processing; examples include undyed/natural-fiber choices and non-water-polluting printing, reducing the environmental footprint of finishing.

Several firms connect with external industries to close loops. BeeUnique routes mixed materials to a partner that converts them into recycled charcoal; CODES, in alliance with Ecom, integrates recycled technology (e-waste) into fashion products. Mar de Gea and X2 Underwear incorporate recycled plastics through their suppliers (e.g., PP eyewear; PET-based fibers. SLOW applies mechanical shredding of textiles to produce inputs for concrete and furniture (e.g., EC2/EBR2 claddings, decorative blocks), returning those products to client companies. Together, these strategies show how cross-industry pathways expand material

recovery beyond apparel, complementing life-extension practices with scaled recycling routes.

Additionally, as part of their direct strategies to engage with communities and promote circularity, Luca Denim implements community co-creation and training activities at their custom lab, in collaboration with educational institutions, to develop repair and upcycling skills and extend the lifespan of existing garments within the local community. Similarly, Mar de Gea supports environmental education and material recovery through beach-recycling initiatives in Bahía Málaga, which are funded and coordinated by the company in partnership with local organizations. The aim is to collect plastics and reduce environmental leakage. They also conduct community awareness programs with children to promote proper waste disposal and encourage future sustainable material recovery practices. These initiatives represent valuable efforts in material recovery and circularity through education and local collaboration.

In order to assess whether the circular practices implemented by the companies are integrated into their business models, Table 5 was designed to interpret the frequency of each practice. A score of 1 indicates that the practice is not implemented, 2 represents occasional implementation, and 3 denotes systemic adoption as part of the company's core business. Table 6 provides the definitions of the practices, using the 9Rs framework adapted by Gasulla Tortajada et al. (2024). Finally, Table 7 presents the frequency of implementation of each practice across all companies included in the sample.

Table 5. *Definition of frequency scale*

Frequency	Definition	Score
Absent	The company does not implement it	1
Occasional	The company implements it sometimes	2
Systemic	It is part of the company's core business	3

Table 6. *Definition of Rs*

R code	Name	Definition (short)
R0	Refuse	Avoid virgin inputs/unnecessary production
R1	Rethink	Rethink models (access, service, closed loops)
R2	Reduce	Reduce resource use (micro-lots, cut optimization)
R3	Reuse	Reuse products as-is (resale)
R4	Repair	Repair/alter to extend life
R5	Refurbish	Refurbish without full redesign
R6	Remanufacture	Disassemble and rebuild
R7	Repurpose	Change application (e.g., textile→concrete; offcuts→accessories)
R8	Recycle	Industrial recycling (re-spinning, PP/PET, panels)

Table 7. *9Rs implementation matrix*

R	Aquelarre	BeeUnique	Codes	Luca Demim	Mar de Gea	MUYSA	New For You	Rediestilo	Slow	X2 Underwear	Total practices
R0	3	3	3	3	3	2	3	3	3	2	28
R1	3	3	3	3	3	2	3	3	3	1	27
R2	3	3	3	3	2	2	2	3	3	1	25
R3	1	3	1	1	1	1	1	1	3	1	14
R4	1	3	1	1	1	2	1	3	1	1	15
R5	1	2	1	1	1	2	1	3	2	1	15
R6	3	3	3	3	1	2	2	3	3	1	24
R7	3	2	3	3	3	3	1	1	3	2	24
R8	2	3	2	2	3	3	2	2	3	3	25
Total	20	25	20	20	18	19	16	22	24	13	-

Table 7 shows that the systemic adoption of circular strategies is mainly focused on avoiding new inputs and overproduction. A reading of the totals suggests higher evidence of integrating circular practices within the business, rather than "more circular" firms. A company heavy in R8 or R7 can score high without strong prevention; conversely, a prevention-led model may score "lower" in breadth but avoid more impact upstream. Most firms consistently implement R0 Refuse and R1 Rethink, demonstrating a strong reliance on existing stocks, including donations, deadstock, and surplus materials. These practices are embedded in business models that minimize new fabric purchases and unnecessary production runs. Similarly, R2 Reduce is widely adopted, supported by strategies such as micro-lots, cut optimization, and maintaining low inventories. By combining smart use strategies with resource-efficient production, these practices achieve higher circularity.

In contrast, R3 Reuse, R4 Repair, and R5 Refurbish are less common, with selective systemic implementation observed only in companies such as BeeUnique, RediEstilo, and SLOW. R6 Remanufacture and repurpose show broader systemic adoption, particularly among firms that integrate upcycling into their core business strategy. These companies include Aquelarre, BeeUnique, CODES, Luca Denim, RediEstilo, and SLOW. For example, R7 Repurpose is rated at level 3 in most cases, with applications such as offcuts transformed into accessories or textiles used as inputs for concrete production. Finally, R8 Recycle is systematically applied in BeeUnique, Mar de Gea, Muysa, SLOW, and X2 Underwear, reflecting strong collaborations with industrial partners for processes like re-spinning, PP/PET input recovery, charcoal production, or panel manufacturing. Other practices remain at an occasional level (2), where routing exists but have not yet become a core business activity.

