

ASSIGNMENT OF STAKEHOLDERS TO THE DEVELOPMENT COMPONENTS OF THE TEXTILE REVERSE SUPPLY CHAIN

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Introdução

The textile industry is characterized by a diverse range of products, encompassing everything from natural fabrics to synthetic fibers, whose use has intensified in the face of the environmental crisis. As highlighted by Menegucci et al. (2015), it is a sector with high solid waste generation, predominantly in the form of fabrics of plant, animal, or synthetic origin. Globally, the industry produces approximately 100 billion garments annually, of which around 33% are discarded within the first year of use (Monash University, 2021).

Problema de Pesquisa e Objetivo

The adoption of sustainable standards is imperative, and the transition to circular models requires technological innovation and integration throughout the supply chain (Jena & Sarmah, 2014). In this context, the Reverse Supply Chain (RSC) plays a strategic role by enabling the reintegration of waste into the production cycle, requiring a systemic and competitive approach (Das & Posinasetti, 2015; Elia & Gnoni, 2015). Accordingly, the present study aimed to assign the RSC components relevant to stakeholders' functions, establishing a reference for the efficient operation of the textile RSC.

Fundamentação Teórica

Research and practice in supply chain (SC) management tend to focus on tangible processes, a tendency that extends to environmental sustainability approaches (Ashby et al., 2012), with little recognition of the importance of the stakeholders relationships in its development (Jena & Sarmah, 2014). These relationships, or organizational arrangements, are critical for organizations, for strategic reasons (Lane & Beamish, 1990; Amato, 2007; Balestrin & Verschoore, 2016) and for sociocultural alignment (Farkas & Avny, 2005).

Metodologia

To achieve the research objective, the study considered, such as components, stakeholders, operational or strategic activities and practices, supporting strategies, technologies, concepts, principles, and circularity guidelines that influence the RSC. A Systematic Literature Review (SLR) was conducted in accordance with the guidelines of Tranfield et al. (2003), Building on the results of the SLR and with the aim of identifying the relationships between SC components and stakeholders, the subsequent step involved mapping stakeholders to the respective components.

Análise e Discussão dos Resultados

The RSC is a complex and dynamic system involving the actions and interactions of multiple stakeholders, whether dependent or independent. These actions influence both the structuring and performance of the RSC through their connection with the components that support its operation and the circularity of materials. Among the components identified in the literature, some can determine the pace and effectiveness of the RSC, as well as establish the active participation and responsibilities of stakeholders.

Considerações Finais

In summary, the effectiveness of the RSC is directly related to the coordination between stakeholders and the various RSC components that structure its functioning. These components achieve scalable and expanded outcomes only when supported by public policies, appropriate technologies, and institutional support strategies. Similarly, the concepts, principles, and guidelines of circularity can provide the normative and ethical foundation to align the interests of different stakeholders and guide their decisions.

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Palavras Chave

Reverse Supply Chain, Textile Industry, Stakeholders

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1 INTRODUCTION

The textile industry is characterized by a diverse range of products, encompassing everything from natural fabrics to synthetic fibers, whose use has intensified in the face of the environmental crisis. As highlighted by Menegucci et al. (2015), it is a sector with high solid waste generation, predominantly in the form of fabrics of plant, animal, or synthetic origin. Globally, the industry produces approximately 100 billion garments annually, of which around 33% are discarded within the first year of use (Monash University, 2021). In the Brazilian context, the textile industry represents the second-largest employer in the manufacturing industry, generating 1.36 million direct jobs and ranking among the four largest industries worldwide (ABIT, 2024). However, only 20% of textile waste received proper disposal in 2018, despite an annual volume of 4 million tons being discarded (Amaral et al., 2018; Abrelpe, 2022).

