Circular Start-Ups in the Textile Industry: Adoption of Circular Practices and Context Barriers

ABSTRACT

This research examines the circular practices adopted by circular Start-Ups (SUs) in the textile industry based on their local legislative context. The textile industry is one of the most ecologically damaging industries in the world due to its wide supply chain that entails many energy-intensive and polluting processes. This is specifically true for established companies that have been carrying out a linear model in their production system. Signs of improvement have been noticed on a smaller scale, for instance in SUs that have introduced circular practices in their core system from the outset of their businesses. However, few studies have been conducted on integrating the performance of circular SUs in the textile industry based on their local legislative context. Legislative context has a significant role in shaping decisions as proper legislation and policies are essential factors for moving towards circularity, but it is often perceived as a barrier for entrepreneurs to move forwards.

To carry out this research, this study investigates the practices and regulatory context of six companies, located in two different countries. The investigation process was based on a framework specifically created for this research aiming at pointing out the circular strategies, practices and barriers of each company. Therefore, the analysis entailed desk research to understand the current local regulatory context; interviews to gain insights into companies' activities and the perceived barriers from their regulatory context; MFAs to have an overview of the production process of the selected companies and identify waste sources; each company was framed into a Business Model (BM) described in Coscieme et al., (2022) to integrate previous findings on opponent factors dependent on a specific BM.

Results show that practices leading to waste reduction, textile reuse and resale, and garments lifespan extension are the most common, although they present some limitations still. Results also demonstrate that the obstacles emerging from their coercive context are mostly due to poor involvement in easing the path towards circularity and to a lack of sufficient investments, but differently stressed in the two countries.

Overall, circular SUs could improve their practices by introducing innovative technical and managerial features. More investments and a systematic vision applied to the textile industry at the regulatory level could help in easing the process.

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1. INTRODUCTION

The fashion industry is one of the most polluting industries on our planet (Niinimäki et al., 2020). This is because of many environmental reasons that arise along all the steps of the value chain, from the processing of raw materials to the distribution and end of life of the products (Karthik & Gopalakrishnan, 2014). For instance, intensive use of pesticides and fertilisers, high land and water use, intense non-sustainable sourced energy use, use of toxic and pollutant chemicals, and distribution of the final products are just some of the environmental problems that this industry encounters (Cai & Choi, 2020). Consequently, carbon emissions and environmental damage are significant and concerning (Niinimäki, 2020). These practices have been mainly embedded in the linear model of production so far, where virgin materials are extracted to manufacture brand-new goods which are destined to be thrown away after consumers' use (Franco, 2017). This take-make-dispose pattern goes hand in hand with the fast-fashion model which provides a continuous offer of trendy items at low prices in order to keep pace with the constant change in consumers' preferences. Despite the great economic revenues of this model, it has many limits when it comes to safeguarding the environment and workers (Jin et al., 2012).

Starting from the '80s, some companies began introducing changes in their production and advocating for specific sustainability causes, slowly spreading awareness of the harm of such industry (Lundblad & Davies, 2016). Many documentaries have been realised in the past years to show the reality behind the trendy products exposed in shops, drawing attention and the urge for a compelling need for change (Lai, 2022). Not just the fashion industry, but the entire textile industry is the focus of this transition, the latter consisting of fabrics, garments, leather and fashion industries (Warwas et al., 2021). Sustainable production can translate into an opportunity to safeguard the environment and people as well as an opening for businesses to gain competitive advantages in the market (Flores-Hernández et al., 2020). Such an advantage is extremely important for businesses, as the fashion industry by itself was valued at more than $1.5 trillion in 2020 and is expected to grow to approximately $2.25 trillion by 2025 (Ikram, 2022). Therefore, creating a brand appealing to consumers who are increasingly interested and engaged in sustainability represents a winning strategy (Flores-Hernández et al., 2020). One way to accomplish that is by implementing a circular approach and following the circular economy principles (Gazzola et al., 2020).

Circular Economy (CE) can be defined as a restorative or regenerative industrial system, whose goal is to enhance the design of products and the choice of materials in order to minimise waste (Korhonen et al., 2018). Already established brands that have been building their business on fast fashion and linear systems models are definitely challenged when asked to embrace this perspective (Dauvergne

& Lister, 2012). An established company is generally defined as a longstanding, well-known and competitive business with significant capital, personnel, infrastructures and strong connections with suppliers or other stakeholders built during the years of activity (FasterCapital, 2023). It is difficult to change an established system: companies are more inclined to keep it intact and improve just a few parts of the whole system rather than make changes on a deeper level (Bocken et al., 2016; Adamkiewicz et al., 2022) even though specific strategies should be incorporated for a long-term CE establishment (Schulte, 2013).

Where already established brands seem to fail, other types of businesses find their way to succeed. Start-ups (SUs) for instance are considered to be frontrunners in the transition towards circularity, particularly in the textile industry where they represent at least 50% of employment in both high- and low-income countries (Henry et al., 2020; Suarez-Visbal et al., 2022). SUs are traditionally defined as young companies that develop a product or a service that is new, innovative and appealing in the market (Baldridge, 2022). It is easier for SUs to put into practice circular economy principles as their values, goals, practices and attitudes are usually new to the market (Van Opstal & Borms, 2023). SUs with a circular focus advocate for the sustainability cause, implement circular strategies from the very beginning in a thorough way with particular attention to material loops and ultimately create environmental and social benefits (Henry et al., 2020). Another distinctive feature of SUs is a "learning by doing" approach that comprises constant adjustments and revisions of the processes used (Bocken et al., 2018). This allows experimentation and the introduction of innovations, resulting in overall more flexibility than big fashion corporates (Ostermann et al., 2021). Innovations here can be defined as the ability to create new products and combine them with the markets, technologies, and organisations to eventually advance companies' sustainability features (Faria et al., 2021).

Many SUs translate all these characteristics directly into their core system adding a circular perspective for the realisation of circular economy goals and the transition towards circularity through different strategies (Geissdoerfer et al., 2020; Coscieme et al., 2022). Companies that pursue this model are prone to incorporate circular strategies that are highly innovative, technology-based, and flexible enough to explore and adapt to the market (Ostermann et al., 2021). The technological innovation that they implement can potentially lead to new ways of conceptualising fabrics' manufacturing, design thinking, and the overall structure of the textile and fashion industry while expanding a brand business (Todeschini et al., 2017).

1.1. Aim and Research Question

Current literature outlines that SUs in different fields can easily adapt to circular models and therefore they can be taken as positive leading examples for integrating circularity in their core system (Van Opstal & Borms, 2023; Henry et al., 2020). Nevertheless, more research is required to fully understand how circular practices are best implemented in SUs in the textile industry, taking into account any possible barriers that may result from their local regulatory context (Suschek et al., 2022). Local regulatory context impacts the dynamics and choices of society, let alone businesses, thus being a fundamental factor to consider when analysing businesses -SUs for this research – and their practices. (Howard et al., 2022). The textile industry's economic worth, the growing need for a shift in production, and the rising leading role of SUs are the strong motivations for this study's intention to investigate SUs' circular business practices. By doing so, this study intends to show how these types of businesses within the textile industry are working towards circularity goals. Therefore, the main research question that will guide this research is:

In which ways are SUs in the textile industry implementing circular practices considering their local regulatory context?

This main research question will be broken into different sub-questions to give a thorough analysis.

- What are the key elements that characterise SU as circular in the textile industry?
This question delineates the SU characteristics that allow them to be considered circular. Thus, it shows their core strategies, practices and achievements that contribute to the implementation of circularity in the textile sector.

- What barriers raised from their local regulatory context have SUs encountered in the implementation of circular practices in the textile industry?
This question aims at investigating whether the practices can be easily implemented by companies or whether there are any system limitations that restrain the full commitment to or implementation of CE practices.

The value of this study, from a theoretical standpoint, is in the investigation of business circularity, considering SU features and external system barriers in different geographical locations. Many publications in literature have explored circular and sustainable practices in the textile realm, but few merge this knowledge with that obtained from the acknowledgement of the local regulatory context.

Finally, this research will contribute to society as its outcomes could be useful for delineating a path of what has been already done and successfully achieved by circular SUs. This could help established companies unravel what has not been achieved yet and how to implement it. New entrepreneurs beginning their journeys into the circular textile industry would also benefit from it as it might shed light on a safe path for the implementation of circular practices.

2. BACKGROUND THEORY

The following section explains relevant theories and concepts embedded in this research. Circular economy concepts will be first discussed as it represents the starting point and cradle of the study. Different BMs built upon circularity theories followed by the characterization of the SU type of business will be then presented as the research is based on the assessment of different companies that can be identified as start-ups that apply circular strategies. Finally, the necessary background to understand the textile industry to date and the current circular practices implemented so far will be disclosed.

2.1. Circular economy

CE's ambition is embedded in its name: creating a close loop in production where waste or discarded material is still valuable and can be integrated again into the system (Wysokinska, 2016, p.1). CE can be defined in many ways (Geisendorf & Pietrulla, 2018). However, they all share the core belief that change should be taken from the very early stages of production (Ellen MacArthur Foundation, 2016). The implementation of a CE approach would result in a win-win-win situation for the economy, companies, and consumers (Aguilar-Hernandez et al., 2021). The economy would benefit from net material savings, mitigation of volatility and supply risk and long-term resilience of the economy itself. Companies would be positively affected by new profit pools and could mitigate some of the strategic challenges that companies are facing today. From the consumer perspective, benefits would arise from the reduced costs of obsolescence and the advantageous multiple purposes that a product incorporates (Ellen MacArthur Foundation, 2015).

Many frameworks have been conceptualized to better define CE; however, the textile sector might need a narrower specification when talking about potential strategies to implement. Suarez-Visbal et al. (2022) for instance outlined specific R strategies for the apparel value chain, more suitable for this industry. This approach consists of 8Rs that start with Re-design, continuing with Reduce/resource Recovery, Rental, Resale, Repair, Remanufacture, Recycle, and finally Recover. This study will adopt this approach throughout the whole research.

As many studies discussed, *Redesign* is the first step to increase circularity in a textile company as through this strategy it would be possible to extend the life of the fabric, facilitate its disassembly or reduce its production complexity (Papamichael et al., 2023; Franco, 2017; Jia et al., 2020). *Reduce/resource recovery* refers to the on-demand production or the use of recycled and regenerated material in the production loop (Ellen Macarthur Foundation, 2021; Jia et al., 2020; Keßler et al., 2021). *Rental, Resale,* and *Repair* are three strategies aiming at extending the life of a good respectively by paying a fee for its use, selling it after its first use (also known as second-hand) and adjusting it (Keßler et al., 2021; Ellen Macarthur Foundation, 2021; Papamichael et al., 2022; Lernborg, 2021). *Remanufacture* refers to the practice of up-cycling and remake, meaning taking discarded parts of a product to create a new one (Moorhouse & Moorhouse, 2017; Jamal & Kapoor, 2022; Marques et al., 2019). *Recycle* includes all the steps from the collection of textiles to the actual mechanical or chemical process of recycling (Keßler et al., 2021; Shirvanimoghaddam et al., 2020; Abbate et al., 2023). Finally, *Recover* is the step where the remaining scraps are used for energy recovery (Farhana et al., 2022; Falcone et al., 2022). All these strategies will help the textile industry in stepping closer to a circular business. However, in a saturated market like the textile one, before focusing on redesign, key practices might be those that focus on reuse (rental, resell, repair) and remanufacture in order to exploit existent stocks. These need more labour and less capital than the development or manufacturing of new materials, consequently resulting in being more financially achievable on smaller scales (Stahel & Clift, 2016).

Applying circular strategies to the textile industry would help in establishing new patterns and detaching from the linear model that has provoked (and still is) much damage to the environment and people (Chen et al., 2021). Implementing CE concepts not only would have environmental benefits but the economic performance and competitiveness of the companies would also be improved (Jia et al., 2020).

2.2. Circular Start-up

Businesses are one of the actors that might accelerate the implementation of CE aspects in their practices by rethinking the value of products, materials and waste in their Business Models (Antikainen & Valkokari, 2016; Reike et al., 2018). Business Models are tools for systemic analysis, planning, and communication as well as a strategic asset for competitive advantage and firm performance (Schulte, 2013; Geissdoerfer et al., 2020). When circular characteristics are introduced into a company's strategy, the BM becomes a Circular BM (CBM). CBM represents the company's path to realise circular goals and the transition towards circularity (Coscieme et al., 2022), which in practical terms, attempts to keep products and materials in circulation in the market at their highest value possible and at the same time make the revenue streams independent from production and resource use (Schulte, 2013). It also attempts to enable companies to offer new services, therefore, becoming more competitive in the market while reducing costs of resource use and input (Ellen Macarthur Foundation, 2021). Unlike established linear companies, SUs, being new market entrants businesses, easily adopt this model enabling a deeper level of circularity from the outset (Bauwens et al., 2019; Dauvergne & Lister, 2012). SUs are keener to incorporate peculiar features in their systems, given their high flexibility, adaptability to the market and explorative approach (Van Opstal & Borms, 2023). Due to a growth in demand for sustainable features, SUs have therefore integrated circular practices in their BM from the early stages of their establishment, allowing them to be defined as circular SUs (Henry et al., 2020). Circular SUs aim at creating new economic and environmental value by focusing on closing the material loop of their systems prolonging the use of resources through their reduction, reuse, recycling or recovery and implementing innovations in their systems at the technological or social level (Henry et al., 2020). In circular SUs, circularity is not perceived as a unique selling point, but more as the prominent way of living and doing business, which is why circular aspects are easily incorporated into their BMs and often circular SUs operate as a non-profit businesses (Van Opstal & Borms, 2023; Henry et al., 2020). Given their strong sense of mission circular SUs can . Circular SUs have been positioning themselves in the market quite steadily during the last few years thanks to recent internal market openness and societal changes that have accelerated and encouraged entrepreneurship and innovation (Okrah et al., 2018). With "innovation", it is meant the further development of something already existing or the creation of something new, which can be knowledge, ideas or products that are then incorporated into the market or at organizational levels (Faria et al., 2021). Thus, innovations can be seen as a tool to stimulate changes in companies in order to boost their economic and environmental value (Ostermann et al., 2021). Leaning towards innovation is indeed one of the core reasons for the success and increasing role of SUs in the circular economy (Okrah et al., 2018). Having a BM that is focusing on both CE strategies and innovations is key for reaching a higher level of

circularity (Henry et al., 2020). It would indeed boost resource efficiency and effectiveness, eventually closing the energy and resource loop by adopting a different approach for interpreting the economic value and the value of products (Pieroni et al. 2019). Within the textile industry, the focus on innovations could enhance the prediction of new technological directions and innovative solutions (Ostermann et al., 2021) which do not imply new technologies only (Santa-Maria et al., 2021). Todeschini et al. (2017) indeed showed that technological innovations particularly in the textile industry do not define successful companies even though they are helpful tools. Innovations can also be seen as alternative strategies - implemented at the social level for instance - that businesses adopt in place of operating as usual (Todeschini et al., 2017).

2.3. State of Art of The Textile Industry

The textile industry is complex and involves many sectors, practices and stakeholders displaced in different parts of the world (Linden, 2016). Such complexity comes with many concerns from different perspectives interconnected with each other (Niinimäki et al., 2020).

Starting from the realisation of fibres, the textile industry already shows some issues at the environmental level. Currently, most of the fabrics are made either of natural fibre (any fibres deriving from a plant) or synthetic ones (man-made fibres usually created with a very energy-consuming process) (Bishop, 2007).

On one hand, cotton is the most used natural fibre, but not the best option in terms of sustainability (Khan et al., 2020). The current way in which it is cultivated needs more than 90% of the total water used in the whole textile production together with many pesticides and other chemicals to ensure its growth (Joy & Peña, 2017). Moreover, cotton has a high rate of land use that largely affects biodiversity when the transformation of natural ecosystems occurs (Sandin et al., 2013). For this reason, it has the highest footprint of any other natural fibre (Wang et al., 2021).

On the other hand, polyester is the most common synthetic fibre, very long and strong made of petroleum (Textile School, 2022). Its creation process requires a great amount of energy and in turn produces significant emissions of CO_2 as it usually originates from carbon fuel (Niinimäki et al., 2020).

The issues relying on the use of energy do not rise from the creation of synthetic fibres only. In fact, several plants and processes in the textile sector use a vast quantity of energy for electricity or steam generation (Farhana et al., 2022). Yarn spinning is the process that consumes the most electricity for all types of fibres, followed by weaving, wet processing and finishing. The last two are particularly relevant for thermal energy use and loss as an average of 35% is lost during steam generation and

distribution (Hasanbeigi & Price, 2012). The environmental concern arising from these facts is that the primary energy source is fossil fuels, which contributes to the increase of greenhouse gases in the atmosphere and consequential global warming (Farhana et al., 2022; Peters et al., 2021).