Within the 9R hierarchy, strategies located upstream deliver higher prevention benefits, whereas downstream measures, although beneficial, are contingent upon available processing capabilities. BeeUnique and SLOW exhibit broad integration, combining reuse/repair with remanufacture and verified routing supported by active collection programs. RediEstilo demonstrates a strong product life-extension model, where repair, refurbishment, and remanufacture are central to its operations. Within the upcycling-focused cluster, Aquelarre, CODES, and Luca Denim systematically implement remanufacture and

repurpose, with moderate engagement in recycling. Muysa and Mar de Gea integrate repurpose and recycling but display more variable uptake of refuse/reuse/repair practices. New For You emphasizes reduction through micro-batches, with limited mechanisms for reuse, repair, or recycling. Finally, X2 Underwear focuses on input substitution (recycled PET and low-impact finishing) within a conventional portfolio, with a narrower spread of other practices.

4.3. Business models

The companies were classified into four overarching business models: Circular Suppliers, Product Life Extension, Product-as-a-Service and Resource Recovery (Coscieme et al., 2022; Fontell & Heikkilä, 2017; Salvador et al., 2020). This classification provides a consistent framework for comparing practices across cases while acknowledging the presence of hybrid strategies. Table 8 presents the identified categories, while Table 9 classifies the companies according to the strategies they employ, along with the observations that support their classification. It is important to note that when a model is highlighted in red, it indicates that the company has not yet fully implemented the model. In these instances, the model is not yet central to their operations, but the companies have initiated adoption and are actively working toward full integration.

Table 8. *Circular Business Models category*

CBM category	Observation
Circular suppliers	Circular materials/inputs replacing virgin materials/inputs
Product life extensión	Repairment/refurbish/resale same item
Product-as-a-Service	Pay a fee to access a product's functionality and benefits (rental, subscription, swaps)
Resource recovery	Upcycling/recycle with secondary inputs

Table 9. *Companies CBM classification*

Company	**CBM strategy** (N. Bocken et al., 2019)	Evidence	CBM category			
			Circular suppliers	**Product life extension**	**Product-as-a-Service**	**Resource Recovery**
Aquelarre	Cycling	Upcycling, remanufacturing surplus garments and repurposing offcuts				✓ (green)
BeeUnique	Cycling and extending	Resale, repairs, routing to recyclers (e.g., recycled charcoal), and mending or restoration to return items to use.		✓ (green)		✓ (green)
Codes	Cycling	Upcycling of apparel and integration of e-waste			✓ (red)	✓ (green)
Mar de gea	Cycling	Recovered inputs (PP eyewear, cassava starch, sugarcane bagasse) and offcuts converted into scrunchies.	✓ (green)			
Muysa moda sostenible	Cycling	Take-back of uniforms; scraps from recycled yarn; uniforms converted into thermo-acoustic panels.	✓ (red)			✓ (red)

Table 9. *(Continue)*

Company	**CBM strategy** (N. Bocken et al., 2019)	Evidence	CBM category			
			Circular suppliers	Product life extension	Product-as-a-Service	Resource Recovery
New For You	Cycling	Garments made from deadstock				✓
RediEstilo	Extending	Personalized repair and alteration and custom upcycling of clients' garments		✓		✓
SLOW	Cycling and extending	Resale, take-back strategies, shredding textiles for inputs for concrete/furniture (industrial symbiosis).		✓		✓
X2 Underwear	Cycling	Recycled PET fiber in underwear line	✓			

Across cases, the dominant strategy is Cycling, led by upcycling/remanufacturing, and where partnerships exist, industrial symbiosis (e.g., mechanically shredding textiles for concrete, utilizing recycled PET/PP inputs, and converting uniforms into panels). Extending appears where repair/mending is a core offer (RediEstilo, BeeUnique). Intensifying is niche, limited to swaps and selective rentals presented occasionally for BeeUnique and Slow with clothing-swap events, and rarely for Codes with selective rental to artists/influencers. Dematerializing is absent as a primary model, but Slow and Muysa offer services and education support circularity, but they do not substitute the physical product. The classification of these CBMs allows for a comparison of companies based on their value creation logic. Each type requires distinct capabilities and KPIs, preventing mixed signals and better guiding decisions for improvement and scaling.

4.3.1. Resource Recovery

Among the companies analyzed in this study, Resource Recovery was the most prevalent model. Its primary objective is to redirect post-consumer textile materials back into reuse or recycling cycles, thereby preventing their disposal in incinerators or landfills. The value captured in this approach primarily stems from reduced material acquisition costs and additional revenue generated from products or materials at the end of their life cycle. Companies such as Aquelarre, BeeUnique, CODES, Luca Denim, Muysa Moda Sostenible, New For You, RediEstilo, and SLOW transform materials previously considered waste into valuable inputs for new textile products or other value chains. Through upcycling, these firms create innovative garments and functional products, including pencil cases, fanny packs, tote bags, customized clothing, coasters, scrunchies, and even applications in concrete solutions.

This business model is particularly valuable because it reincorporates textile waste into the industry and, in some cases, enables industrial symbiosis, converting unrecoverable textiles into concrete, panels, or charcoal. Key capabilities for this model include collection and containment, fiber-based sorting, partnerships with material processors, and certification by weight. Currently, only SLOW tracks KPIs, such as kilograms collected, since it issues certificates to other companies. The main barriers identified for this model are limited sectoral capacity, high capital expenditures (CAPEX), and regulatory gaps, including the absence of Extended Producer Responsibility (EPR) frameworks.