The adoption of sustainable standards is imperative, and the transition to circular models requires technological innovation and integration throughout the supply chain (Jena & Sarmah, 2014). In this context, the Reverse Supply Chain (RSC) plays a strategic role by enabling the reintegration of waste into the production cycle, requiring a systemic and competitive approach (Das & Posinasetti, 2015; Elia & Gnoni, 2015). Accordingly, the present study aimed to assign the RSC components relevant to stakeholders' functions, establishing a reference for the efficient operation of the textile RSC.

2 THEORETICAL FOUNDATION

Research and practice in supply chain (SC) management tend to focus on tangible processes, a tendency that extends to environmental sustainability approaches (Ashby et al., 2012), with little recognition of the importance of the stakeholders relationships in its development (Jena & Sarmah, 2014). These relationships, or organizational arrangements, are critical for organizations, for strategic reasons (Lane & Beamish, 1990; Amato, 2007; Balestrin & Verschoore, 2016) and for sociocultural alignment (Farkas & Avny, 2005). Waste management in this industry should be effective, as textiles are composed of diverse materials that decompose slowly, requiring recovery to mitigate environmental and social impacts (Parajuly, 2017). Furthermore, the textile industry generates additional negative effects, such as climate change, chemical pollution, biodiversity loss, and risks to human health (Fletcher & Grose, 2011).

Accordingly, the textile industry must align with the Circular Economy (CE) which keeps materials in circulation through maintenance, reuse, remanufacturing, and recycling, while addressing challenges such as waste, pollution, and the use of finite resources. However, research in SC management still prioritizes tangible processes and largely underestimates the role of relationships in advancing sustainability (Ashby et al., 2012). The textile SC is extensive and complex, involving both forward and reverse flows. Despite the market volatility characteristic of emerging economies, strengthening the sustainability of the Forward Supply Chain (FSC) remains essential (Lin et al., 2023). Achieving this requires the integration of recovery practices and appropriate disposal measures across the entire SC.

3 METHODOLOGY

To achieve the research objective, the study considered, such as components, stakeholders, operational or strategic activities and practices, supporting strategies, technologies, concepts, principles, and circularity guidelines that influence the RSC. A

Systematic Literature Review (SLR) was conducted in accordance with the guidelines of Tranfield et al. (2003), comprising four main stages: a pilot review, protocol development, article selection, and data extraction and analysis. The pilot review was used to test and refine search terms; the protocol established the research questions along with the inclusion and exclusion criteria; and the data extraction phase ensured that only studies directly aligned with the research objective were considered.

Building on the results of the SLR and with the aim of identifying the relationships between SC components and stakeholders, the subsequent step involved mapping stakeholders to the respective components. This mapping positioned each stakeholder according to their role and function within the RSC.

4 ANALYSIS AND DISCUSSION OF THE RESULTS

The following presents the SC components identified in the RSL. These components encompass stakeholders, operational or strategic activities and practices, supporting strategies, technologies, concepts, principles, and circularity guidelines that influence the functioning of a RSC. The stakeholders were organized into categories, and the collected information is presented in Tables 1 and 2.

Table 1 – Categories of stakeholders in the textile RSC identified in the literature