The activities of the textile industry are not only affecting the atmosphere but also the waters (Mukherjee, 2015). The whole textile supply chain uses more than 90 billion cubic metres of water annually (UNEP | Cyril Villemain, 2019), which is mainly needed for cotton cultivation in regions that are threatened by drought (Niinimäki et al., 2020). Moreover, the whole industry contributes for 20% to industrial wastewater deriving from pre-treatment, wet and laundering processes (Bailey et al., 2022). Hazardous chemicals and refractory contaminants are usually discarded in wastewater without any pre-treatment causing problems associated with high levels of pollution (Li et al., 2023). These chemicals are mainly used in the dyeing processes during fabric production in countries where regulations and control over the disposal of toxic substances are lacking or weak (Uddin, 2021).

It is indeed common practice to dislocate the supply chain of the textile industry (Kazancoglu et al., 2020). The design and retail phases are usually located in industrialized countries while fibre cultivation and manufacturing in the South of the Globe, particularly in India, Bangladesh, China and Vietnam (Niinimäki et al., 2020; Esteve-Turrillas & de la Guardia, 2017; ali& Habib, 2012). Such dislocation translates into an environmental problem when considering the distribution of the final products (Mukherjee, 2015). Garments and textiles travel half the globe by air cargo, container boats, or trucks before arriving in Western shops (Quantis, 2022). The final product already carries a high footprint mainly because of the production processes, but when displayed on the shop shelves, distribution impacts should not be forgotten even though they account for an average of 4% of the total impact (Niinimäki et al., 2020).

Finally, another significant environmental concern in the textile industry is the production of waste. The fashion industry only accounts for 20% of waste production worldwide (Papamichael et al., 2023). This leads to severe environmental and social issues as almost 40 thousand tons of waste are shipped to dry deserts in low-income countries annually (Bick et al., 2018; Papamichael et al., 2023). The problem with waste can be tackled from two different perspectives: waste produced after consumers' use and waste created in the production phase (Niinimäki et al., 2020). The former is guided by the "buy-and-throw-away" philosophy that led Western Europeans to use an average of 22 kg of textiles per consumer every year, while southern Asia countries only 5 kg with low recycling rates in both cases (Shirvanimoghaddam et al., 2020). The latter refers to the waste flow of manufacturing, where different percentages of materials become waste due to technical particularities of the production

processes, low quality of fabrics or problems related to logistics and suppliers (Papamichael et al., 2022; Aus et al., 2021).
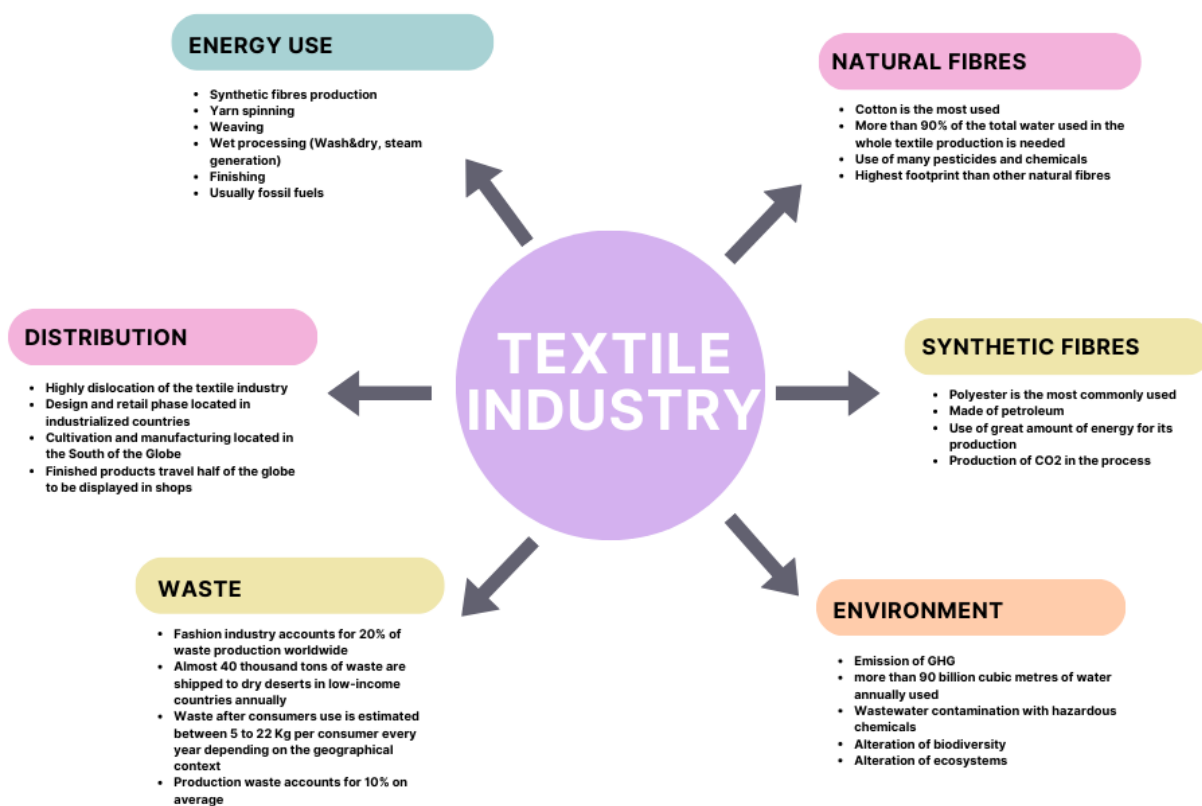

Fig 1. Overview of the state of the art of the textile industry created for this research based on what explained in 2.3.

2.3.1. Circular Strategies in the Textile Industry

The need to change the current path in the textile industry is evident as described above. The rising interest in circular textile manufacture and business has led many scholars to develop frameworks, theories and studies on this topic. This section explores circular textile strategies and innovations that have been investigated so far.

Changes can be made in several areas of the textile industry in order to promote circularity and ultimately achieve sustainability. Here are some examples.

Tackling the design phase has been argued to be one of the most effective ways to improve circularity in the textile industry (Franco, 2017). By addressing the first stage of production environmental problems could be avoided in the first place, and recyclability and long-term use would be refined in an effort of reducing waste (Jia et al., 2020). It is not always a simple procedure because of the complexity of the product creation itself and the challenge of merging functionality, aesthetics and

durability (Franco, 2017). However, some brands have already challenged themselves in creating products with a durable and sustainable design in mind as evidence that the transition is possible if concrete efforts, open-mindedness and little audacity are well-channeled (Moorhouse & Moorhouse, 2017). New sustainable designs include digital features or alternative fibres and textiles, which are still mainly in the prototype phase even if the textile industry is slowly integrating them into the system (Shishoo, 2012).

As above stated, innovations can be also related to the type of business or characteristics embedded in a company (Pedersen et al., 2018). Recycling and reuse for instance are two pillars of CE and represent prominent interventions in the textile and fashion industry to date (Keßler et al., 2021). Especially the former has been seen as the go-to practice for implementing circularity, but it only partly has a positive impact using the current methodologies (Juanga-Labayen et al., 2022). Recycling is indeed a way of postponing a product's end-of-life by investing additional energy, chemicals and labour. The recovered fibres, in the case of the textile industry, need to be reassociated with virgin ones to be usable, therefore not always increasing the sustainability of a product (Keßler et al., 2021). Despite what just said, recycling processes are gaining more nuances, especially in the fashion industry. Upcycling, downcycling and closed-loop recycling are becoming more and more popular and different technologies are being tested to lower the energy and chemicals used during the process (Pedersen et al., 2018). Anaerobic fibre digestion, composting, and fermentation are just some examples of innovative processes for the creation of new fibres or other second products like ethanol in the case of fermentation (Juanga-Labayen et al., 2022).

Reuse is a practice that extends a product's life through repurposing, transferring, swapping, renting and repairing until the product is no longer usable (Keßler et al., 2021). Reuse practices are well established in car rental facilities and are becoming in vogue when it comes to second-hand or vintage shops for garments (Hu et al., 2014). These last two are making their way into the market, not only through physical shops but also digital ones, increasing their popularity among young generations for both environmental and economic reasons (Laitala & Klepp, 2018). Vintage shops are proof that products are more durable than thought and the need for new clothes is just a perceived need imposed by society (Lai, 2022). This is also one of the reasons why, rental and non-ownership services for clothing are having some difficulties in establishing themselves in consumer habits (Armstrong et al., 2016). Even though scepticism is still present, clothes rental shops represent a great sustainable alternative: retailers do not have to handle unsold deadstock or returns that can no longer be sold, raw material input is significantly diminished, and customers can enjoy a new outfit for a lower price without risking of never wearing it again (Adam et al., 2018; Armstrong et al., 2016). Nevertheless,

reuse practices perform best if high-quality materials are used in the first place to ensure longer durability and a lower impact on the environment (Keßler et al., 2021).

It is believed that new business models that incorporate innovations in their design, recycling, and reusing practices as the examples above are slowly but steadily transforming the textile industry (Pedersen et al., 2018). However, they might not be sufficient to induce companies to distance themselves from the linear business model (Papamichael et al., 2022). Barriers are found at multiple levels - organisational, supply chain, customer behaviour, product process, regulatory and financial – challenging the industry into becoming circular and ultimately sustainable (Roy et al., 2022). Yet, implementing a CBM with an emphasis on innovations has been proven to help the textile and apparel industry be proactive and move towards a company's circular and sustainable goals. However, this is only true if these goals align with the company's core principles and the surrounding context is maturing in the direction of circularity and sustainability (Pedersen et al., 2018).

2.4. Importance Of Geographic and Legislative Context

Context is an element that is often overlooked when studying circular businesses, but it is actually of high relevance as geographical context shapes relevant factors of those businesses (Howard et al., 2022). All actions are embedded in a certain context which influences individual's choices, their outcomes and the overall dynamic between business, society and the ecosystem they're embedded (Howard et al., 2022). Arsova et al. (2022) sustain that contexts set the tone for the transition towards sustainability and at the same time, they are responsible for how changes are acquired. Therefore, considering the context is key to better understanding entrepreneurial activities and decision-making processes (Autio et al., 2014). As context can be framed in different ways (Autio et al. 2014), for this study the institutional and legislative context is the one considered. Proper legislation and policies are essential factors for moving towards circularity and its interconnection between the implementation of circular practices, entrepreneurship, market and regulations makes it a significant element for this research (Khan & Haleem, 2021; Tatadkacs et al., 2022).

What is interesting about this specific context is its dual nature since it can act either as a barrier or an enabler for companies that want to implement circular strategies (Govindan & Hasanagic, 2018). Governments can for instance act as enablers when they enact a law or regulations aiming at promoting cleaner production through research, pilot studies and funds (Arsova et al., 2022). Enabling factors could also be regulations that support collaborations along the supply chain, competitors and external actors like NGOs (Oelze, 2017). Nevertheless, the legislative and

institutional context is more easily perceived as a barrier because of the absence of a clear and straightforward vision for the implementation of circular practices. Some scholars sustain this as Table 1 shows.

Takacs et al. (2022)	Lack of institutionalized system and standardization
	Lack of sufficient interest and involvement in CE
	Bureaucratic burdens due to disruptive legislation and restrictive regulations
Oezle et al. (2017)	Regulations are not always in favour of more sustainable practices, complicating the Practices of those companies that want to be sustainable.
	Lack of advancements in policy implementation procedures
	Constant changes in legal requirements
Rizos et al. (2015)	Lack of government support and encouragement towards environmental investments
	Disregard for the necessities of small businesses or SUs in the realization of environmental management tools
	Lack of clarity in the current regulations
	Complex monitoring and reporting processes

Table 1. Table created for this research showing the regulatory context barriers based on Tackacs et al., (2022), Oezie et al., (2017), and Rizos et al., (2015)

In the textile industry regulations are much needed, however, the non-harmonization of regulations, laws, and policies might affect the competitiveness and coordination of regulative institutions (Sugeng et al., 2022). Thus, governments should understand that clear rules and guidelines are essential for textile businesses to improve or implement their circularity practices (Bui et al., 2023). However, if environmental regulations were more stringent, businesses would be forced to abide by them, which would encourage the promotion of innovations and the development of new elements in their system, which is one of the most important aspects for SUs (Huang et al., 2020). This is because definite regulations help in decreasing competitors' pressure and allow SUs to explore and discover new opportunities and resources (Huang et al., 2020). Funds or other facilitators are nonetheless necessary to sustain companies on this path, especially when a company aims at reaching larger markets and having a positive environmental impact (Bui et al., 2023; Singh, 2020).

National coercive pressure affects the implementation of circular practices, and this influence is even more perceived in developing contexts (Huq & Stevenson, 2020). Therefore, despite its complexity,

the institutional backdrop is crucial for the development of enterprises, especially when environmentally oriented SUs are taken into consideration (Horne & Fichter, 2022; Zhang et al., 2022).

2.5. Analytical Framework

Coscieme et al. (2022) provides a helpful framework that combines the above-mentioned elements for investigating the implementation of circular practices of circular SUs in the textile industry. This framework is based on previous studies on CE by the European Environment Agency (EEA) but the purpose is extended to mapping circular business models in the textile industry focusing on the role of innovations and the link between innovations, policy, and behavioural change. It also points out circular practices and emphasises the importance of external factors to reach circularity goals.

The framework presents concentric circles where the CE goals are positioned in the centre. Moving toward the outside, it presents the innovation section where innovations are understood as technical or social. Surrounding this, is a circle representing external enablers namely policymaking, education and behaviour change. The framework focuses on different life cycle phases of the textile industry that are shown at the extern of the outer circle, namely design, production and distribution, use, end-of-life and materials.
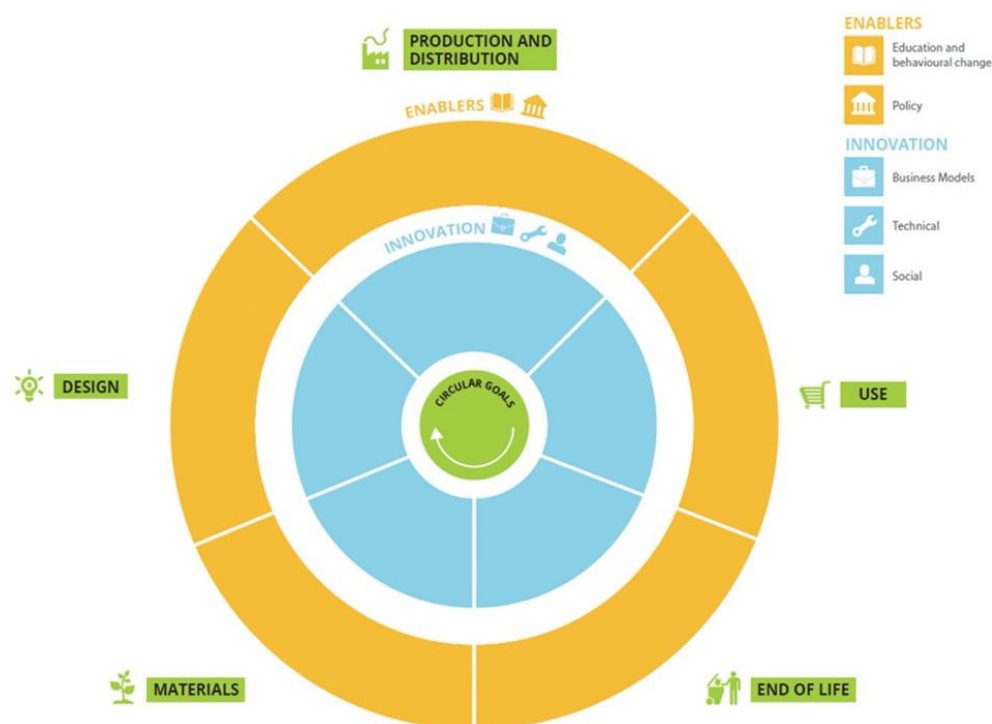

Fig 2. Coscieme et al., (2022) framework

The work of Coscieme et al. (2022) serves as a baseline from which a new framework has been elaborated for the analysis of different companies and in the mapping of general circular practices in their businesses. Where Coscieme et al., (2022) framework was applied to common circular Business Models in the textile industry, this study applies the newly elaborated framework directly to different companies and their practices. Nevertheless, the BMs classification described by Coscieme et al., (2022) and shown in Table 2 are used as an element of investigation: Business Models represent the building blocks of a company and serve to the characterisation of the company's path towards circularity (Geissdoerfer et al., 2020). The classification and description of the identified BMs in Coscieme et al., (2022) find a proper application for the companies analysed in this study.

Circular approach	Definition
Access-based model	Focus on renting, leasing and sharing of garments with the goal of lowering resource utilization and increase the use rate of the product
Collection and resale	Focus on extending the useful life of textiles after the first user. Common practices are second-hand retail, collection and resale to the market for reuse and recycling
Longevity and durability	Focus on extending the lifetime of garments, reducing the need of purchasing new ones and allowing for various modes of reuse. Common practices are also customized production, offer repair and maintenance services and focus on design for repair.
Recycling and reuse of materials	Focus on repurposing textile waste, creating new raw material and ultimately new textiles. Common practices are reusing parts and cuts of fabric, producing recycled fibres for re-spinning

Tab 2. Definition of Business Models described in Coscieme et al., (2022) and applied to the analysis of the companies of this research.