4.3.2. Circular suppliers

Circular Suppliers business models involve companies that prioritize the optimization of resource use by reintegrating materials into the production cycle. Mar de Gea, for example, manufactures all of its products from recovered materials, including cassava starch, sugarcane bagasse, and recycled bottles and caps, emphasizing responsible sourcing through the policy: *"more than being a sustainable brand, we want to have sustainable suppliers."* In contrast, Muysa Moda Sostenible and X2 Underwear have sought to incorporate circular suppliers; however, most of their products still follow traditional production processes due to financial and technical challenges associated with a full transition to circular practices. As a result, both companies maintain dual production lines, one conventional and one circular, where the circular line requires additional effort and coordination. In this line, X2 Underwear uses threads derived from recycled plastics, while Muysa Moda Sostenible employs undyed textiles and environmentally friendly fibers.

This approach illustrates industrial symbiosis and the practical integration of circular supplier models, reducing dependency on virgin materials. Key capabilities for this model include reliable sourcing of materials (e.g., PET, PP, and other recycled inputs), quality control of recycled fibers, and performance validation. Typical barriers involve the premium price of recycled inputs, supply variability, and traceability of sustainability claims.

4.3.3. Product Life Extension

Product Life Extension is exemplified by companies such as BeeUnique and SLOW, which extend the lifespan of their products through take-back schemes. These firms recover and curate used textiles, which are subsequently sold in their second-hand stores or, depending on the condition, sent to partner companies specializing in upcycling. Similarly, BeeUnique and RediEstilo offer repair services to customers, providing the opportunity to restore garments to their original condition. Their experience shows that many items are discarded while still functional due to minor issues, such as missing buttons or broken zippers, which can be easily repaired to make the garment reusable.

This model is characterized by higher value per product life cycle, low CAPEX, and product differentiation through uniqueness. Key capabilities include careful curation,

garment-specific pattern adjustments, repair and remanufacturing, as well as size and quality control. The model's main challenges lie in its high labor intensity and the difficulty of standardizing the process.

4.3.4. Product-as-a-Service

Among the cases, only CODES shows intermittent adoption, it offers occasional garment rentals to influencers/artists, mainly for visibility, but this is not its core business model. The practice is ad hoc rather than systemic (no subscription, maintenance, or performance-based contracts), so it is coded as occasional rather than a full PaaS strategy. It monetizes the repeated use of each garment; the business earns from rotations, not from ownership. It cannot be deemed circular if operational externalities (such as long-distance transport or intensive laundering) exceed the environmental savings achieved. Accordingly, spatial proximity, the use of micro-hubs/lockers, durable garment selection, and efficient laundering systems are critical enablers. In brief, the model is circular because it maximizes wear per garment, reduces the need for new production, and closes the loop through maintenance and end-of-life recovery.

4.4. Enabling and challeging factors

After identifying the circular strategies employed by each company and determining the category of CBM to which they belong, the focus now shifts to the factors that influence circularity. Following the structure of the interviews, in which they were asked at the end about the facilitators and challenges they had faced, this section examines the enablers, the conditions and resources that make circular practices possible, and the challenges, the obstacles that hinder their implementation and scaling.

4.4.4. Enabling factors

4.4.4.1. Feedstock access & partnerships

Feedstock partnerships have emerged as a key enabler for securing material inputs and supporting circular operations. Manufacturers willing to sell their surplus provide reliable inflows of deadstock and excess materials, benefiting companies such as New For You and Luca Denim. In addition, Aquelarre has established strategic collaborations with BeeUnique and SLOW, which, through donations and textile waste management, supply

garments for Aquelarre upcycling purposes. Similarly, CODES relies on partnerships with Ecom to recover e-waste and with Recupera Colombia to obtain post-consumer textiles suitable for upcycling. SLOW further leverages collection networks by placing containers at points of sale and conducting targeted collection campaigns to engage customers. The company manages both transportation and kg-based certification that quantifies how much textile waste client companies divert. As of now, SLOW operates five containers in Medellín and one in Bogotá, reinforcing reliable supply while engaging customers in recovery.

These partnerships not only provide access to essential materials but also foster industrial symbiosis across the sector. For example, alliances with other industries strengthen the business models of BeeUnique, SLOW, Muysa, Mar de Gea, and X2 Underwear, enabling access to re-spun fibers, panels, recycled charcoal, concrete, and PP/PET inputs. In the case of X2 Underwear and Mar de Gea, allied suppliers also provide recycled fibers and sustainable fabrics, further supporting the adoption of circular strategies and reducing dependency on virgin materials.

Figure 4. *Collection container at an Allied Point in Medellín* (SLOW, 2025)

4.4.4.2. Consulting and financing programs

The companies highlighted programs that have supported their growth and consolidation. For instance, the Secretariat of Economic Development (*Secretaría del Desarrollo Económico*) and the Chamber of Commerce provide platforms to support SMEs, focusing on formalization, access to financing, management, financial, and marketing training, as well as connections to networks and resources. These initiatives have guided

companies such as SLOW and CODES through the process of legalizing their brands, while also offering entrepreneurship, sustainability, and textile consulting to Muysa and Mar de Gea.