Categories	SC	Stakeholders	References*
Consumers	FSC/ RSC	Consumer; Customer; Society; Communitie; Media	24; 35; 4; 30; 23; 3; 20; 2; 11; 19; 27; 25; 18; 32; 17; 15; 28; 31; 1; 7; 14; 33; 29; 8; 16; 6; 21; 13; 5; 34; 9; 22; 26
Repairers	RSC	Repair services; Seamstress	22; 24; 11; 19; 31; 7; 33; 13
Reusers	RSC	Resale sites; Flea markets; Second-hand clothes stores	24; 20; 12; 32; 31; 16; 34; 21; 23; 22; 11; 25; 28; 7; 5
		Rental companies; Rental platforms; Clothing library	7; 13; 22; 12; 31; 16
		Charities; Charitable associations/organizations; Commercial clothing reuse companies	31; 16; 27; 5; 24; 11; 12; 19; 1; 7; 34; 20; 21; 13; 35
Voluntary Drop-off Points (VDP)	RSC	Voluntary Drop-off Points	11
Collectors	RSC	Collection companies; Collectors; Waste pickers; Waste picker cooperatives; Collection centers	14; 5; 18; 20; 32; 17; 33; 13; 28
Logistics operator/ Transporter	RSC	Waste exporters	5
Processors	RSC	Sorting cooperatives; Sorters; Sorting companies; Collection centers; Collectors	11; 13; 10; 28; 31; 33
NGOs	RSC	NGOs; Social enterprises; Sustainable organizations; Activists	11; 15; 22; 31; 7; 8; 26; 19; 28; 24; 35; 27; 13
Waste managers	RSC	Waste management companies; Waste vendors	19; 27; 26; 9; 7; 32; 20; 28
Remanufacturers	RSC	Upcyclings; Entrepreneurs; Reuse companies; Upcycling companies; Designer	20; 27; 28; 6; 31; 30; 11; 19; 18; 17; 15; 7; 14; 34
		Remanufacturers	19
Recyclers	RSC	Recyclers; Recycling organizations; Recycling companies	3; 20; 11; 19; 27; 18; 32; 17; 28; 29; 5; 15
Other FSC	FSC/ RSC	Brick industry; Cement industry	28; 32
Landfill/Incinerator Operators	RSC	Landfill; Incinerators	4; 23; 5; 19; 25; 10; 32; 17; 28; 31; 1; 33; 29; 8; 16; 6; 13; 21
Government	FSC/ RSC	Government/ Authorities; Policy makers	35; 20; 11; 19; 27; 18; 9; 17; 15; 28; 22; 31; 7; 33; 8; 16; 13; 26; 24; 30; 23; 12; 32; 1

Researchers and Technology Developers	FSC/RSC	Academy; International industry and research consortia; Technology developers	35; 30; 20; 19; 12; 27; 1; 13; 26; 28; 17
Creditors	FSC/RSC	Investors; Financial institutions	30; 13

*Reference Code: 1 - Abdallah *et al.* (2024); 2 - Abdelmeguid *et al.* (2024); 3 - Adenle; Haideri; Sandouka (2024); 4 - Ashby (2018); 5 - Boschmeier; Ipsmiller; Bartl (2024); 6 - Choudhury; Tsianou; Alexandridis (2024); 7 - Degenstein *et al.* (2023); 8 - Dhiwar; Bedarkar (2024); 9 - Dursun; Ulker; Gunalay (2023); 10 - Edirisinghe *et al.* (2024); 11 - Ermini; Visintin; Boffelli (2024); 12 - Ghoreishi; Bhandari; Franconi (2022); 13 - Gomes *et al.* (2023); 14 - Han *et al.* (2017); 15 - Härrri; Levänen (2024); 16 - Juanga-Labayen; Labayen; Yuan (2022); 17 - Kayikci *et al.* (2022); 18 - Kazancoglu *et al.* (2022); 19 - Khan; Wang; Padhye (2023); 20 - Kim; Wu (2021); 21 - Moazzem *et al.* (2022); 22 - Neto *et al.* (2024); 23 - Patwary *et al.* (2023); 24 - Pera; Ferrulli (2024); 25 - Ranjan *et al.* (2024); 26 - Rumanti *et al.* (2021); 27 - Singh *et al.* (2019); 28 - Sinha *et al.* (2022); 29 - Solis *et al.* (2024); 30 - Staicu; Pop (2018); 31 - Staicu (2019); 32 - Tang (2023); 33 - Teixeira *et al.* (2023); 34 - Vehmas *et al.* (2018); 35 - Yadav; Majumdar (2024).

Source: Authors (2025).