The three different aspects of investigations of this research are the circular strategy, circular practices and barriers found. This structure is found in the three concentric circles of the framework in Fig 3.

"Circular strategy" identifies the R- strategy currently implemented between those described by Suarez et al., (2022) and explained in 2.1 and 2.3.1.

"Circular practices" are understood either as technology-based tools or solutions from a social perspective. The former identifies practical features that define the circular path of a company in terms of inventions or production processes. For instance, recycling facilities for water reuse, or technologies for remanufacturing of wasted plastic shall be understood as technology-based tools. Solutions from a social perspective identify solutions and processes that attempt to or meet social sustainability goals for eventually reconfiguring the organization and structure of the textile industry from a social perspective. For instance, the involvement of local communities or the preference for employers with a refugee background in the hiring process shall be understood as solutions from a social perspective.

The outer circle "Barrier" identifies the challenges emerging from the regulatory and legislative context as this research is interested in finding how regulations and legislative context can constrain the adoption or implementation of circular features by circular start-ups.

The framework describes circular practices and barriers dividing the finding based on four life cycle phases, namely production, waste, materials and design. These have been chosen as they represent four phases where circular practices can be mostly applied. No particular significance has been given to the position of these four phases in the framework.

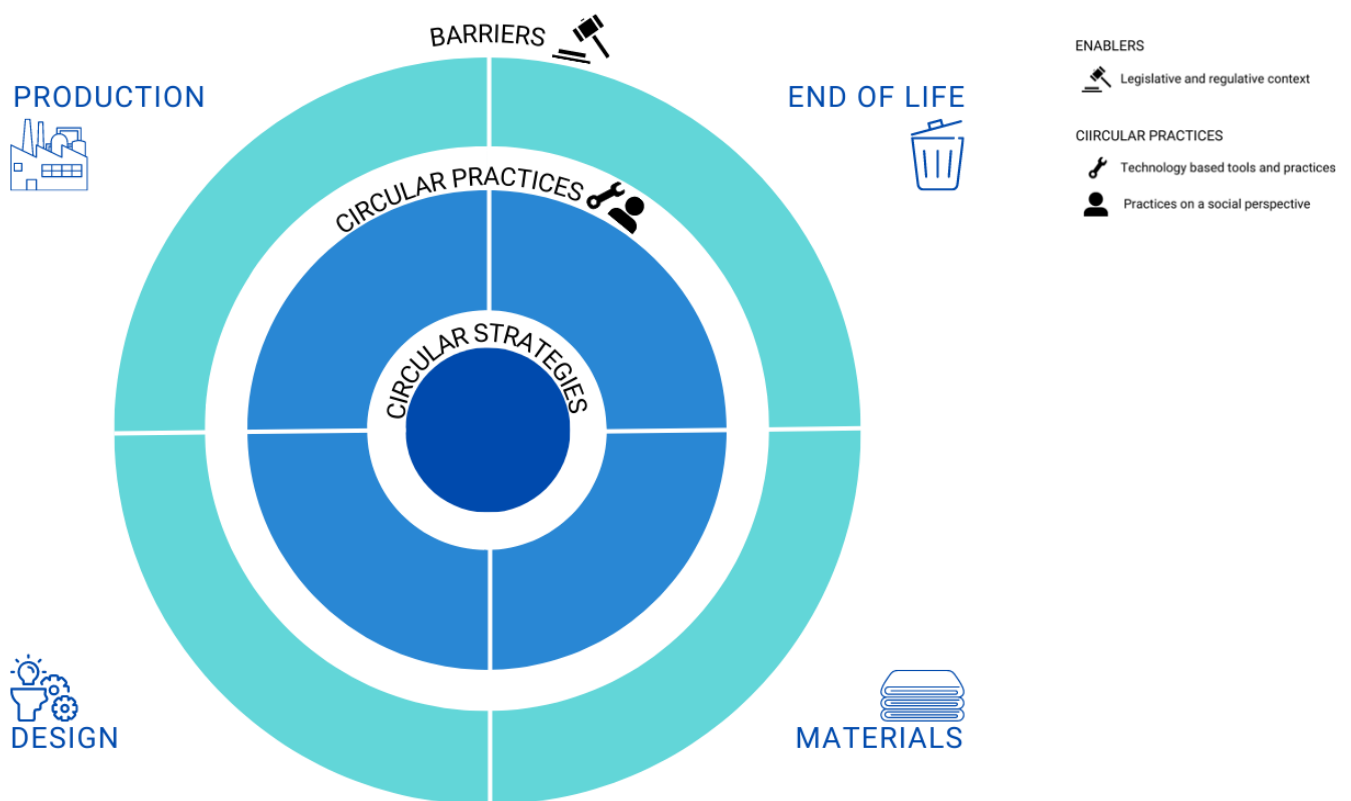Fig 3 thus represents the framework realised for the investigation of this study.

Fig 3. Newly elaborate framework based on Coscieme et al. (2022)

3. METHODS

This research relies on a multiple case study analysis, a variant of the traditional case study analysis where multiple related examples are examined instead of simply one (Gerring, 2004; Verschuren et

al., 2010). Different companies are analysed with a hierarchical mixed methods approach, meaning that they are first considered one by one qualitatively and quantitively and then the information gathered is merged to point out relevant aspects for this research (Verschuren et al., 2010).

A qualitative approach is mainly utilized: the research explores in depth the selected cases rather than taking a broad approach (Verschuren et al., 2010). A depth analysis with multiple case studies has the advantage to reveal both concurring and inconsistent characteristics or mechanisms of the companies involved in the investigation in order to eventually expand theoretical knowledge from the assessment of the current situation (Ridder, 2017). This type of research is characterized by nonrandom samples and an interest in their contextual condition as part of the examination itself (Ridder, 2017). These elements are present in this study, thereby making it an appropriate strategy for this research.

Nevertheless, a quantitative approach has also been integrated. The study points out some concrete facts that help in a clearer and more complete portrayal of the companies. For instance, production flows with mass balances between goods and waste have been analysed and taken into account for the examination of companies. Including both approaches makes the analysis more thorough and exhaustive, therefore facilitating the answering of the research questions (Zainal, 2007).
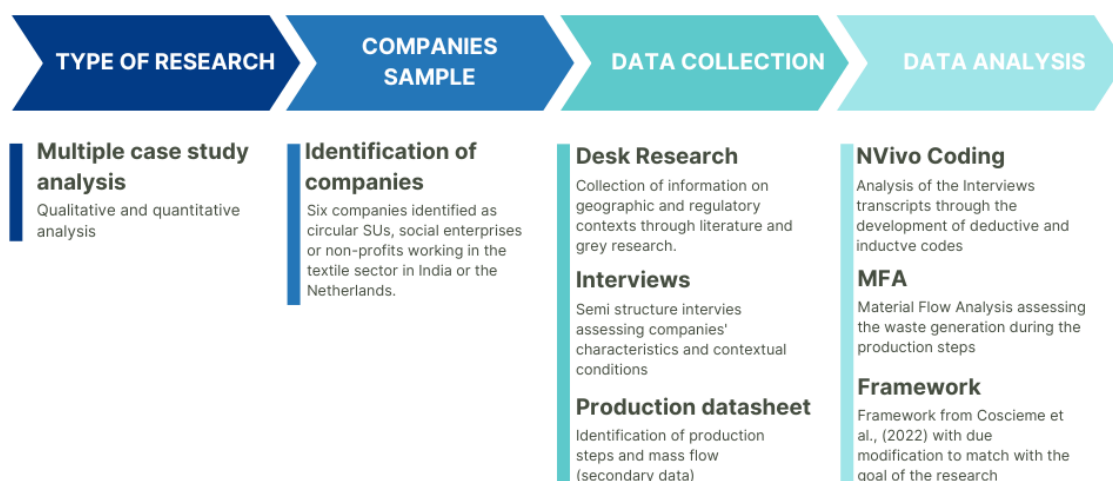

TYPE OF RESEARCH

Multiple case study analysis
Qualitative and quantitative analysis

COMPANIES SAMPLE

Identification of companies
Six companies identified as circular SUs, social enterprises or non-profits working in the textile sector in India or the Netherlands.

DATA COLLECTION

Desk Research
Collection of information on geographic and regulatory contexts through literature and grey research.

Interviews
Semi structure intervies assessing companies' characteristics and contextual conditions

Production datasheet
Identification of production steps and mass flow (secondary data)

DATA ANALYSIS

NVivo Coding
Analysis of the Interviews transcripts through the development of deductive and inductve codes

MFA
Material Flow Analysis assessing the waste generation during the production steps

Framework
Framework from Coscieme et al., (2022) with due modification to match with the goal of the research

Fig 4: Methodology representation

3.1. Companies Sample

The chosen companies are based on a previous study from Suarez-Visbal et al. (2022). These are SUs that implement at least one circular strategy between Re-design (R1), Reduce/resource (R2) Recovery (R3), Rental (R4), Resale (R5), Repair (R6), Remanufacture (R7), Recycle (R8), Recover (R9). Moreover, they are located in two different geographical and regulatory contexts, India and The Netherlands. The choice fell on these two countries as they both hold a significant role in the textile industry, yet with some differences. The textile industry in India represents a pillar in the culture and economy of the

country as textile manufacturing tradition dates few centuries back (Kumar R, 2018). However, the textile industry in India seems to have made advancements in innovative practices inconsistently across the country for lacking adequate policy measurements and strategies as one of the impediments (Mangla et al., 2018). Additionally, India represents one of the largest countries in the world for SU development, even though just a few can be considered circular or sustainable (Bhatnagar et al., 2022).

The Netherlands is already advanced in its research and application of circular processes (Halog & Anieke, 2021). The Dutch government is indeed aiming at establishing a complete circular economy by 2050 tackling five main sectors including manufacturing hence the textile industry as well (Ikiz Kaya et al., 2021). The Netherlands is also leading in the implementation of innovations in the textile industry especially concerning technological processes (Hartley et al., 2022). In addition to that, SUs find a good environment to establish and develop in the Netherlands but only few include circular features in their system (Bauwens et al., 2019; Techleap.nl & Utrecht University, 2021). Choosing two countries draws attention to how the geographical and regulatory context can obstruct the improvement of the textile industry. Table 3 in Appendix 1 describes the six chosen companies for the analysis of this study pointing out the type of business; what they do; the circular elements in their system; their location. The name of the companies has been omitted for privacy and confidentiality reasons.

In this research, circular SUs are defined as for-profit or non-profit organisations that operate with the principles of the circular economy as its core foundation addressing specific societal or environmental challenges usually through innovative practices. However, the sample includes two companies that do not fall under the definition of SUs, but rather established NGOs. This is justified as follows.

NGOs included in the research sample operate in the field of textile waste management, recycling, and reusing to improve the textile industry. They demonstrate a willingness to innovate and collaborate across sectors to achieve circularity in their systems. Regardless of their organisational structure, they share with the circular SUs of the research key characteristics such as the commitment to waste reduction, resource optimisation, continuous research for innovations, and strong motivation and vision that does not prioritise profit (de Pádua Pieroni et al., 2018; Von Kolpinski et al., 2023).

Including NGOs in the sample could have undermined the credibility of the study. However, given i) the similar approach with which these NGOs work compared to the other companies of the study, ii) despite the NGOs being well established, they have quite recently incorporated circular practices into their system (no more than eight years), and iii) the easy access to the necessary data to carry on the analysis, they have been included in the sample.

3.2. Data collection

3.2.1. Desk Research

In order to give an overview of the geographical and regulatory contexts of the six companies, desk research has been carried out. Information was gathered from scientific literature found through Google Scholar, Indian and Dutch government websites and other gray literature. Particularly, this desk research focused on pointing out the state of the art of regulations in both countries concerning the textile industry and circularity. The desk research was needed to describe the contextual background of the two countries in order to increase the overall effectiveness of the investigation.

3.2.2. Interviews

Interviews have been conducted with the purpose of delineating a profile of the companies and of capturing what has enabled or obstructed the embedding of circular practices in their system in relation to the regulative contexts.

 Twelve questions, provided to the companies beforehand (Appendix 1), were asked in 30 minutes to each of the six companies focusing firstly on the characteristics of the company itself and secondly on enabler-opponent factors.

With the first set of questions, information regarding company goals, R strategies, type of business, legal form and the process of acquiring data for the MFAs were disclosed. To ease the interviewees, definitions of R strategies, the type of business and the legal form were provided in the form of tables. The R strategies table was based on the eight strategies delineated by Suarez et al., (2022) for the textile industry.

With "type of business" shall be understood the circular approach and the business model applied by a company. Definitions of circular SUs and their business model was based on three studies, Coscieme et al., (2022), Henry et al. (2020) and Ostermann et al. (2021). Coscieme et al., (2022) define four circular approaches most commonly found in the textile industry. Henry et al., (2020) categorize circular SUs based on the type of type of business pursued by a company. Ostermann et al., (2021) distinguish circular SUs on their type of offer, namely as product-based or service-based. Table 4 in Appendix 1 shows the relevant definitions used in the question guide provided to the companies.

Henry et al., (2020) also categorize circular SUs based on their economic value, defined as for-profit, not-for-profit and non-profit. This classification was used throughout the research and for the specification of the legal forms of the companies in the question guide, as shown in Table 5 in the Appendix 1.

With the second set of questions, the focus then shifted to shed a light on enabler-opponent factors particularly in the regulatory sphere. First, companies were asked whether they found challenges and difficulties at the establishment of their circular business and how they overcome them. Here, challenges and difficulties identify anything that created obstacles to a smooth start of the company, for instance, lack of consumer interest, lack of cooperation in the value chain, high initial investments and so on. When not mentioned, a supplementary question on challenges brought by the regulatory system was asked to get some knowledge on the perception of the political and regulatory context. Following this, companies were asked whether they were supported by any grants, incentives or funds provided by their government and whether they consider it a worthwhile process. Lastly, the interview gave space for the company's perceptions of barriers to the implementation of circular practices and eventually to the scale-up of the business. Examples of successful circular models in the textile industry that they look up to and their personal experience in leading a circular business were also asked. On a last note, an opinion about the role of innovations in the improvement of their business was also asked, together with what would they use these innovations for.
The interviews were held online, in English and with the prior consent of the companies, registered and automatically transcribed. Where the transcriptions were not clear, corrections were made manually by re-listening the recordings.

3.2.3. Production datasheet/Material Flow Collection Data

In order to perform an analysis of companies' production flows with their mass balance, information on companies' processes and corresponding materials weights have been used. Previous interviews addressing the relevant steps of production and the social aspects of the company had been held. For this research, only the former has been used with the purpose of creating the production datasheet. The production datasheet shows the process steps of companies specific for the three (in some cases four) most sold product lines. Steps vary for each company, however, type of material, material composition, manufacturing and cleaning phase and delivery (or deadstock) were common to all the companies. After creating the tables, companies were asked to fill them with accurate data on weights for each step in Kg (L for cleaning/washing phases) or percentages. Table 6 in Appendix 1 shows the excel sheet format sent to the companies.

3.3. Data Analysis

3.3.1. NVivo Coding Analysis

Interviews transcriptions were analysed on NVivo. NVivo is a CAQDAS program that assists qualitative research in categorizing and analysing qualitative data, like interview transcriptions. This software provides coding, classification and mapping tools to point out relevant information for the scope of the study helping in the organization of data. The interpretation of data is nevertheless left to the researcher (Dhakal, 2022). Codes have been developed both deductively (thematic coding) and inductively (open coding) (Hennink et al., 2020). The former was based on issues anticipated and in line with the purpose of the interviews. For instance, codes were created for the barriers found by the companies, sub-categorizing them into barriers in the regulatory system or in funds accessibility. Inductive codes reflect issues raised by the interviewees that were not expected but were of relevant importance to the interviewees. Codes identify significant chunks of the interviews that tackle the topics of relevance and are therefore important for the examination of the companies, their circular practices and their context. The approach of creating the codes was based on the criteria outlined by Hennink et al., (2020): i) relevance to the research topic, representation of the issue; ii) recognition in data; iii) issues raised by the interviewees; iv) findable in text segments. A codebook has been then developed (Appendix 1), where the codes identified are explained with due examples.