SLOW has positioned itself as a key connector across different sectors, which has enabled the company to consolidate its role in advancing circularity within the textile industry. Its progress is largely attributed to active participation in dialogue platforms, strategic alliances, and the benefits of programs offered by institutions such as the University of Medellin. SLOW has also signed the "Green Manifesto" with six local companies, joined the city's Green Companies initiative to receive guidance on building SBMs, and participated in the textile waste panel discussion alongside large companies and academic institutions. Additionally, SLOW was recognized as a finalist in a program organized by the Colombo-British Chamber of Commerce. The company attributes these achievements to alignment with Sustainable Development Goal 17, emphasizing collaboration and knowledge-sharing across industry, academia, and business.

An additional incentive mentioned by the companies is the GIZ program, the German International Cooperation in Colombia, implemented through its initiative *Promoting the Circular Economy in Colombia through Innovation* (ProUSAR). This program supports the development and implementation of green business models based on a sustainable and productive economy. It employs a results-based financing approach, where payments are made only upon verification of specific targets and measurable impact. While most companies have not yet participated due to the need for precise performance data, they are preparing to engage in the program. SLOW is an exception, having already benefited from the initiative.

Finally, Luca Denim and Mar de Gea benefited from the *Capital Semilla* program (financing provided to entrepreneurs and micro-enterprises for the creation or consolidation of their businesses, especially in the initial stages) in different modalities, which facilitated their growth. Additionally, Mar de Gea received support from the entrepreneurial program of the sugar mills in Valle del Cauca (*Ingenios*), gaining training in business planning, sales, and digital marketing. This support strengthened local economies while promoting sustainable development in the regional sugar industry.

4.4.4.3. CEOs Previous Experience

The CEOs from companies such as Rediestilo, SLOW, BeeUnique, and Mar de Gea emphasized that their prior knowledge in areas such as fashion, sustainability, and entrepreneurship has been crucial for their growth and consolidation. Whether acquired through formal education or professional experience in the sector, this background provided a solid foundation for establishing their own businesses, enabling them to avoid linear economic models and adopt circular practices effectively.

RediEstilo and Mar de Gea entered the sector with prior garment-making experience gained through courses, which enabled them to start producing and selling apparel. By contrast, the founders of SLOW and BeeUnique built their business models on backgrounds in law and business administration. This managerial and regulatory knowledge helped them frame the textile waste problem, design solutions around it, and scale more effectively. In short, different founder capabilities, technical craft versus managerial/legal, shaped both the design of the models and their growth trajectories.

4.4.4.4. E-commerce platforms

All companies analyzed in this study utilize e-commerce systems to engage with customers and showcase their products. Platforms such as Instagram and company websites are widely used to promote products, facilitate sales, and communicate their processes. These digital tools have enabled companies to increase visibility, reach new clients, and establish strategic partnerships, supporting the scaling of their CBMs.

With the exception of X2 Underwear, all firms began with fully online sales. Over time, Aquelarre, BeeUnique, and Mar de Gea secured shelf space in multi-brand stores, while CODES and Luca Denim opened their own physical locations in 2025. RediEstilo and New For You remain online-only. Although BeeUnique and SLOW have a physical presence, their collection-driven models mean they rely primarily on online channels to communicate with customers and coordinate intake.

4.4.5. Challenges

4.4.5.1. Supplies quality and quantity

The inconsistent quality and features of second-hand inputs pose significant challenges for companies, leading to heavy curation requirements, slow throughput, and difficulties in standardizing sizes, as observed in Aquelarre and Luca Denim.

Irregular availability of surplus lots and the variability of fiber blends further complicated production planning and quality assurance, affecting companies like NEW FOR YOU, Luca Denim, and Mar de Gea. Constraints also arise when specific recycled inputs, such as PET or PP, are not continuously available, limiting production consistency for X2 Underwear and Mar de Gea.

4.4.5.2. Labor

The high manual labor involved in processes such as unsewing, cutting, and adjusting garments increases both unit costs and processing times. Additionally, there is a shortage of skilled laborers willing to undertake detailed deconstruction and upcycling tasks, resulting in bottlenecks at companies like Aquelarre.

4.4.5.3. Technology and infrastracture

Limited processing capacity restricts the ability of firms to absorb all available textile waste, increasing the risk that materials may be diverted to energy recovery rather than reintegration into production, as seen in SLOW. Moreover, the lack of scalable infrastructure for shredding, sorting, and remanufacturing at volume presents a critical barrier to growth and efficiency, affecting companies such as SLOW and Muysa Moda Sostenible.

4.4.5.4. Finance

On the cost side, high capital expenditure requirements for recycling equipment prevent many small and medium-sized enterprises from developing in-house processing plants, as noted by Muysa Moda Sostenible. The cost premium of recycled inputs also increases production expenses, making it difficult for firms such as X2 Underwear to maintain profitability while using eco-friendly materials.

On the market side, consumer sensitivity to pricing limits the demand for products made from recycled or sustainable materials. X2 Underwear has therefore reduced the share

of eco-friendly inputs in its product line. Similarly, the limited willingness of customers to pay for circular add-ons in uniforms or B2B segments constrains revenue opportunities for firms like Muysa.

4.4.5.5. Regulatory vacuum

The absence of binding Extended Producer Responsibility (EPR) legislation in Colombia creates weak incentives for companies to finance end-of-life management of textiles. For instance, the national bill on EPR was archived in 2022, leaving the firms with limited policy support to implement comprehensive circular strategies, especially companies such as SLOW, whose aim is not only to sell textiles but to reshape how they are managed nationwide.