Table 2 – Categories of other components of the textile RSC identified in the literature

Categories	Others RSC Components	References*
Reverse Logistics	Extended Producer Responsibility; Collection and Sorting; Take-back Systems; Post-consumer Waste Separation; Source Separation; Reverse Logistics Systems	11; 16; 28; 7; 29; 32; 1; 6; 12; 14; 19; 5; 33; 34; 35; 21; 3; 4; 17
Recovery	Redesign; Wallet Manufacturing; Slipper/Shoe Manufacturing; Trashion; Circular Economy; Repair and Alteration; Donation; Sale/Resale; Second-hand Markets; Remanufacturing; Fiber Reprocessing; Recycling; Mechanical Recycling; Thermal Recycling; Biochemical Recycling; Chemical Recycling; Enzymatic Recycling; Pellet Production (Polyester and Nylon); Enzymatic Hydrolysis of Cotton/Polyester; Upcycling; Downcycling; Reuse; Reuse; Use as Carpet Padding; Use as Acoustic Insulation; Polymer Conversion / Polymer Production; Felt Production; Industrial Cleaners; Disposable Diaper Manufacturing; Napkin Production; Recycled Fiber Production; Geotextile Production; Mechanical Separation; Gasification; Composting; Anaerobic Digestion	24; 2; 7; 23; 22; 21; 33; 34; 30; 17; 8; 6; 13; 4; 11; 19; 3; 25; 12; 28; 31; 1; 16; 32; 9; 15; 5; 27; 10; 35; 29; 14; 6
Final Disposal	Export of waste; Incineration; Landfill; Waste management; Environmentally friendly disposal practices	5; 28; 31; 16; 6; 21; 24; 30; 23; 12; 25; 9; 14; 22; 7; 29; 13; 4; 10; 3; 26; 1
General	Consumer/stakeholder education/ awareness; Buying ecologically conscious and environmental preferable clothing; 4Rs; Subscription plan; Renting clothes; Policies; Government incentives	11; 32; 9; 5; 28; 22; 7; 14; 8; 13; 30; 23; 3; 33; 2; 31; 16

*Reference Code: 1 - Abdallah *et al.* (2024); 2 - Abdelmeguid *et al.* (2024); 3 - Adenle; Haideri; Sandouka (2024); 4 - Ashby (2018); 5 - Boschmeier; Ipsmiller; Bartl (2024); 6 - Choudhury; Tsianou; Alexandridis (2024); 7 - Degenstein *et al.* (2023); 8 - Dhiwar; Bedarkar (2024); 9 - Dursun; Ulker; Gunalay (2023); 10 - Edirisinghe *et al.* (2024); 11 - Ermini; Visintin; Boffelli (2024); 12 - Ghoreishi; Bhandari; Franconi (2022); 13 - Gomes *et al.* (2023); 14 - Han *et al.* (2017); 15 - Härrri; Levänen (2024); 16 - Juanga-Labayen; Labayen; Yuan (2022); 17 - Kayikci *et al.* (2022); 18 - Kazancoglu *et al.* (2022); 19 - Khan; Wang; Padhye (2023); 20 - Kim; Wu (2021); 21 - Moazzem *et al.* (2022); 22 - Neto *et al.* (2024); 23 - Patwary *et al.* (2023); 24 - Pera; Ferrulli (2024); 25 - Ranjan *et al.* (2024); 26 - Rumanti *et al.* (2021); 27 - Singh *et al.* (2019); 28 - Sinha *et al.* (2022); 29 - Solis *et al.* (2024); 30 - Staicu; Pop (2018); 31 - Staicu (2019); 32 - Tang (2023); 33 - Teixeira *et al.* (2023); 34 - Vehmas *et al.* (2018); 35 - Yadav; Majumdar (2024).

Source: Authors (2025).

Table 3 presents the assignment of other RSC components to stakeholders according to their position and function within the SC. This allocation of components can support the creation, establishment, and expansion of the RSC in the targeted context, serving as a basis for decision-making during the structuring of these SC.