3.3.2. Material Flow Analysis

The Material Flow Analysis (MFA) has been applied as a quantitative approach of the analysis. An MFA is an assessment tool that evaluates the state and changes of the material flow in a system by calculating the mass balances between the steps of production (Corona et al., 2019). Through MFAs, it is possible to identify waste sources and consequently create recommendations to improve the production process of the companies (Boer & Abokersh, 2022). An important characteristic of MFAs is that they are based on the principle of physical balance, meaning that the mass entering the flow must be the same that exits the flow, but its form can change in between (OECD, 2008). Keeping this ground rule in mind, an MFA needs to be structured on a few steps before working with the actual data. A) define the objectives and parameters of the analysis; B) define the balance scope and period; C) define

the process steps (Fresner, 2010, Chapter 6). For this study, these steps developed as follows. A) The objective of the analysis was to detect where the most waste was created in the production. B) The balance scope was framed in the production process of the top items sold by the company in a time frame of a year, usually 2021 - 2022. The starting month was arbitrarily chosen by the companies. C) The process steps were identified through inherited (secondary) data based on tables representing the company's production steps as described in 3.2.3**.**

MFA steps	Corresponding step in this research
Define the objectives and parameters of the analysis	Detect where the most waste was created in the production process
Define the balance scope and period	Production process of the top items sold by the company in a time frame of a year, usually 2021 - 2022.
Define the process steps	Based on tables representing the company's production process and materials weight

Table 7. MFA steps

Having these three elements, the analysis was then conducted creating deliverables in the form of flow diagrams (Appendix 2) and Sankey diagrams. Flow diagrams were created manually following the tables as a guideline. Rules followed when creating these diagrams were: i) identification of the system boundaries using a dashed line where the system boundaries incorporated the different production lines investigated in a company; ii) labelling and boxing of accumulation flows; iii) arrows represent moving mass; iv) Kg as measuring unit; v) weight of moving mass written on the arrows; vi) dashed arrows represent waste materials; vii) steps not in a box represent waste accumulation; viii) different colours represent different lines of products.

Data provided in the tables of the process steps were either in the form of percentages or weights. Once creating the diagram with the table information, the percentages of moving mass and the actual weight of waste mass were calculated in order to have both percentages and weights at every step of production. The congruency of mass weights and their balance was then verified, analysing the production steps backwards following the mass balance principle where

"the mass of all inputs (imports) into a process (system) equals the mass of all outputs (exports)

of this process (system) plus the change of stock (ΔS) that considers accumulation (ΔS > 0) or

depletion (ΔS < 0) of material in the process (system):

$$\sum^j_{i=1} m_i = \sum^k_{i=1} m_{.i} + \Delta S"$$

(Laner & Rechberger, 2016)

Where data were found inconsistent, companies were reached back to provide more accurate weight results.

Sankey diagrams were created using an online software specific for making flow diagrams, hence a useful tool for the representation of the material flow, SankeyMATIC (*SankeyMATIC*, n.d.). Here, the steps of the production with their relative weight input and output were entered together with the colour coding used in the flow diagrams to define different product lines. Not only Sankeys are useful visual tools for representing the material, but they helped with the verification of balances, since automatically detected by the software itself.

3.3.3. Framework

As a guideline for the analysis of the companies, the framework described in 2.5 has been used. The framework has the role of gathering and displaying the information obtained from the coding of the interviews and the Material Flow Analysis. Thus, it provides an easy and straightforward view of the elements of interest in the companies involved allowing the generalization of evidence and ultimately answering the research questions. Each company has been analysed following the circles' scheme of the framework: circular strategies, circular practices, and barriers. The transcribed interviews were particularly useful for detecting the companies' purposes, circular practices and challenges they may have found within their context; MFA also helped clarify the circular practices but with a focus on the production process. Finally, companies were framed into a Business Model described by Coscieme et al., (2022) to integrate in the companies' analysis the findings on peculiar barriers or enabling factors dependent on a specific BM.

4. RESULTS

The structure of this chapter is as follows. It first provides a brief overview of India's geographical and regulatory context. It then moves onto a description of the qualitative and quantitative results obtained during the analysis and concludes with a comprehensive overview of the selected Indian companies based on Coscieme et al. (2022). The same structure is followed for the analysis of the Dutch geographical and regulatory context and companies.

4.1. India

India is the world's largest democracy with more than 1.2 billion inhabitants which is slowly establishing itself as a global player in the worldwide market (*The World Bank*, 2023). Positioned in Southeast Asia, it has the ideal climate to develop the agricultural sector, especially for cotton and juta, fibres extensively used in the textile industry (Mondal, 2013). India holds the title of hosting one of the largest textile industries in the world owing to its manufacturing capability throughout the whole value chain and in particular the mill sector (*Ministry of Textiles | GoI*, 2022). Given its economic and cultural importance, the textile industry is represented by a specific ministry the Ministry of Textile (*Ministry of Textiles | GoI*, 2023). The Indian textile industry also holds social relevance as millions of people in India rely on this well-established industry which is the second-largest employment provider in the country (*Invest India*, 2023). One of the reasons for the significance that the textile industry holds in India is its role in the export of fabrics and apparel which highly contributes to the country's GDP (*IBEF*, 2023). Europe and the USA are the two major markets with which India works to provide fabrics and garments (Kumar R, 2018). However, this high request is showing its effects on the social and environmental levels. Many Indian workers in manufacturing live in almost extreme poverty, are mainly women and episodes of harassment, abuse and child labour are frequently reported (Mukherjee, 2015; Jamal & Kapoor, 2022). Moreover, the extensive fibre cultivation and formation brings with it a high rate of pesticide contamination and GHG emissions. The extensive chemical use for textile dying contributes to the pollution of wastewater. Manufacturing processes also contribute to the creation of GHG emissions, dust and excessive noise. All these factors have an impact on the surrounding biodiversity and ecosystem balance (Hasanuzzaman & Bhar, 2016; Sharma & Narula, 2020). The increasing awareness of these issues has influenced Indian entrepreneurs to slowly conform their businesses to the rising sustainability trend. Not only the environmental awareness but also the advantages that a sustainable company brings along such as improvement of brand image and higher market competitiveness has convinced entrepreneurs to switch towards more sustainable businesses (Sharma & Narula, 2020).

However, the path towards sustainability in India is hindered by many aspects. For instance, the particular Indian tax structure also represents an obstacle for newly small sustainable businesses in the textile and apparel industry to thrive. As an example, man-made fibre yarn and natural fabric are unequally taxed, creating an imbalanced tax burden throughout the production chain. Consequently, this imbalance in tax rates gives rise to a disparity in market competitiveness, which can significantly impact the operational efficiency and sustainability of businesses (Chain, 2020). Unfair labour wages,

lax regulations on labour standards, and no accurate regulation of informal workers are other elements that pose obstacles to the sustainable growth of the Indian textile industry (Mezzadri & Srivastava, 2015). Labour conditions are also influenced by the demonetization process affecting all economic sectors of the country, with a particular impact on small enterprises and activities that heavily rely on cash payments for their daily workers and expenses (Vishwakarma et al., 2022). Additionally, India faces a scarcity of funds, technical expertise, and financial aid (Chourasiya et al., 2022). Consequently, this scarcity directly impacts the limited accessibility of cutting-edge technology and hinders the ability to meet global standards in adopting sustainable and circular practices, especially for small businesses within the textile industry. (Kumar R, 2018). The low implementation of such practices is also due to scarce regulations in favour of environmentally friendly approaches, unpredictable policy changes and weak employment and educational opportunities (Chourasiya et al., 2022; Sharma & Narula, 2020; Raichurkar & Ramachandran, 2015). The Indian government seemed to have captured the significance of the textile industry both at the economic and social levels when publishing the National Textile Policy in 2000. The goal of the policy was to create a proper environment for growth and technological modernization while still supporting traditional textile manufacture (Ministry of Textiles, 2000). Even though fiscal incentives were allocated, those were not sufficient for the adequate support of small enterprises and therefore the policy has been modified to face emerging challenges related to sustainable development, infrastructure improvements, social issues and digitalization (*New Textile Policy*, 2021). Nevertheless, even though the Indian Ministry of Textile has taken such measures and implemented more related projects, schemes and subsidies, it seems a non-sufficient effort for businesses to transition towards proper sustainable manufacturing in the textile industry (Yoganandan, 2015; Chourasiya et al., 2022).

4.1.1. Indian Companies
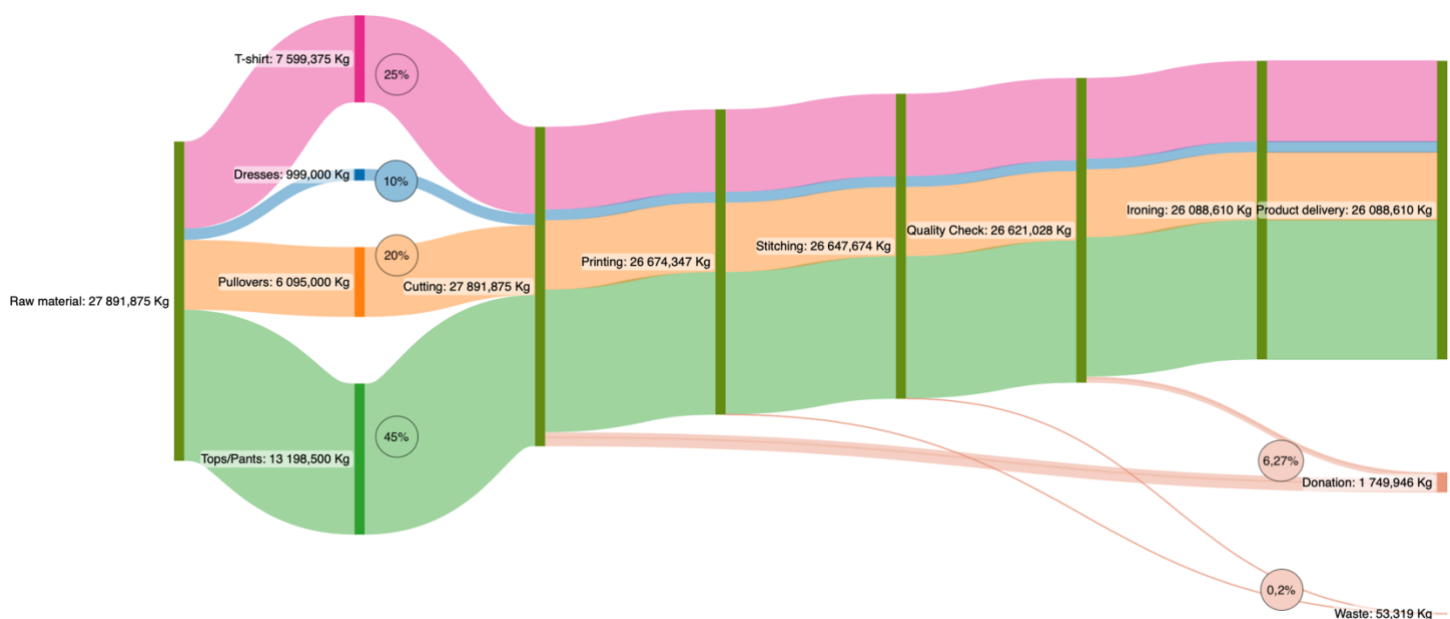
4.1.1.1. Business A

Business A is a product-based for-profit SU producing garments with organic cotton for third parties based in India.

Business A claimed that the company's goal was to maintain high consumer satisfaction along with financial gain and continuous economic growth with an attentive eye on employee development and well-being. Only recently they introduced circular features in their practices:

"*circular company or idea was very new for us. […], so earlier we were doing nothing in this field. And so I must say we are not a circular company right now […] we are in the process*".

They have recently implemented a circular practice that regards the repurposing of wasted material during production. Waste is either sold to contractors in local markets, used to create children's garments, or repaired/corrected to be donated to charitable Indian trusts. Moreover, the company works only on demand: brands commission a certain amount of units and only those are produced, taking into account the average percentage of fabric or items discarded after cutting and quality check. The company does not overproduce and therefore does not hold any dead stock. Furthermore, water for washing and drying during production is reused 4 to 5 times thanks to a purifying treatment machine. Eventual waste is collected by external certified companies.

Four product lines were analysed for the MFA: t-shirts, pullovers, dresses and shirts-pants-tops, which were differentiated by different colours as Fig 5 shows below and Fig 5a in the Appendix 2. Fabric is mainly discarded after cutting and quality check phases, with almost 1750 kg donated for the creation of children's clothing. Waste is also generated after the printing and stitching phases with approximately 53 Kg of fabric which only accounts for 0,2% of the initial mass of both phases.

Fig 5. Sankey diagram Business A. Pink = t-shirt; Blu = dresses; Orange = pullovers; Green = tops-pants-shirts

When discussing the challenges that the company have encountered, on a technical side, finding the arrangement of plant machinery and equipment has been difficult. Hiring candidates able and willing to work following the business' criteria has been also found critical, especially at the beginning. This issue is not specific to Business A, as generally, India is facing a low employment force due to a lack of profit and growth in the manufacturing sector (Karishma, 2022; Misra, 2021). When considering challenges not directly linked with company practices, two facts have been pointed out. First, winning

the trust of the most skeptical customers because of insufficient knowledge of what circularity is, its benefits and the reasons behind a higher cost of products. Second, the increasing competition with other businesses producing garments at a cheaper price.

"…*right now, it's quite new here. I don't know the industries, maybe other people may use this, but in our context it's quite new. This is the main problem, circular economy or circular practices company were not there*".

During the interview, other challenges that surfaced were understanding the appropriate timing for the right actions, along with financial management and overall costs. When the business was first established financial aids were not in place but thanks to the SU programs that the Indian government has recently provided, being eligible for funds has become easier than before, according to the company. Yet, since then, this SU has not been sustained by any grants or funds and seems not willing to apply in any despite the simplified funds process. Yet, funds could be helpful in the implementation of social and technological innovations which were mentioned as an important strategy to survive and be competitive in the circular textile industry in India.

Here, the regulatory context was not portrayed as a constraint to the implementation of circular practices, and neither as an enabler nor a supporter of the company goals. However, the company has noticed that the regulatory system is changing and it is easing the path for circularity and sustainability in small steps.

"*Earlier it was a little difficult for new company to get grant from the government. […]3, 4, 5 years back, there were few reforms, so now it is quite easy [: the] startup programs the government has […] lot of initiatives to create new start ups so […] anyone can get a grant from the government. Easy not so easy, but little easier than earlier.*"

When considering the BM of this company, it does not completely fall into any of the category described by Coscieme et al., (2022). For this research the *Recycling an Reuse of Materials* has been chosen to represent Business A's BM. This BM regroups those companies that focus on repurposing textile waste into new products whose employment differs from the original purpose. While textile waste repurposing is not the primary focus of Business A, it does, nevertheless, repurpose the waste generated during the cutting phase. For this reason, this study has decided to frame its BM into the category above stated and use the most suitable elements pointed out by Coscieme et al. (2022) for the portrayal of Business A.

For instance, the lack of established manufacturing processes for upcycling purposes represents a barrier for circular businesses focusing on material reuse. The absence of guidelines or standardization

create a challenging environment for businesses to thrive, especially when they want to implement circular practices such reuse and upcycling. Highly competent personnel, efficient infrastructures and product norms or hubs regarding design, production and market approaches are much needed. However, currently there is no evidence of those elements being implemented. To enable and enhance companies with this BM, Coscieme et al., (2022) remark that policies could incentivize recycling and upcycling practices so to extend the producer responsibility schemes and implement recycling or upcycling targets.

BOX 1

The figure below shows the analytical framework of this research for the characterization of each business. Circular strategies, practices and barriers that have emerged throughout the analysis of Business A are presented in black. The elements pointed out by Coscieme et al., (2022) in their study that were appropriate for characterising Business A and explained in the section above are presented in red. The elements present in the "Barriers" outer circle shall be understood as "lack of".

The figure can be read either following the circles or following the production phases. In the first case it shall be read as "*Circular strategies of Business A …. Circular Practices of Business A for the Production phase are ….; for End of life phase are …; for Materials phase are …; for the Design phase are… . Barriers for Business A in the Production phase are…; for End of Life phase are…; for Materials phase is… ; for Design phase are …*" . In the second case, it shall be read "Circular strategies for Business A are… *In the Production phase, the circular practices of Business A are… and the barriers found are…; in the End of life phase the circular practices of*
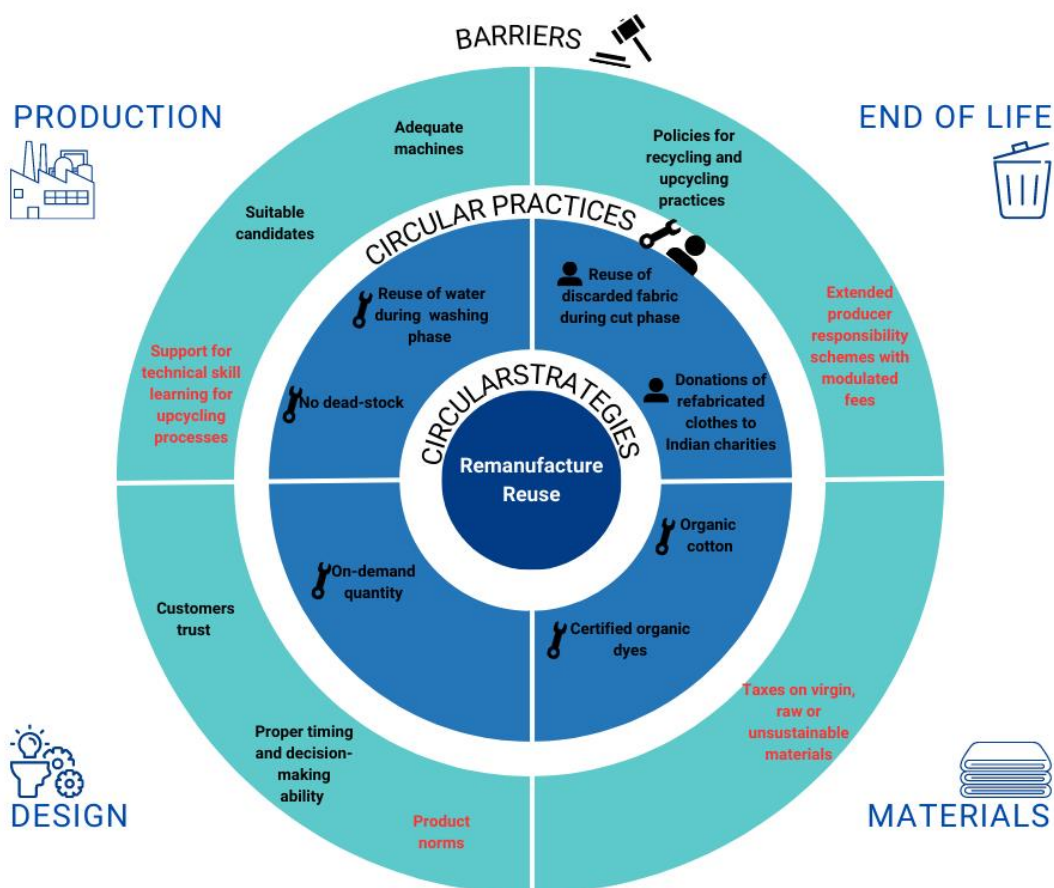
Fig 6. Overview Business A. Red = insights from Coscieme et al., (2022) on the *Recycling and Reuse of Materials Based* BM that suits Business A characterisation.