4.4.5.6. Logistics & geography

Logistical challenges pose significant barriers to circular operations. Shipping costs for custom repairs and redesigns outside local areas often exceed the cost of labor, making such interventions viable only in batches, as observed for RediEstilo. Furthermore, coordinating multi-partner flows, including containers, transportation, and recyclers, adds both cost and complexity to the supply chain, affecting companies like SLOW and BeeUnique.

4.4.6. Social part: recyclers and garment workers

Interviews indicate that recyclers and garment workshops are critical enablers of circularity in Colombia; however, they also face significant structural challenges. Recyclers secure post-consumer feedstock that is later converted into recycled yarns or other materials. While brands such as Aquelarre, CODES, Luca Denim, New For You, and Mar de Gea outsourced, often women-led workshops provide flexible small-batch production. Aquelarre, Luca denim y New for you mention that Upcycling is highly labor-intensive: deconstruction, repair, and reassembly demand specialized skills, which increases unit costs and extends lead times for small workshops.

This dual reality makes the social link both an enabler and a bottleneck. Without recyclers and skilled garment workers, the models would not be viable; yet, fair integration remains challenging when margins are thin, and volumes fluctuate. Some firms signal their intent to

pay fairly and collaborate more closely with recyclers and workshops, but practical frictions persist, making it challenging to ensure predictable rates, short payment terms, and basic social protection when businesses must also absorb variability in materials and demand. Transparent fees per kilogram, short payment terms, and basic contracts, along with support for women-led workshops via training, personal protective equipment, and predictable orders, are essential.

5. Discussion

Based on the multiple case studies and the evidence collected, small firms are voluntarily adopting circular practices and business models. However, given the size of the sample and of the companies themselves, their representation within the national textile industry is limited; therefore, the results should be read as illustrative rather than statistically representative of the sector's transition. Even so, documenting these cases provides concrete evidence of how companies advance circularity across the value chain. At the design stage, input-driven decisions utilizing donations, deadstock, and surplus materials reduce dependence on virgin inputs, while fiber screening and planned use of remnants enhance quality and material efficiency. In production, small batches executed in distributed workshops prevent overproduction. Deconstruction, repair, and reassembly extend product life, although these processes increase labor time and costs. Offcuts are routed to recycling partners to generate secondary raw materials. On the distribution side, micro-drops and low inventories minimize dead stock, while resale and swap mechanisms intensify the use of garments and keep them in circulation. Finally, post-consumer strategies such as collection points, take-back schemes, and community programs recover materials at scale and raise user awareness. Together, these coordinated actions reduce waste and reliance on virgin inputs, deepen consumer engagement, and make circular flow more resilient, with the main trade-off being increased coordination and labor intensity.

Classifying firms by CBM allows for a clear comparison between companies; each type requires distinct capabilities and KPIs. It also helps map enablers and barriers with precision. For instance, circular suppliers depend on reliable recycled-input vendors and claim verification; resource recovery relies on sorting and shredding infrastructure and kilogram-based certification; life extension depends on skilled labor and process standardization. With that clarity, the typology also guides policy and finance: shared infrastructure and extended producer responsibility (EPR) for resource recovery; CAPEX credits and recycled-content procurement for circular suppliers; and targeted training for life extension enable a coherent approach to scaling circularity.

However, financing remains a critical barrier. Colombian firms currently implement circular practices voluntarily, without direct incentives, and often must secure funding

independently. This situation makes it challenging to compete against traditional business models, which dominate the market, resulting in only approximately 5% of textile waste being properly managed (Aguirre González, 2024). Inspired by European policies, Colombia could adopt regulatory frameworks that encourage durability, recyclability, and producer responsibility along the value chain, thereby reducing landfill and incineration flows (VELA-MICOULAUD & ENCISO-SANTOCILDES, 2022). Although a national bill was proposed, it is archived, leaving companies without legal obligations or incentives. Under this bill, large producers and distributors are expected to manage textile waste, implement educational campaigns, accept returns at no cost, design treatment strategies, supply information to registered managers, and report incidents to the Ministry of Environment. Consumers are encouraged to return textiles responsibly, while waste managers must meet technical and environmental standards. These mechanisms, if activated, could provide a structured framework to support CBM adoption.

Strategic financing, technology, and collaboration are essential for scaling CBMs. According to Arnold et al. (2010), firms can enhance access to capital by demonstrating sustainability performance, providing clear impact metrics, and engaging investors. Partnerships with NGOs, government agencies, and impact investors can support technology acquisition and model expansion. Blended finance, combining grants with soft loans, and performance-based disbursements linked to recovered kilograms or recycled content can further promote circular initiatives. Expanding awareness of local and national programs such as GIZ initiatives, seed capital programs, the Colombo-British Chamber of Commerce, and local economic development offices can help firms leverage these resources.

Shared technological capacity could be particularly relevant in the textile industry. Regional public-private centers for fiber sorting and mechanical shredding could allow SMEs to access advanced recovery pathways (e.g., re-spinning, panels, concrete inputs) without investing in expensive machinery. This approach lowers entry barriers and enables broader participation. Equally important is robust measurement, traceability, and performance verification. Even minimum viable systems tracking kilograms collected, routing by fiber type, batch certification, and recovery rates can generate trust with investors and buyers without large IT investments.