Table 3 – Assignment of Other RSC Components to Stakeholders

Categories	Other RSC Components
Consumers	Source Segregation; Repair and Modification; Donation; Sale/Resale; Purchase of Environmentally Conscious and Preferable Clothing; 4Rs; Subscription Plan; Clothing Rental; Environmentally Responsible Disposal Practices
Repairers	Repair and Modification; Redesign
Reusers	Reuse; Sale/Resale; Second-hand Markets; Purchase of Environmentally Conscious and Preferable Clothing; 4Rs; Subscription Plan; Clothing Rental
Voluntary Drop-off Points (VDP)	Collection and Sorting
Collectors	Collection and Sorting
Logistics operator/ Transporter	Waste Export
Processors	Post-Consumer Waste Separation
NGOs	Consumer/Stakeholder Education and Awareness; Donation
Waste managers	Waste Management
Remanufacturers	Upcycling; Downcycling; Reuse; Repurposing; Pellet Production (Polyester and Nylon); Felt Production; Industrial Cleaners; Disposable Diaper Production; Napkin Production; Recycled Fiber Production; Geotextile Production; Wallet Production; Sandal/Footwear Production; Trashion; Remanufacturing
Recyclers	Recycling; Mechanical Recycling; Thermal Recycling; Biochemical Recycling; Chemical Recycling; Enzymatic Recycling; Enzymatic Hydrolysis of Cotton/Polyester; Use as Carpet Padding; Use as Acoustic Insulation
Other FSC Stakeholders	-
Landfill/Incinerator Operators	Incineration; Landfilling
Government	Policies; Government Incentives
Researchers and Technology Developers	-
Creditors	-

Source: Authors (2025).

The RSC is a complex and dynamic system involving the actions and interactions of multiple stakeholders, whether dependent or independent. These actions influence both the structuring and performance of the RSC through their connection with the components that support its operation and the circularity of materials.

Among the components identified in the literature, some can determine the pace and effectiveness of the RSC, as well as establish the active participation and responsibilities of stakeholders. For example, Consumers can assume or participate in the following components: source segregation; repair and modification; donation; resale; purchase of environmentally conscious and preferred clothing; the 4Rs; subscription plans; clothing rental; and environmentally responsible disposal practices.

Just as some stakeholders act directly, others occupy strategic, supporting, or indirect roles, which can be mobilized by the government or non-governmental organizations through regulations, tax incentives, and public policies. Such strategies provide the institutional framework necessary to legitimize and sustain the RSC, creating favorable conditions for companies to internalize circularity practices.

Similarly, the relationships presented in Table 3 aim to guide stakeholder behavior and provide practical parameters for aligning divergent interests. These relationships also support the establishment of commitments to product collection and reuse, with Consumers and Governments reinforcing the return cycle.

Thus, the creation of the relationship between stakeholders and RSC components is not linear but systemic, as this cycle materializes only when different stakeholders recognize their responsibilities and interact collaboratively. In this sense, the effectiveness of the Textile RSC depends not only on the technical execution of activities but also on the social, political, and cultural engagement of the stakeholders who sustain it.

5 FINAL CONSIDERATIONS

In summary, the effectiveness of the RSC is directly related to the coordination between stakeholders and the various RSC components that structure its functioning. These components achieve scalable and expanded outcomes only when supported by public policies, appropriate technologies, and institutional support strategies. Similarly, the concepts, principles, and guidelines of circularity can provide the normative and ethical foundation to align the interests of different stakeholders and guide their decisions.

Establishing relationships between RSC components and stakeholders can offer clarity to those involved stakeholders regarding the development of the RSC, whether as a starting point for its implementation or as a means of expanding a pre-existing model. Since Table 3 presents several components that may not yet be effectively in use (due to lack of investment or technology), particularly in emerging economies, their listing and assignment enable their visualization and strategic application.

Thus, the performance of the RSC depends not only on the execution of technical processes but also on the ability of multiple stakeholders to engage around shared objectives of sustainability, transparency, and efficiency, consolidating a circular model.

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