4.1.1.2. Business B

Business B is a SU based in India whose goal is to expand the lifespan of garments through a rental service. The clothing collection that they offer ranges from casual and informal to ceremonial and special occasion pieces. These garments either belong to designers or customers who receive a percentage of the rental share, or they are part of the company's own inventory.

"so the entire business model was: What if we can utilize those outfits at multiple numbers of times and increase the lifespan?"

Therefore, the service that business B offers, gives access to expensive and high-quality items for a low price but limited time. The intention is that customers feel like they were in a luxury showroom with a tailored shopping experience where everything is taken care of, namely prior adjustments, (dry)cleaning after the rental (through an external party), quality check, and eventual repair. After that, the items are available again for new rental orders.

"we expand that lifetime of the garment as much as to about 8 times"

Every couple of years, the brand's inventory go through a sorting phase, where items can be either discarded, labelled as dead stock, returned to consumers, sold, or donated to NGOs. This SU can be defined as i) service-based because of the rental service; ii) platform based as an online platform is provided besides physical shops; iii) and product based since garments at the end of their life can potentially be sold. Moreover, the company has a recycling program where deadstock pieces are upcycled and find new purposes. Fig 7 and Fig 7a in the Appendix 2 shows the three main product lines that were analysed, namely lehengas, sherwani and bridal gowns. Being a rental service, waste is represented by garments that have been discarded because worn-out or by garments that contribute to a deadstock not exposed in shops or online, but still usable.
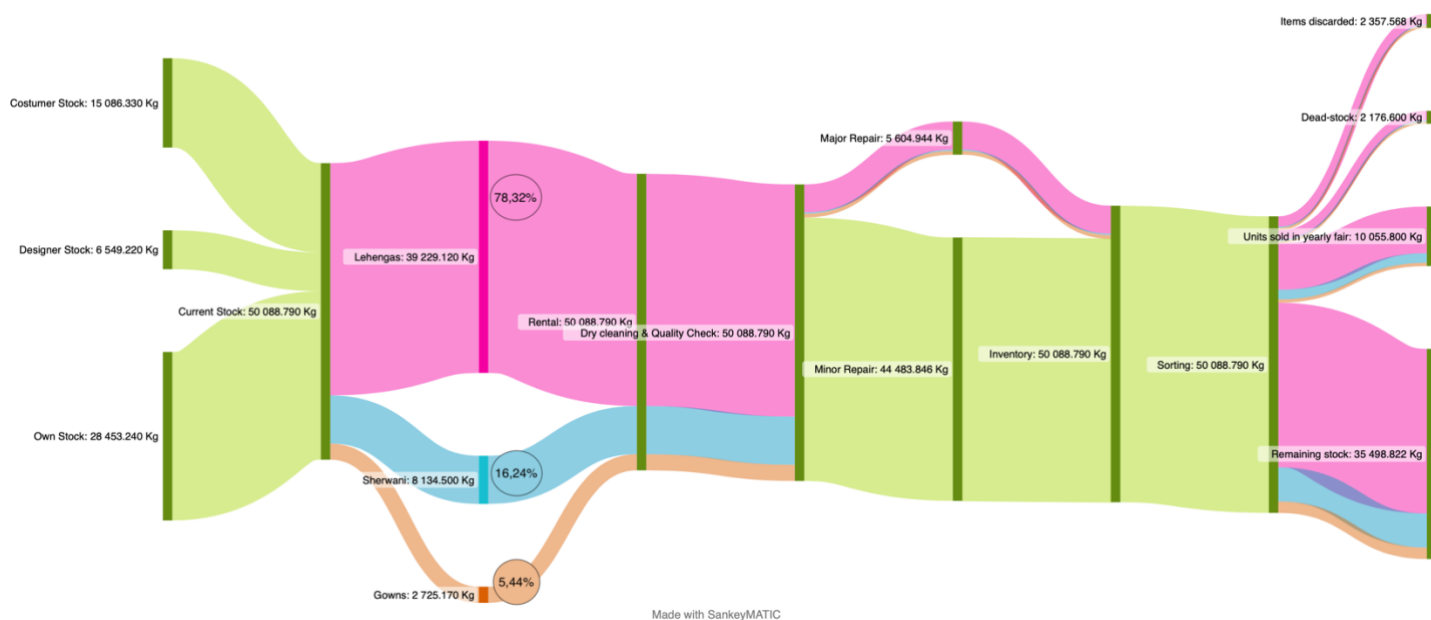

Fig 7. Sankey diagram Business B. Pink = lehengas, Blu = sherwani; Orange = bridal gowns.

Rental services have just recently begun to be popular in the fashion world. However, scepticism among Indian customers is still present. One of the biggest challenges that the company had to face at the beginning was changing the mindset of users who were not aware of a rental option in garments. This was dealt with by addressing the masses through marketing strategies and the involvement of famous personalities among Indian people.

"we have to reach out to those people. So how do we do that? We have to have a lot of marketing involved. And when you talking about consumers in India, at least the influences and celebrities, they play a very important role."

Rental services provide a cheap alternative to an expensive purchase and that is the main reason why this model and the company grew over the years.

"to make a business big you are catering to the masses in India. So the masses, the middle class, the upper middle class, they are price sensitive market […] from the consumers point of view we say instead of […] spending ₹100 you rent this item in ₹10. So we're talking about saving money and saving the environment hand in hand."

From a more technical perspective, the company found some challenges in elements of the business operationality. As they were the first company in India to offer such a service for garments, understanding the process steps, operations, and general set-up has been found difficult and not always straightforward.

"I'll just tell you like a small example. All the products are barcoded, […] now that barcode is supposed to sustain 15 rounds of dry cleaning. So initially the kind […] of ink we had, it would just fade off in 4 dry cleanings […] because you know, nobody thinks when you're making a profit from purchase point of view, you don't care about the barcode that has to be just there all the time […]."

This SU has never leveraged funds or financial aid and has always been treated as an ordinary company with the application of regular taxes by the Indian State. According to company B, the Indian government is not putting enough effort into creating sustainable funds and grants and instead of depending on those, this company would preferably use private grants.

" [We] would probably reach out to funds who care about the climate. There are a lot of funds, private investment funds, proper individuals who would be putting in money for, for environmental basis but with profitability."

The lack of specific funds for sustainable companies is a problem highly perceived by this SU, they have asked the Ministry of Textile of India for implementing a change in policy frameworks to benefit and help companies that want to improve their sustainability or circularity.

Business B falls into the *Access Based* Business Model described in Coscieme et al., (2022) where the goal is to decrease resource utilization by increasing the use rate of the products and ultimately by switching the ownership with the use and return of garments. Coscieme et al., (2022) state that this particular BM can positively impact the fashion and textile industry since it tackles key problematic elements like resource exploitation, overproduction and customer behavioural change. However, there

are aspects that might represent barriers to its implementation and scale-up. Some of these could be related to Business B. For instance, implementing and improving product quality standards on durable design could prologue the rental of garments maintaining the quality and postponing the end of the rental life phase. High-quality textiles are usually more durable, thus leading to positive environmental performance as less fabric end in waste and fewer resources are exploited. Financial aid for this kind of business should be in place to reward or incentivize new entrepreneurs. However, as Business B claimed, there is no recognition of well-performing companies in terms of environment and circularity in India and consequently no financial incentives for service businesses. The lack of product standards defined by the Indian government and the lack of financial incentives for service businesses might represent a barrier to the improvement of Business B.
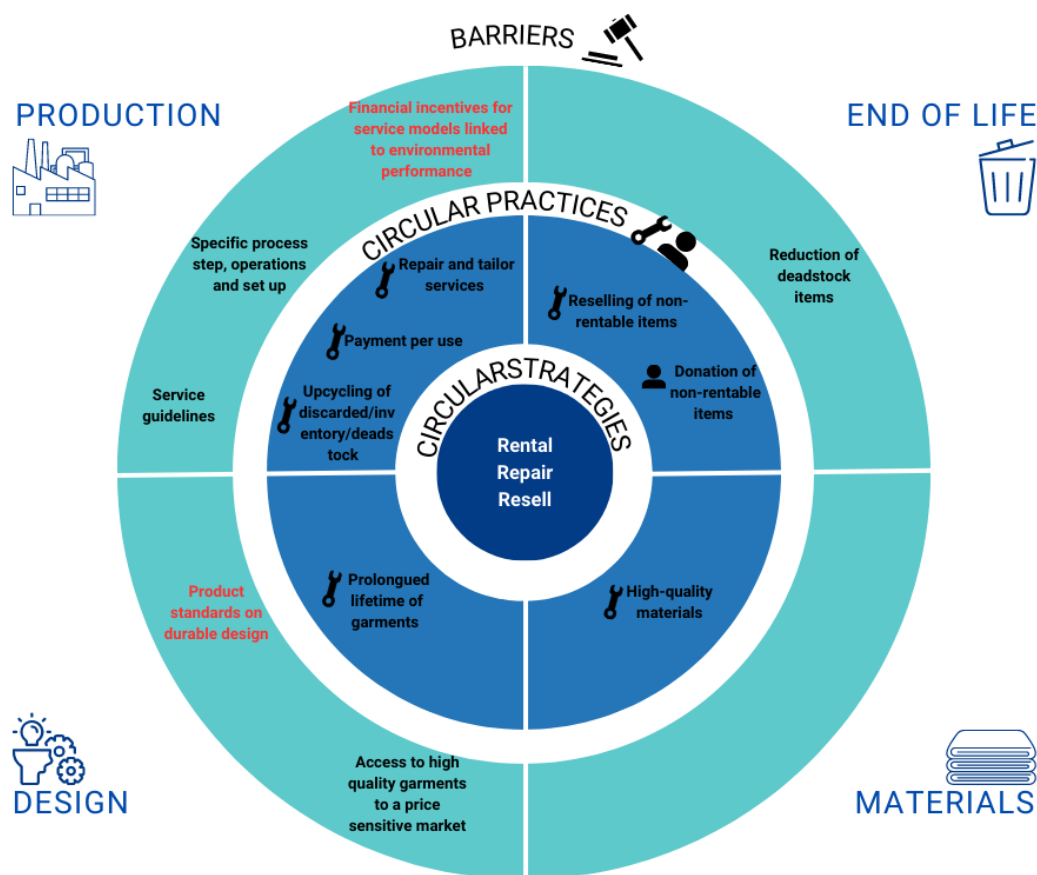

Fig 8. Overview of Business B. Red = insights from Coscieme et al., (2022) on the *Access Based* BM that suits Business B characterisation.

4.1.1.3. Business C

Business C is an Indian social enterprise combining the work of a registered non-profit organisation with a for-profit SU that wants to tackle both the problem of plastic waste and poverty in India and at the same time create a platform for upcycled products. What they do is create a particular recycled

fabric made from discarded polythene bags (handmade recycled plastic, HRP) used to produce bags, wallets and laptop sleeves mainly. They involve communities in the picking of plastic waste and the categorization per colour. Trained artisans then transform that plastic into something new and profitable from.

" *[We] train waste workers and artisans to use technologies that [they]'ve created and this technology is like converting plastic bags into material or recycling textiles or various materials*"

The company does not have a physical shop but mainly works as an intermediary: when an order is placed by a customer on their online platform, they transfer it to the artisans that work with HRP.

"*when our buyers place orders with us, then we pass on those orders to these groups and then monitor the production, the quality and then export these products. We buy these products from these groups and then export them*"

As shown in Fig 9 below and Fig 9a in Appendix 2, approximately, 3400 Kg of multilayer plastic MLP (hard plastics) and low-density polyethene LDP (flexible plastics, films) are collected but half of it is usually not employable for the process. All the steps of recycling produce a percentage of waste that can be still recollected after the washing and pre-cut phase, but not after the assembly and cut phase.
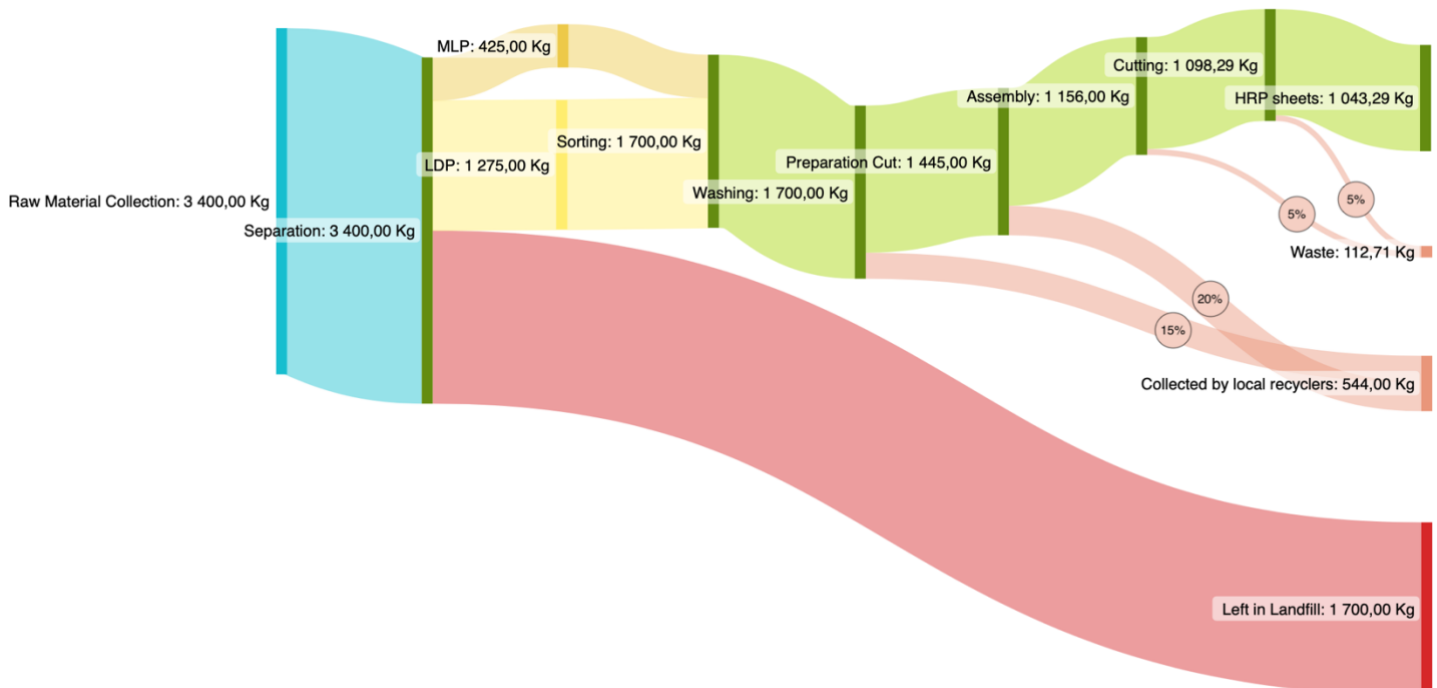
Fig 9. Sankey diagram of Business C. Blu = all raw material collection; Orange = MLP; Yellow = LDPL.

Business C when founding the company did not find a gap of interested customers in the Indian market and still now is quite a niche. The vast majority of what they make is exported.