Skill development and community engagement through repair and upcycling labs, workshops, and schools alleviate labor bottlenecks and extend product lifespans. Community initiatives also raise awareness of the environmental and social value of circular products, fostering conscious consumption. Therefore, promoting local and sustainable consumption is critical. Encouraging the use of locally produced clothing helps mitigate the impacts of imported low-cost textiles. Public policies could encourage high-quality local production and restrict unsustainable imports. CBM should aim to recover garments actively rather than discarding items due to slow sales. Companies must collaborate with clients to ensure the implementation of take-back and repurchase mechanisms for sustainable products, thereby enabling continuous product circulation.

Coherence and collaboration across the value chain are essential for effective circularity. All actors, fiber suppliers, manufacturers, retailers, and consumers must align to support the CE. Industrial symbiosis, where one actor's by-products become another's inputs, also matters; although examples in our sample were limited, they include SLOW's textile-to-concrete/furniture routes, BeeUnique's partnerships that convert mixed streams into recycled charcoal, Muysa's take-back uniforms transformed into thermoacoustic panels, and CODES' integration of e-waste components. Moving away from a linear "produce and consume" mentality toward thoughtful production and consumption is fundamental. Products should be designed for longevity, not merely to follow trends, allowing consumers to use items across multiple contexts and reducing waste in the system.

This transition must include recyclers and workshop workers, many of whom currently operate informally without social protection, standardized tariffs, or strong bargaining power. Upcycling work is labor-intensive, increasing unit costs and lead times for workshops. There is a risk that these actors could be excluded if CBMs expand without integrating them, especially given cash-flow constraints and fragmented orders. Several companies have expressed a willingness to engage recyclers as active collaborators in a fair manner. To maintain this social dimension as an enabler, firms can implement transparent floor rates and simple contracts, provide basic training and equipment, and monitor social KPI such as average salary per kilogram, percentage of female-led units, and training hours, ensuring that circularity contributes to inclusive growth. Effective integration of these informal workers

requires close collaboration among government, firms, institutions, and civil society to create conditions that promote formalization, social protection, improved labor standards, and sustainable economic competitiveness (Caicedo Manrique, 2021; Rodríguez López & Vergara Ángel, 2015; Yepes Palacio et al., 2008).

Circular fashion encourages consumers to make informed choices while pushing the industry to adopt more sustainable and responsible production methods. Societal changes and evolving consumer needs make it essential for companies to rethink their current practices. In this sample, circularity progresses when firms align three key elements: reliable access to waste-based inputs, flexible small-batch production capacity, and partner networks that enable recycling and closed-loop processes. Conversely, progress stalls when infrastructure and financing are insufficient, and regulatory signals are weak. The combination of micro-lot production, industrial symbiosis, and social inclusion emerges as the most viable strategy for scaling circularity in the Colombian textile sector.

6. Conclusions

The implementation of CE practices has become a strategic necessity, driven by the ongoing environmental crisis, increasing social and market awareness, and the lessons learned from successful initiatives in other countries. In Colombia, this challenge is particularly significant due to the lack of public policies, incentives, environmentally conscious business models, and studies supporting the sector's transition toward more sustainable practices. Implementing circular practices to reduce environmental impacts in the textile industry has therefore been a complex task for companies.

Despite the growing interest in the CE, collaboration between companies, government, and academia remains limited, which has slowed the widespread adoption of practices that could scale CBMs in the country. In this context, the present study focused on the practices currently implemented, the business models adopted, and the factors that facilitate or hinder their implementation. The aim was to provide a documented basis of companies that have committed to the transition, illustrating how they have approached it. Such evidence can serve as a model for other firms, guide policy development, and contribute to understanding the current state of CE adoption in Colombia, ultimately supporting future improvements in the sector.

To address the research question and meet the study's objectives, a qualitative methodology was employed, using a multiple-case study design with purposive sampling. Ten small companies were selected based on their implementation of circular practices, formal recognition by the Chamber of Commerce, and willingness to participate in the study. Through semi-structured interviews, the study aimed to identify the circular practices and business models applied by these companies, as well as to examine the challenges and enabling factors influencing the adoption of circular practices within the Colombian context.

The results, analyzed under the framework of the 9Rs, highlight the circular practices adopted by Colombia's textile SMEs. R1 (Refuse) was prominent, with companies focusing on minimizing the use of virgin materials, a critical issue in the national industry. Strategies such as producing in small batches within distributed workshops prevent overproduction, while micro-lots and low inventories reduce deadstock. R6 (Remanufacturing) and R7 (Repurposing) were also widely applied. R3 (Reuse) and R4 (Repair) are applied where

service capabilities exist, and recycling is implemented when industrial partners are available. Deconstruction, repair, and reassembly extend product life, although they can increase labor time and costs. Resale and garment swaps help intensify product use and keep items in circulation. As a post-consumer strategy, some companies have established collection points, take-back schemes, and community programs to recover materials while raising consumer awareness, reinforcing both environmental and social dimensions of circularity.