"Indian audience was not as perceptive to upcycle products as they are today and like even today, the markets pretty small but like in 2017, it was still just very, very nascent"

"explaining to consumers why upcycled products, maybe even more expensive than virgin products was, it has been a challenge"

Another challenge that Business C had to face was the maintenance of high-quality end products when relying on a decentralized and informal workforce and on waste. Informal employment in India is common practice and indicates those working in private enterprises engaged in the sale and production of goods and services, operated on a proprietary or partnership basis and with less than 10 total workers, domestic workers, family workers, casual day labourers and workers in the formal sector without social security benefits (Raveendran & Vanek, 2020; Ashraf & van Seters, 2021). Wastepickers for Business C are casual day labourers paid based on the quantity and quality of plastic they deliver therefore there is no guarantee of a constant flow of wasted plastic for HRP manufacturing. Moreover, as also found in the literature, access to waste for upcycling companies like Business C has been found particularly challenging lately in India due to unclear policies regarding waste collection by the informal sector and waste use (Singh, 2021). This is making problematic the collaboration and relationships with those workers therefore representing an obstacle to the practices of business C. According to Business C, even though circularity is gaining more interest from the Indian government, effective policies are still not into place.

"circularity is a big focal point for the government at the moment, but it is challenging to create policy for it, because like, especially talking about waste, it's largely dealt with by the informal sector. And that's why policies can't easily take effect"

"in India, like the policies are very, very backwards like we do need a lot more help in terms of policy and [...] building infrastructure basically and understanding what circular products are"

Furthermore, receiving grants from the government takes a lot of effort according to business C and therefore prefers to be funded by international funding agencies. In this way, they would have the possibility to improve the technological aspects of their processes and eventually implement new solutions for showing more transparency in their supply chain.

The Business Model described by Coscieme et al., (2022) most suitable for Business C is *Recycling and Reuse of Materials* BM. Even though this model indicates companies repurposing textile waste, Business C recycles plastic waste into HRP fabric and then into new products. Some of the aspects pointed out by Coscieme et al., (2022) as opponents in the implementation of circularity can help characterising Business C. Here, as for Business A, the lack of support for technical recycling processes in the production phase represents a barrier for the development of companies because of unpredictable challenges that can hinder the production flow, especially in small companies (Singh et al., 2019). Another obstacle pointed out by the study are the lack of norms that provide guidelines for upcycle production or collection and sorting schemes to facilitate the use of waste. Furthermore, the lack of taxes on unsustainable materials can represent obstacles to the scale-up of the company, as upcycling companies do not gain any recognition for using waste instead of virgin material.
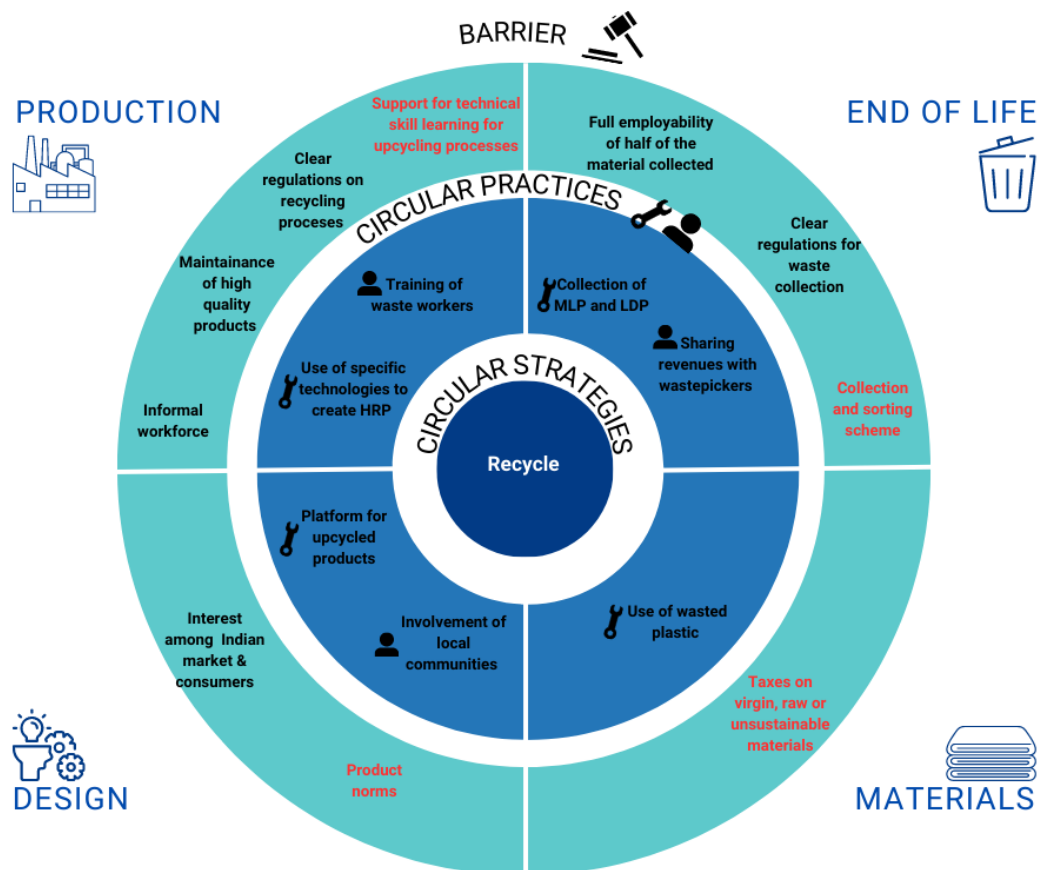

Fig 10. Overview Business C. Red = insights from Coscieme et al., (2022) on the *Collection and Resaled* BM that fits with Business C characterisation.

4.2. The Netherlands

The Netherlands is a European country member of the OECD with a high GDP and a high quality of life (OECD, 2022; OECD, 2020). Due to this high quality of life the Netherlands is led to patterns of negative and impactful production, excessive consumption, and waste, similar to those observed in other Western countries of the Global North. (Statista, 2022). Fibre production significantly affects the environment in the Netherlands. Cotton and wool are the most commonly utilized, with wool having the greatest impact in terms of agricultural and land occupation (van de Vreede et al., 2010). Excessive purchase and use is another key characteristic among Dutch consumers who approximately spend more than 5% of their income on mainly new clothing items (Soyer & Dittrich, 2021). Dutch consumers are also found to be the ones washing their clothes more than other European countries, resulting in more energy use and faster deterioration of the garment (van de Vreede et al., 2010; Soyer & Dittrich, 2021). Thus, garments but also general textiles are easily thrown away with scarce attempts to repurpose or repair them. As evidence, in 2019 almost 5500 kilotons of textiles were circulating in the Netherlands only, more than 550 were thrown away as waste, recuperated and resold in second hand shops, 86 were collected by municipalities and 174 were thrown away as residual waste (*Mumster*, 2021). Statistics also report that 61% of used clothes are landfilled or incinerated, while the remaining 39% is either reused (84%) or recycled (16%) (Warwas et al., 2021).

The Dutch government is aware of these problems and has set the goal of a fully circular economy by 2050 encouraging a circular transition among approximately 14000 registered textile, apparel and shoe manufacturing companies (*Circle Economy*, 2021). However, it should be noted that, like many other European countries, the manufacturing industry no longer thrives in the Netherlands, but has been displaced outside Europe where labour is cheaper (*Mumster*, 2021). The impact of exporting manufacture and labour outside the country should not be ignored and in fact, the Netherlands seems to care that proper working conditions are respected in companies that import pre-finished and finished products (*Circle Economy*, 2021). As evidence, agreements fostering international Responsible Business Conduct have been created, such as the Dutch Agreement on Sustainable Garments and Textile (AGT) (*International RBC Agreements*, n.d.). The dislocation of manufacturing seems also to have created room for new circular businesses in the Netherlands to grow, such as second-hand, different types of recycling systems and repair which are now becoming popular due to the sustainability trend (Reike et al., 2023). The Dutch government is supporting this new trend, developing a plan and implementing measures to promote textiles' reuse, repurpose, and recycling (Ministerie van Algemene Zaken, 2023). One of the measures recently came into effect is the Extended Producer Responsibility (EPR). Under this policy, from 1st July 2023 textile producers or importers are now accountable for the post-consumer stage of their products. This means they are responsible for

ensuring the collection of discarded textiles for proper reuse and recycling (Krahl, 2023). The methods of collection are arbitrarily chosen but they have to be effective enough to accurately report the volume of sold, reused and recycled textiles (Ministerie van Algemene Zaken, 2023). The Netherlands has set ambitious targets through this measure: by 2030, they aim to ensure that at least 75% of the weight of textiles sold in the previous year is either reused or recycled. By 2025, they plan to incorporate 25% of all discarded textile fibres into the materials for new products (Business.gov.nl, 2023). Although this particular measure shows an approaching attitude towards circularity goals, the Dutch government is found to be still lacking significant direction and system support in the implementation of circular design, production and consumption (Reike et al., 2023).

4.2.1. Dutch Companies

4.2.1.1. Business D

Business D is a social enterprise based in the Netherlands. It is a service-based company, providing repair services for textile and clothing brands that have a return program for their products. The social mission of the company is, as stated by Business D

"*creating opportunities for employment for people with distance to the labor market*"

"*provide different types of programs for rebuilding trust and finding the next step in their career in the Netherlands and inside the creative industry and the textile*"

The tailors involved are people with a refugee background that not necessarily have experience in the textile world and who are in any case trained and given the possibility to be reintegrated into the job tailoring market.

Together with that, Business D provides a repairing service and upcycles old garments. These innovative circular practices help alleviate some of the pressures faced by the textile and clothing industry. By prolonging the lifespan of existing products in circulation, they reduce the need for new inputs, contributing to a more sustainable approach.

As shown in Fig 11 below and Fig 11a in Appendix 2, three main lines of operations were analysed for the MFA: reparations on waterproof jackets, jacket zippers and damaged denim. Some inconsistencies were found when analysing the zippers' data, which would not permit the mass balance. Therefore, those have not been considered for the Sankey diagram representation. Waste after the repair of items is minimum considering the total amount of the repairing material. However, if considering the average

repair material used especially for jackets and what is discarded, waste fabric represents more than 50% of the fabric actually used.
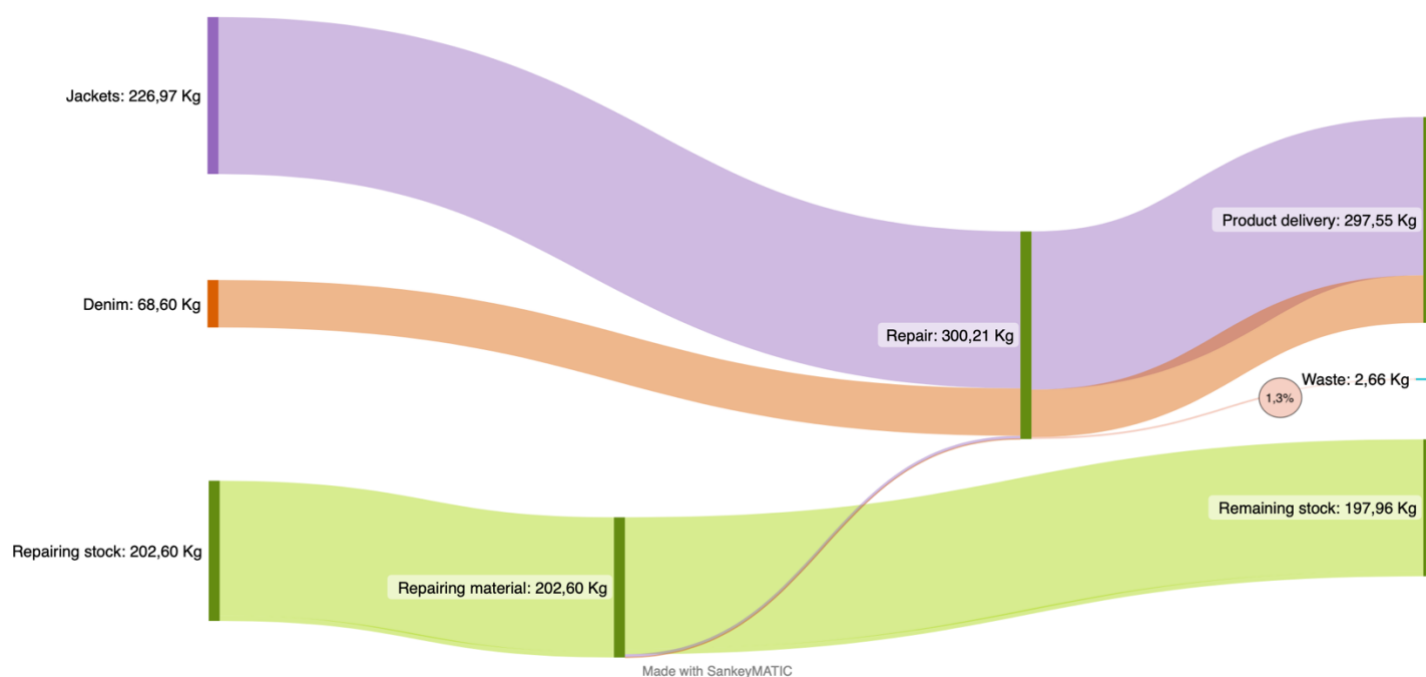

Fig 11. Sankey diagram of Business D. Purple = jackets; Orange = denim; Green= repairing material

Lack of physical space has been problematic to business D. Not having enough space to be able to scale up and introduce new machines led also to the impossibility to collect leftover materials that could still be used. However, at the time of the interview, this problem was already solved as a new bigger location was found. Besides that, business D found some challenges at the bureaucratic level in particular at the establishment of the company. Hiring people with a refugee background is not straightforward because of many intermediary passages of bureaucratic nature. This can take some time and has represented an obstacle to the company's practices and goals.

"*hire the people that we're targeting […] people that have already refugee background, their legal frameworks in order for them to be able to work sometimes is not so straightforward, needs to be via a collaboration with the municipality*"

"*so each people with refugee background is assigned to a manager* [of the municipality] *and each manager can have 200 people*"

To date, this problem has been partly resolved and the hiring process has become faster and more efficient. Nevertheless, the slowness of bureaucracy might be an unbeatable barrier that hinders the scale-up at which the company is aiming.

For what concerns governmental funds and grants, Business D did not express any interest or shared a relevant insight since they are an investors-based company.

Business D falls into the Business Model based on *Longevity and Durability* as described in Coscieme et al., (2022) where the goal is to extend the lifespan of a garment through services like repair, customisation or maintenance services. The need of buying something new is lowered as repair or customisation increases the emotional attachment to products and therefore fosters a longer use. Longer use in the textile and fashion industry means that a garment will be worn more than the time it is considered trendy. This would tackle the volatility of fashion and consequently, the excess waste created by discarded garments. Moreover, it would encourage in using more high-quality fabrics as a garment is worth to be repaired if high-quality fabrics are used in the first place. Coscieme et al. (2022) point out elements that might represent a barrier for companies with this BM that suits for Business D as well. For instance, policies should define quality requirements and increase taxation for less durable products so to sustain companies with this BM. Moreover, implementing standards in durability or longevity for garments could boost repairing companies such as Business D. For instance, garments producers would have to comply to those standards and implement return policies for repairing consequently creating work for repairing businesses.
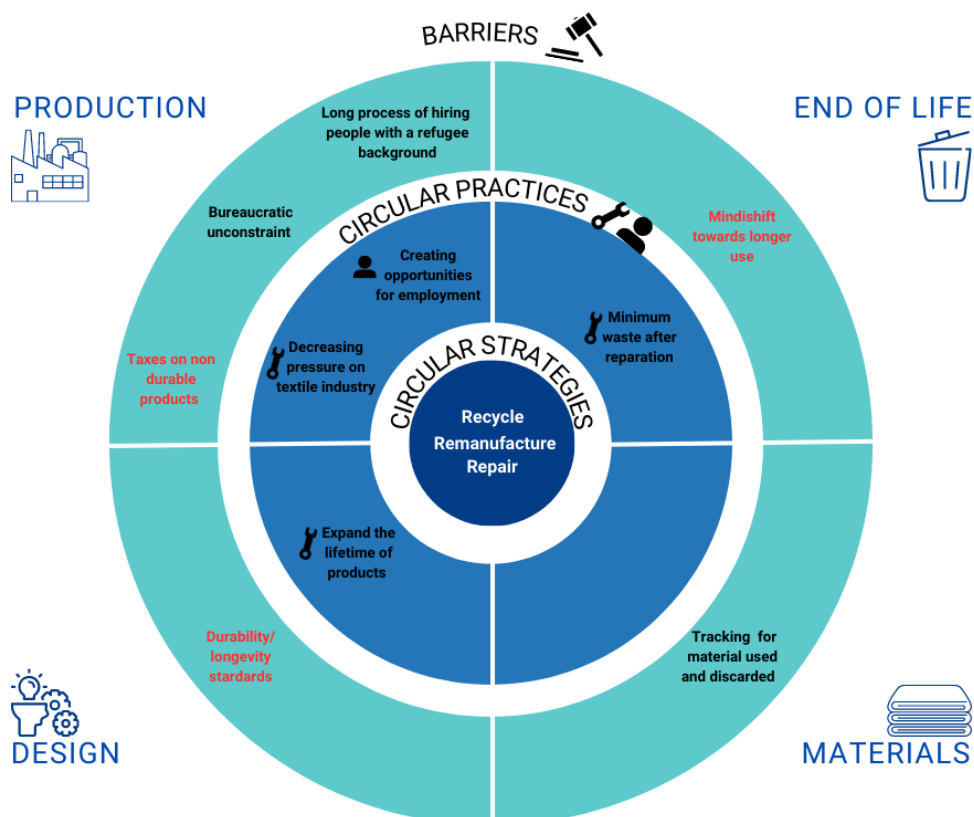

Fig 12. Overview of Business D. Red = insights from Coscieme et al., (2022) on the *Longevity and Durability* BM that fits with Business D characterisation.