Across cases, the companies' CBMs strategies revealed a clear preference for cycling, primarily through upcycling and remanufacturing, and, where partnerships exist, through industrial symbiosis. Extending product life through repair and mending was observed only occasionally, offered by two of the firms in the sample. Intensifying strategies were limited to clothing swaps and selective rentals, implemented sporadically by BeeUnique and Slow through swap events, and rarely by CODES for selective rentals to artists or influencers. Dematerializing did not emerge as a primary strategy; however, Slow and Muysa provide services and educational initiatives that support circularity, although they do not replace the physical products. It is also noteworthy that Luca Denim and Mar de Gea have pursued a model that goes beyond textiles, actively engaging with the community through direct strategies to promote circularity. These include co-creation and training activities in collaboration with educational institutions, as well as material recovery initiatives, such as beach-cleaning and plastic collection programs in partnership with local organizations. These efforts demonstrate a commitment to sustainability and community impact, reflecting a business model that seeks to generate value beyond economic gains, even as small enterprises.

Regarding the business models identified among the companies in the sample, the Circular Suppliers model is fully implemented by Mar de Gea, which follows a clear policy of sourcing exclusively from sustainable suppliers. In contrast, Muysa Moda Sostenible and X2 Underwear have only partially implemented this model, as they continue to face financial and technical obstacles that prevent a full transition to circular supply chains. In the Product Life Extension category, BeeUnique, Rediestilo, and Slow have focused on strategies such as second-hand clothing sales and garment repair services to extend the lifespan of their

products, preventing premature disposal and ensuring items remain in use for longer periods. The most prevalent model across the sample is Resource Recovery, as Aquelarre, BeeUnique, Codes, Luca Denim, New for You, Rediestilo, and Slow actively engage in upcycling, transforming textile waste into new garments, accessories, or innovative solutions such as furniture and concrete applications. For Muysa Moda Sostenible, this model is only partially implemented, as the company has yet to fully consolidate circular operations and continues to maintain a line of traditionally produced products.

It is essential to acknowledge that the adoption and scaling of circular practices rely on several key enabling factors. Key drivers include reliable access to feedstock through deadstock, surplus, or donations; the establishment of partner ecosystems and industrial symbiosis with recyclers and material processors; and maintaining flexible production capacity, often achieved through satellite workshops that handle small batches. Adoption is further supported when the business model aligns with circular practices, such as micro-lot production, made-to-order B2B processes, or service add-ons like curation and certification. Institutional recognition, including awards, seed funding, or backing from municipalities and corporations, can reinforce adoption. Meanwhile, basic traceability systems (logs, joint records, or kilogram certificates) and community engagement initiatives (training, co-creation, and awareness campaigns) facilitate acceptance and support future material recovery.

Conversely, several barriers limit the implementation and scaling of circular practices. These include material heterogeneity and labor intensity, given the time-consuming nature of deconstruction and reassembly; infrastructure gaps in sorting, shredding, and remanufacturing; financial and market constraints, especially in high-capex environments or price-sensitive markets; and regulatory gaps, such as the absence of binding extended producer responsibility policies. Logistics frictions, skills shortages for detailed upcycling, and limitations in measurement systems beyond basic weight metrics also hinder proof of impact and value capture. Furthermore, recyclers and small garment workshops, while essential to circular flows, often represent vulnerable links. Many operate informally, with non-standard tariffs and limited bargaining power, while upcycling labor in workshops is

intensive and frequently paid per piece. Companies have expressed intentions to ensure fairer compensation and to integrate recyclers more formally as collaborators.

The study identifies concrete circular practices and business models present in the Colombian textile sector, analyzing both the strategies employed and the constraints faced by companies. It provides a practical overview of where circularity is already embedded and where it is emerging. Additionally, the study offers recommendations derived from lessons learned and insights from the literature, aiming to support the scaling of circular models and practices in the Colombian context. The results suggest that the transition to circularity must be addressed at multiple levels. At the governmental level, it requires the creation of incentives and regulatory systems that ensure responsible and sustainable production.

Beyond national policy, the transition to textile circularity requires coordinated action by multiple actors. Companies should prioritize R0–R2 (refuse, rethink, reduce) while developing use-phase services (repair, take-back, resale/swaps), standardizing upcycling modules, and ensuring fair contracts and payments for recyclers and workshops, tracked with simple metrics (kg diverted, % recycled content, life extension). Suppliers, recyclers, and processors can enable industrial symbiosis by offering pre-sorted flows and offtake agreements. Retailers/marketplaces can host collection containers, repair/resale corners, and provide clear information on the repairability and recycled content of their products. NGOs and community organizations can foster recycler cooperatives and coordinate neighborhood collection drives. Universities and technical centers could provide research in the design area for disassembly and durability, run repair labs, and develop digital product passports for SMEs, supporting companies in their transition process. Investors and lenders can provide blended finance (grants plus soft loans) and results-based guarantees tied to kilograms processed. Local governments can facilitate shared infrastructure and collaborative logistics and include recycled-content criteria in public procurement. Ultimately, consumers can opt to repair, return, rent, or repurchase, thereby supporting brands with traceability and fair pay. Taken together, these levers align upstream prevention with viable downstream routes, making circularity credible, measurable, and scalable.

This research is innovative in presenting empirical evidence of circular practices and business models implemented in SMEs across Colombia’s textile industry. It identifies local

SMEs and industrial symbiosis (textile to concrete, recycled charcoal, and PP/PET), an area that remains under-documented in the Colombian context. This study integrates the 9R prevention hierarchy, linked to concrete practices in the value-chain stage, to classify the circular business model (CBM) and demonstrate how different levers work together rather than in isolation. It demonstrates how firms operate them as business models and what conditions help or hinder their adoption. The diverse cases of remanufacturing, reuse, deadstock management, and e-waste recovery illustrate practical circular pathways that go beyond traditional recycling. Furthermore, the research highlights the social dimension, especially recyclers and workshops, as both an enabler and a challenge. Finally, the study bridges the gap between business and policy by translating bottlenecks, such as limited production capacity, CAPEX constraints, and regulatory voids, including extended producer responsibility (EPR), into recommendations, including shared infrastructure, financing mechanisms, and public procurement with recycled content. Through this, the study connects firm-level practices and clarifies how small and medium enterprises scale circular business models by combining R-strategies (9R) with circular business model (CBM) logics and enabling factors for scaling circularity, as well as the challenges that these different business models have presented.

While the study offers valuable insights into how small Colombian textile companies implement circular practices, several limitations should be considered. First, the sample included 10 companies, selected from a total of 30 companies that were initially contacted through various sources; however, due to time constraints and availability, only 10 companies were ultimately considered in the research, which limits the representativeness of the results and makes it difficult to generalize the findings to the entire Colombian textile industry (Appendix 1 presents the full list of all identified companies). Participation depended on the availability and willingness of the interviewees, which could create a self-selection bias, as companies more committed to sustainability and circularity might have been more likely to participate. Due to location constraints, all interviews were conducted virtually, even though some companies were open to in-person visits. This limits direct observation of their processes and practices. Finally, because the data comes from self-reported information by the interviewees, there may be biases or subjective interpretations of their circular practices.

For future research, it would be valuable to further quantify the environmental and economic impacts of circular practices, including metrics such as greenhouse gas emissions, water usage, and cost-benefit analyses. Pilot programs for extended producer responsibility (EPR) or take-back schemes could be implemented and measured within Colombia, while social outcomes for recyclers and workshops should be assessed in depth. Additionally, examining public policies and regulations could provide insights into how they might support the transition to a more sustainable industry and facilitate the adoption of CBMs in fashion companies, both in Colombia and in countries with similar contexts.

The findings indicate that the circularity of Colombia's textile sector can scale by reinforcing the strategies already proving effective in the cases studied. These include securing reliable waste-based feedstock, maintaining flexible production with low inventories, establishing credible recycling partnerships, and ensuring fair inclusion of social actors such as recyclers and small workshops. With targeted financing mechanisms and clearer policy guidance, these practices could evolve from niche initiatives to sector-level capabilities, supporting a more sustainable and resilient textile industry. Within the Colombian context, circularity progresses when SMEs manage steady flows of waste and feedstock, leverage distributed workshop networks, and anchor B2B circular services with traceable and reliable partner routes. Conversely, progress is hindered when heterogeneous materials meet labor-intensive methods without sufficient infrastructure, under conditions of price-sensitive demand and in the absence of regulatory frameworks.

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ChatGPT Plus and NotebookLM, AI-based tools, were used to improve the readability and language of the work.

Appendix

Appendix A. *List of identified and contacted companies*

Company name	Web page	Willing to participate?	Contact	Position in the company
Aquelarre	https://aquelarre.co/	Yes	Manuela Toro and Maria Paula Gonzalez	Founders
BeeUnique	https://www.beeuniquecol.com/	Yes	Sandra Mejía	Founders
Codes	https://www.codesfashion.com/	Yes	Mateo Prieto	Founder & Creative Director
Luca denim	https://www.instagram.com/lucadenimm/	Yes	Estefanía Monroy and Karina Álvarez	Founder and CMO
Mar de gea	https://www.instagram.com/mardegea.bw/	Yes	Kelly Yohana	CEO
Muysa moda sostenible	https://muysa.co/	Yes	Lida Paola Trujillo	CEO
New for you	https://newforyoushop.com/	Yes	Paulina Franco and Veronica Bacci	Founders
Rediestilo	https://www.instagram.com/rediestilo/	Yes	Yeimi Acosta	CEO
Slow	https://slowreciclaje.com/	Yes	Vanessa Baez	CEO
X2 Underwear	x2underwear.com	Yes	Sonia Gonzalez and Ricardo Arias	CEOs
Alejandro Crocker	https://www.alejandrocrocker.com/	No	-	-
Bee Surreal	https://beesurrealsw.com	No	-	-

Bohio	https://bohioplaya.com	No	-	-
Broncealana	https://www.broncealana.com	No	-	-
Carmen Helena joyas	https://www.instagram.com/carmenhelenajoyas/?hl=es	No	-	-
Closet Up	https://closetup.com	No	-	-
Eleonora Morales	https://eleonoramorales.com	No	-	-
Fibretex	https://fibretex.com.co	No	-	-
Keidypalaciosmoda	https://www.instagram.com/keidylorenapalacios/	No	-	-
Look Twice	https://looktwice.co	No	-	-
Michelle Macia	https://michellemacia.com	No	-	-
Patiamarillos	https://www.instagram.com/patiamarillos.co/?hl=es	No	-	-
Protela	https://protela.com	No	-	-
Pura	https://puraclothes.com	No	-	-
Retrosoul	https://retrosoultienda.com	No	-	-
Saju	https://www.saju.co	No	-	-
Segunda Historia	https://segundahistoria.co	No	-	-

Talego	https://talego.com.co	No	-	-
Tienda Madre Tierra	https://madretierra.com.co	No	-	-
Trans	https://www.instagram.com/_trans_forma/	No	-	-