4.2.1.2.   Business E

Business E is a non-profit company based in the Netherlands that collects and recycles discarded clothes. The collection happens through numerous containers in many municipalities where citizens can throw clothes they want to get rid of. Business E works together with municipalities to pursue its mission.

 "[to be] *as supportive as possible for a sustainable environment*."

Municipalities play a central role in the practices of Business E. They are responsible for the placement of containers; the establishment of rules for their employment; the education of citizens on how to use the containers in terms of what is suitable to be thrown in those containers.

When still in good condition and usable, part of the collected clothes is repaired but the majority are directly sold for reuse and second-hand market. Items no longer wearable are down-recycled into carpet or insulation material. As visible from the Sankey diagram in Fig 13 below and in Fig 13a in Appendix 2, part of what is collected is not suitable for recycling, therefore left out of the whole process because considered garbage and consequently disposed of as textile waste by municipalities. Suitable textiles are the ones that go through sorting, cleaning and quality check, creating other waste during the process. Usually in the end 70% of what goes through the quality check phase is sold for reuse, while 30% is recycled.
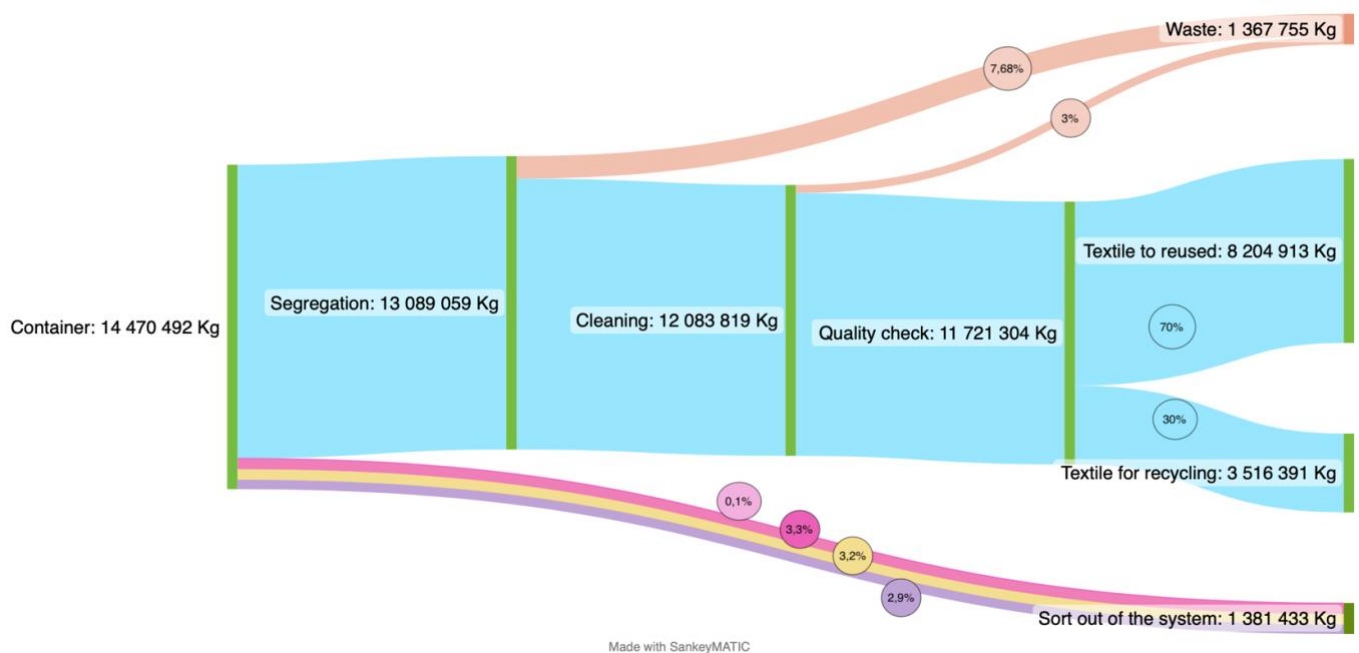

Fig 13. Sankey diagram of Business E. Blu = suitable textile going through the reuse/recycle process, Pink = electro-domestic (discarded from the process); Fuxia = duvet & pillow (discarded from the process); Yellow = wet textiles (discarded from the process); Purple = garbage (discarded from the process).

As the garments are not handpicked, the collection of proper garments comes with some challenges. People do not really know and are not informed enough about what they should and should not throw in the container. Often happens that even garbage ends up being part of the collected material, ruining what is actually still valuable.

"a lot of people throw their household waste into the bins and that affects our textile"

"clothes, get damaged and we have to pay for the garbage to take it away"

Even though the company has provided instructions on the containers and shared on social media and their website what should be put in the containers, it seems not to have a real effect.

"We need a more proactive municipality on this, they have to talk to the citizens"

According to the company, municipalities do not care enough about the textile waste problem, hindering not only the right conduct of business but also the proper execution of a circular practice.

"for them, textile is waste. So it is in their waste programme and they have paper and they have glass and they have household waste, and textiles really small parts of all those streams"

Municipalities need to show more involvement in business E practices since they are working together in improving the textile waste situation that the Netherlands is facing. When the municipalities are involved, it would also be easier to better educate citizens on what and why only certain clothes should be placed in the containers.

Business E Business Model falls into *Collection and Resale* described in Coscieme et al., (2022). Here, the focus relies on closing the material loop by repurposing wasted material. Materials employed by these businesses are originally discarded, therefore there is no exploitation of new resources, reinforcing circular model. Businesses with this BM are the ones mostly close to the practices of reuse and recycle of the circular economy, making them a virtuous example to follow. This is because no new raw material is required for the redistribution of garments and those that cannot be resold are recycled to serve new functions (D'Adamo et al., 2022). Among the elements pointed out in the study, logistics play a significant role for companies operating under this business model, as the collection and redistribution of sorted textiles come with considerable costs. Similarly, logistics also play a crucial role for Business E due to two main reasons. First, containers must be picked up, emptied, and returned to their original places. Second, sorted textiles must be delivered to their end destinations, such as

second-hand shops or foreign markets, while non-suitable textiles for the recycling facilities in use must be disposed of. Thereby, subsidies or tax reductions implemented by the government would be helpful in improving the business and covering logistics costs.
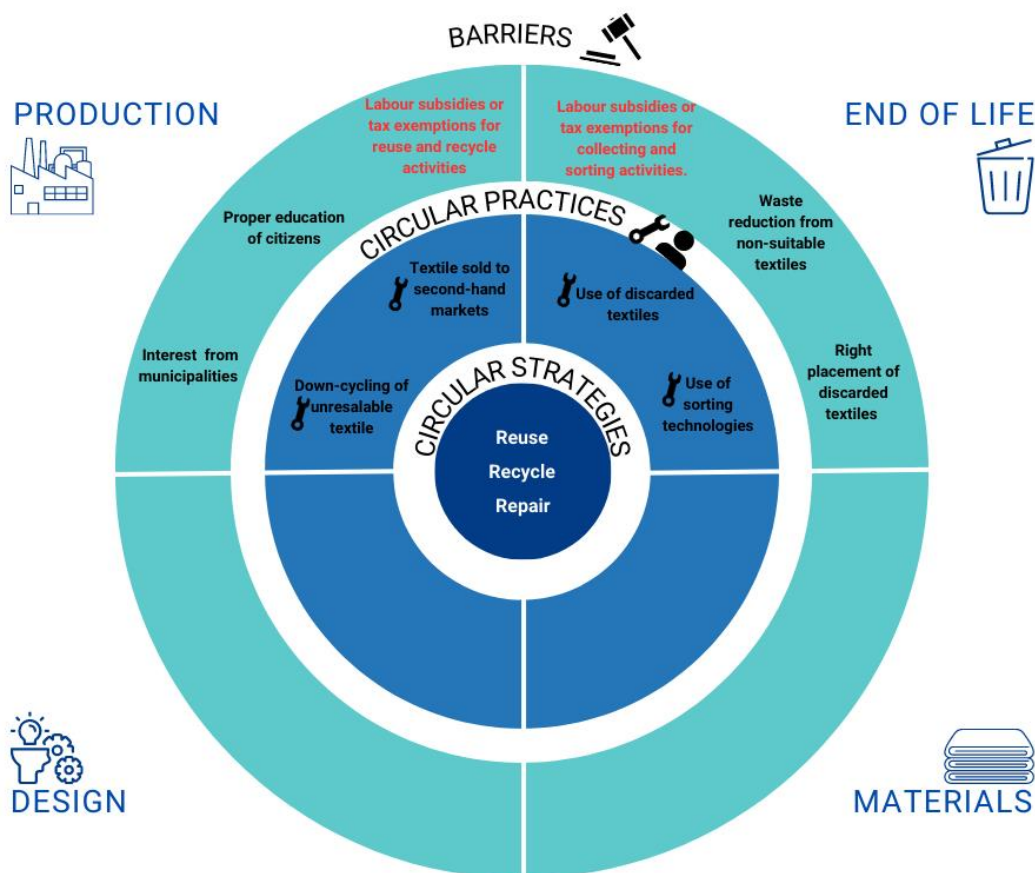
Fig 14. Overview of Business E. Red = insights from Coscieme et al., (2022) on the *Collection and Resaled* BM that fits with Business E characterisation.

4.2.1.3. Business F

Business F is a non-profit company SU based in the Netherlands that collects and resales old clothes in their second-hand shops and to other countries as well. Their goal is to:

"*Getting a circular textile chain, or at least contributing to it by maximizing the collection of textiles and sorting it for reusing purposes*"

They want to offer modern items at a reasonable price for every income and create work opportunities for those who have difficulties finding a job and being reintegrated in society.

What they do is collecting old clothes that people are willing to give away from small containers positioned in partners' shops and from city. Garments go through a sorting process to assess whether

reparations are needed and whether they are still resaleable What is too damaged and not suitable for being exposed in the shops is then recycled by third parties.

As Fig 15 below and Fig 15a in Appendix 2 show the system of Business F is quite complex due to the many streams that the garments can follow and the quantity of clothes that the company has to manage. Only a small part of what is collected and donated is resold or becomes part of the inventory. Almost 20% (circa 720 thousand Kg) of what is collected is then wasted while 60% is stocked in bulk.

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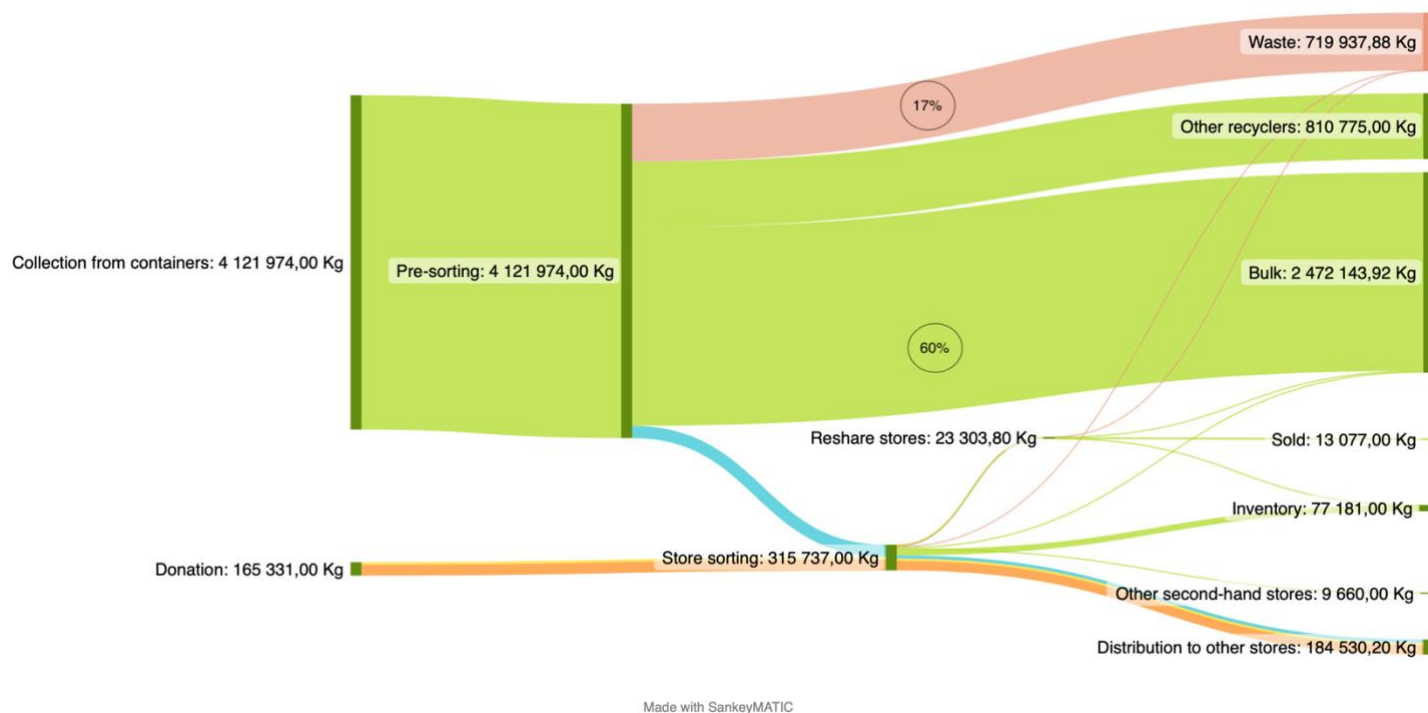
Fig 15. Sankey diagram of Business F, Blu = textile collected from containers; Yellow = textile collected from donations from brands; Orange = textile collected from donations in store

When a company depends on donations, the quality of what is donated represents a challenge. Company F claimed that on the technical side, challenges have been found when donated garments have unremovable stains, present sparkles that make the item non-recyclable or are low-quality items that cannot be resaleable.

"it's really difficult to reuse all the clothing and on the technical level, […] the recycling part"

Another challenge has been found in creating solid and transparent collaboration with chain partners following the producer's responsibility. New laws are about to be passed regarding producer responsibilities that list characteristics producers should implement in their products for the right collection and recyclability of those items. However, according to the company, this law will affect textile collectors and recyclers, that is why Business F is putting pressure on the government for better policies on textile waste collection.

"we're lobbying at the government for better legislation on recycling of clothing."

If the government set stricter guidelines on production enhancing the quality of garments, collection, resale and recycling practices would have an easier and even more circular execution as fewer items would be discarded.

"that's what we're trying to do by talking to the production side of the chain and tell them this problem and tell them like if you are producing an item like this and it's really, really hard to give it a second life for us"

Ultimately, capital has been pointed out as an obstacle to the technological advancement of the company.

"there's not being enough money to invest in it".

The company is sustained by a European project that provides grants for companies working with sorting of fibres and recycling methods. However, business F claimed that funding is necessary but not as easy to get as one would expect when working with circularity.

"it's just really it's so difficult and it takes so much time up to uh to explore all the fonts and to apply".

The Business Model that most suits this company is again the Collection and Resale model described in Coscieme et al., (2022). Subsidies and tax reductions installed by governments or municipalities could be helpful for Business F as well. Even though they collect and repurpose discarded garments, they still face technical problems concerning the unrecyclable features of collected garments. Moreover, Coscieme et al., (2022) pointed out that raising awareness among consumers on second-hand purchases as a sustainable alternative could enable the scale-up and improvement of companies with this BM. This could be implemented by Business F as well not only on the advantages of buying second-hand but also for educating consumers on what is most suitable for their collection and recycle processes.
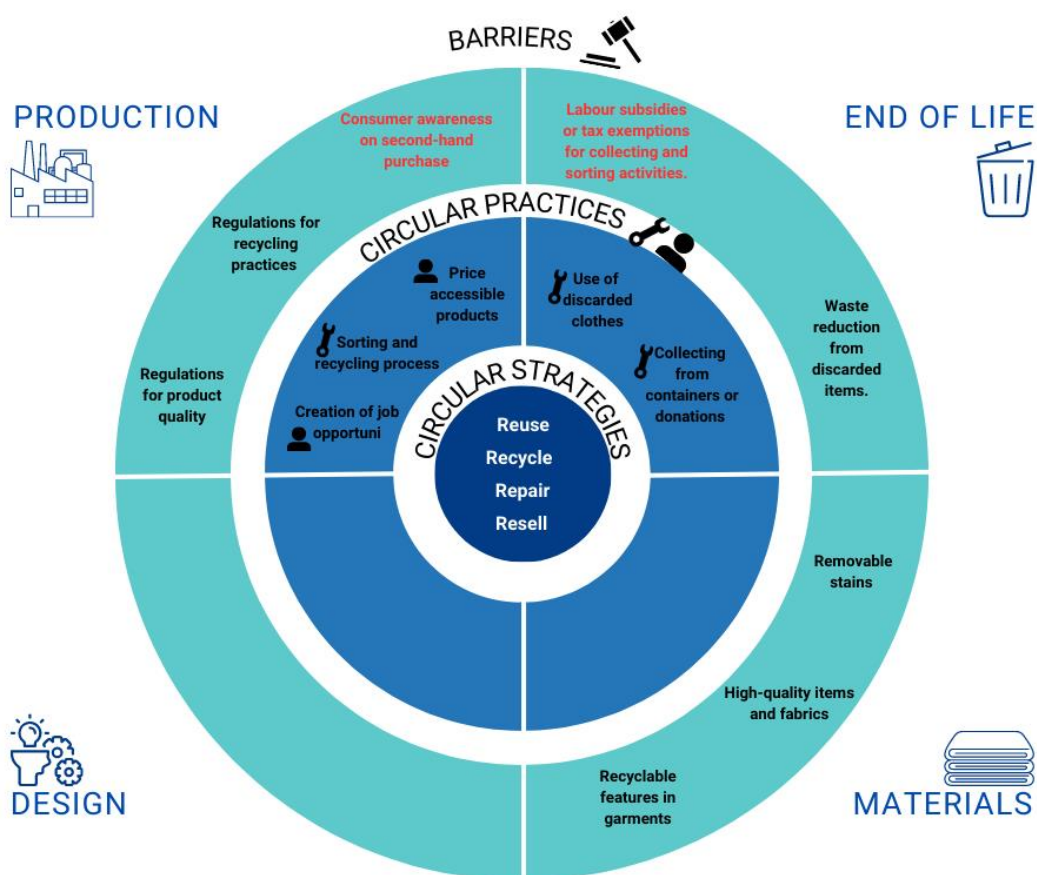
Fig 16. Overview Business F. Red = insights from Coscieme et al., (2022) on the *Collection and Resale* BM that fits with Business F characterisation.

5. DISCUSSION

The chapter that follows analyses the findings from the investigation of the selected firms, tying them to theoretical aspects that characterise this research. Circular practices are addressed first, followed by context-specific and funding-related barriers.

5.1. CIRCULAR PRACTICES

Results show overall how interviewed companies integrate circular features in their companies pursuing the ultimate goal of sustainability. Among the considered companies, special attention was paid to practices that aim to minimize waste, repurposing of waste, recirculating what is still wearable

and the use of specific technologies for recycling, alleviating in this way the pressure on waste generation and primary resource exploitation. Services that extended the lifespan of products also emerged as circular virtuous practices. On a social aspect, the companies interviewed were overall engaged in involving local communities.

5.1.1. Waste Reduction

Tackling waste generation is an ambitious but necessary responsibility for circular companies. In this research, the minimization of waste seen among the selected companies refers to upstream discarded textiles, namely waste created during the production phase. Other significant streams of waste in the textile industry deriving, for example, from wastewater or chemicals were not part of the analysis. Although post-consumer waste constitutes a significant portion, it is crucial not to overlook pre-consumer waste (Jaume Duch Guillot, 2020). In textile production, upstream waste encompasses the industrial waste generated after the cutting phase, damaged or substandard products, and excess production (Keßler et al., 2021). The cutting phase alone accounts for approximately 13% of the waste produced in textile manufacturing, while the quality check stages contribute around 7%, with both figures influenced by the fabric's type and quality in non-circular textile industries. Moreover, unsold items make up nearly 30% of the garments circulating in Europe only (Islam et al., 2021). Circular companies try to tackle these aspects as much as possible to avoid negative impacts on the environment and people caused by landfilling and incineration and to avoid financial losses due to unused potentially profitable textiles (Marsh, 2021; Khairul Akter et al., 2022). As evidence, interviewed companies being already applying circular strategies and practices have a lower percentage of production waste and unsold inventory. Reducing upstream waste through more efficient processes or innovations are ways that help reach circularity goals (Raveendran & Vanek, 2020), as also demonstrated by the SUs interviewed. However, as the Sankeys diagrams and MFAs flow diagrams in Appendix 2 show, a small part of the production flow becomes waste even if most discarded textiles are reemployed for creating something new. This shows that it is still difficult to achieve complete circularity in production processes despite circular strategies being applied. Creating close loops in production is indeed almost impossible for how the concept of circularity has been developed so far, where materials circulate forever in different forms to be reintegrated into existent systems regenerating themselves (de Man, 2022). Although true for biological cycles, this definition is not valid for technical human-kind cycles where materials don't last and must be replaced or reinforced with new inputs (Huether et al., 2022).

5.1.2. New Life to Waste and Recirculation of Clothing

Practises that encouraged remanufacturing waste and resale of still useable clothing were identified as being common during the investigation. Remanufacturing or upcycling discarded textiles is considered one of the most circular practices as requires little energy and merely no new materials input and it adds economic value to what considered waste (Kamble & Behera, 2021). This practice has the potential to be adopted by any textile production system due to the waste generated during the cutting phase. Currently, it appears that only certain tailors and small companies have shown interest in embracing this circular approach. If well-established companies were to incorporate a remanufacturing process into their systems, they could enhance productivity, minimize waste, and benefit from cost reductions in logistics and raw materials (Sunhilde & Simona, 2018). However, upcycling is still an expensive and labour-intensive alternative as technologies have not been developed to ease the pattern-making process yet, and the high costs that intake (Caldera et al., 2022; Marques et al., 2019).

The resale of still wearable or second-hand garments has recently increased its popularity and it is also considered one of the most circular practices within the textile industry (Machado et al., 2019). The advantages entail avoiding the use of new material input and adding economic value to what was discarded as a finished product (Dos Santos et al., 2021). As no new raw materials are required to create garments, the costs and impacts of production are minimized consequently often showing a lower final price for consumers (D'Adamo et al., 2022). Giving a new purpose to discarded clothes is a way to prologue their life, lowering the pressure on production and waste disposal processes (Marsh, 2021). However, reselling second-hand clothes encompasses different steps that might not always be without negative impacts (Islam et al., 2021). The quality and state of the garments collected depend on what consumers throw into the containers; logistics concerning the pick-up of those containers and the transportation to the sorting facility have their own emissions; items might need reparation and sanitation; not everything that is in the container can be resold and those garments are usually recycled (Dos Santos et al., 2021; D'Adamo et al., 2022). All of these steps require energy use that if not sourced by renewable sources, contributes to negative impacts (Sandin & Peters, 2018). This is especially true for recycling processes whose technologies use a great amount of energy in order to properly disassemble textiles into fibres (Keßler et al., 2021).

5.1.3. Extending the Lifespan

Practices encouraging the lengthening of a garment lifespan have not been quite implemented in the textile industry yet, but have emerged during the analysis. These are represented by rental and repair

services. Together with the goal of lengthening the life of garments or textiles, they both aim at reducing the creation of new products (Lang et al., 2020; Laitala et al., 2021). Rental services have gradually gained attention as they allow consumers to wear, even for a limited timeframe, high-quality items that might be too expensive or just meant to be worn a few times or just once for a lower price than purchasing the item (Luján-Ornelas et al., 2020). Rental services have shown positive impacts on the environmental, social and economic levels so far: it contributes to reduce the volume of deadstock and discarded items; it allows people to have access to high-quality garments for reasonable prices; it reduces the overconsumption of clothing (Lang et al., 2020). However, concerns arising from consumers entail scepticism and hesitance in renting garments due to mistrust in sanitation and cleaning processes (Tsironis & Tsagarakis, 2023).

Repairing services are also on the rise as repairing skill knowledge and tradition are gradually fading (Zhang & Hale, 2022). Extending the lifespan of an item through repair contributes to decreasing the demand for new garments and eventually reinforces the sentimental attachment to a particular one (Laitala et al., 2021). Repair services can also stimulate take-back initiatives by established companies and therefore create collaborations that could benefit both parties (Pal, 2016). However, this practice has not been implemented extensively yet, and many manufacturing companies are not prepared to integrate this kind of service or collaboration (Arnold et al., 2023). Moreover, the success of repair services depends on the willingness of consumers to repair an item that they own, which could rely on costs, feasibility of the repair, and quality of the garment to repair (Laitala et al., 2021).

From a social point of view, the interviewed companies have shown care and interest in the well-being of their workers and local communities often collaborating with NGOs or charities. It has indeed been demonstrated that especially the involvement of local communities is essential for tackling social issues as they can reflect the effects and advantages of circular approaches and activities on society (Padilla-Rivera et al., 2020). Thus, local communities need proper education and training in order to meet high-quality standards and increase the value of the product (Luján-Ornelas et al., 2020). In this way, products acquire both circular and social value that is essential to becoming a sustainable business (Abreu et al., 2021).

5.2. BARRIERS

Results also show how the considered companies have found barriers or still are hindered by the regulatory context for accomplishing their goals. Overall, the obstacles identified by the enterprises

examined that arise from a regulatory system are related to poor involvement in easing the path towards circularity and facilitating the companies' practices. These elements were differently stressed among the Indian and Dutch companies. Moreover, the lack of enough investment, or available funding was stressed in both contexts.

5.2.1. Indian Context

Indian companies pointed out issues more at the systemic level, meaning that policies and regulations are perceived as weak and not helpful enough to sustain born-circular companies. Circular SUs in India seems not to have the same regard and attention as non-circular SUs for which India has put in place specific funds and norms (Mukherjee, 2022). Many challenges arise when discussing the adequate implementation of CE principles especially in the textile industry in India (Jia et al., 2020). Regulations, policies and government involvement are frequently occurring barriers even though India largely relies on this industry and it would be expected that the textile sector would be facilitated in its practices (Saroha et al., 2020; Saha et al., 2021). Circular and sustainable practices are difficult to implement in India where insufficient awareness is shown and insufficient incentives are predisposed by the government (Saha et al., 2021). This is a major barrier, especially for small companies and SUs that are moved by circular goals but do not find the right support or effective legislation that enables their development (Chen et al., 2021). For sustainable concepts implementation, strong policies and a stable regulatory context are indeed needed but are currently lacking in India (Saroha et al., 2020; Sharma & Narula, 2020). Once policies addressing circularity that also financially assist businesses have been strengthened both at the national and regional levels, there would be a more proactive environment for the implementation of circular practices (Sharma & Narula, 2020). For instance, the Indian government could enact laws for tax cuts, accessing to green technologies and supporting waste management and recycling facilities for circular companies (Majumdar et al., 2022). Overall, what seems to be lacking in the Indian regulatory context in order to diminish the barriers to implement circular practices is a lack of a long-term vision of sustainability goals and therefore a lack of investment from the government.

5.2.2. Dutch Context

Interviewed companies based in the Netherlands instead have stressed problems at the bureaucratic level, pointing out the insufficient involvement of municipalities in waste management and social issues. The Netherlands is considered a frontrunner in Europe for pursuing circularity and indeed, companies did not find barriers at the system level (Chen et al., 2021). The Dutch government has

been actively interested in finding solutions for waste disposal, implementing different initiatives at the national and regional levels that aim at a fully circular economy by 2050 (Ikiz Kaya et al., 2021). Recently the Dutch government has enacted a law and a plan for which by 2030 half of the textile products shall be made of sustainable or recycled material for at least 30% and at least 50% of the textile products shall be recycled after their use (Reike et al., 2023). Through this active commitment and plans, The Netherlands creates a stimulating environment for companies to approach and implement circularity in their practices or for entrepreneurs to start a circular business (Fischer & Pascucci, 2017). Circular SUs also find an optimal environment for adopting strategies and innovations, potentially encouraging the economy to higher levels of circularity (Bauwens et al., 2019). However, as interviewed companies pointed out, some obstacles addressing proper involvement in textile recycling and funding are still to be resolved at the municipality level. Dutch municipalities are responsible for waste collection, disposal and waste separation policies. Even though the Netherlands has more than 20 years of experience in recycling programs, textile recycling is lagging compared to compost or paper recycling (Dijkgraaf & Gradus, 2014). This could reflect a lack of experience in textile waste and separation as seen in other North European countries (Christensen, 2021). For textiles in particular, Dutch municipalities started to tender with external parties that collect and separate discarded textiles which are mainly NGOs or social enterprises. In this way, municipalities are not completely involved in the process, hence, they do not perceive what could be enhanced at practical and social levels (Coco Martin, 2020).

5.2.3. Funding

Another major constraint pointed out by interviewed companies is the lack of proper funding. This is consistent with scientific literature claiming that the high cost of circular production or service provided is one of the most recurrent obstacles for companies which also affects the cost-competition with other linear products (Hartley et al., 2022; Chen et al., 2021). SUs more than regular companies need a wide base of funds in multiple forms such as seed money, loans, or bonds to improve their development and guarantee a scale-up but often lack direct and easy access to them. Being new businesses in the market with potential innovative solutions or practices, they might not have a market valuation and therefore represent a risk for potential private investors (Bauwens et al., 2019). Financial support from the government in the form of so-called "patient capital" (grants, low-interest loans or business incubators) is therefore much needed to sustain textile circular SUs and new entrepreneurs in launching a circular SU which might implement technological innovations, social solutions or different business models new to the market (Bauwens et al., 2019; Pohls, 2020).

6. RECOMMENDATION

Circular SUs that were interviewed appeared to acknowledge that their work is still far from flawless but that it is moving in the right direction—that of circularity and ultimately sustainability—and that there is still much opportunity for development.

Improving the performance of textile companies could be translated into implementing new technologies, new ways of employment, innovative ways of management or engagement with local communities. Innovations can indeed enhance circular practices and strategies by reaching a higher efficiency that eventually can be translated into less waste (Furferi et al., 2022). Circular SUs are more keen on implementing innovations especially if they represent radical innovations that can move forward sustainability goals (Sadma, 2021). Led by strong ideologies, integrating innovations is the element that makes circular SUs stand out from established companies in the textile industry; gain a competitive advantage in the market and occasionally; be adopted and employed by established firms (Von Kolpinski et al., 2023; Huynh, 2022).

Yet, innovations alone might not be sufficient for improving circularity in the textile industry. Orchestration and collaboration have been pointed out as other significant factors by scholars for serving the same purpose: textile companies need the supply chain to be circular in order to deliver a circular product (Kazancoglu et al., 2022). Understanding how to manage and coordinate resources, innovations, suppliers and other stakeholders would represent a concrete step to improve circularity and eventually the competitive performance of a company within this industry for circular SUs. Orchestrations ensure alignment within the company supply chain in the implementation of circular practices (Saccani et al., 2023). Collaboration is also a significant element in enhancing circularity. It represents the process of interaction between stakeholders having the same goal – in this case, the reaching of circularity in the textile industry – that leads to the creation of shared rules, norms and governing structures that mutually advantages the parties (Danvers et al., 2023). As the textile industry is dependent on many parties, circularity cannot be implemented without the full participation and involvement of stakeholders, circularity could not be fully implemented if the participation and involvement of stakeholders are not put into place (Kazancoglu et al., 2022). Collaborations can contribute to enhancing circularity by broadening or intensifying the relations with new partners; it can facilitate the sharing of knowledge between government, non-governmental organisations, academia and industries; and it can provide opportunities for multilevel collaborations (Danvers et al., 2023). Studies show that circular SUs are more inclined in collaborating with other companies, sharing data, projects and best practices, which is an opposing mindset to traditional established companies (Von Kolpinski et al., 2023; Kazancoglu et al., 2022). Sharing knowledge is indeed perceived as an

opportunity to grow, learn, and advance circular practices, eventually creating a mutual advantage for the parties involved (Sawe et al., 2021).

Many studies point out that CE weaknesses and regulatory barriers could be overcome through a change in mindset and practices in decision-making and leadership. If not, proper implementation of circularity would be almost impossible to achieve (Metcalf & Hinske, 2022). Failing to achieve circularity will lead to a failure in achieving true sustainability as the two are complementary concepts (Beehner, 2022). A change in the narratives and actions of leaders is needed to address the complexity of these interrelated concepts, and a system-thinking approach is what most scholars suggest as the most appropriate strategy (Metcalf & Hinske, 2022). A system approach would tackle CE weaknesses but also regulatory constraints and social and environmental issues providing an accurate picture of our society and economy and thus, the necessary adjustments (Hoomans & Welp, 2022). To align this vision within the context of this research, it could be stated that a holistic overview, that is a systemic perspective that includes the multifaceted aspects of society, applied by leaders or policymakers could enhance the effectiveness of CE principles. Consequently, it could lead to social transformation and eventually to the potential achievement of sustainability if coupled with accurate policies that lower the pressure on barriers and challenges faced by circular SUs (Nikolova & Ness, 2022).

7. LIMITATIONS AND FURTHER RESEARCH

The analysis performed in this study was not without limitations starting from the data collection methods. On a general note, interviews are undoubtedly an effective way to get direct contact with interested parties. However, as a qualitative method of research, they might provide subjective information that could not be accountable or relevant to general knowledge (Bailey et al., 2010). Considering what was just stated, more limitations specific to the use of this qualitative method in this research should be highlighted. A better formulation of questions of the interviews – sharper about the question but broad enough for discussion at the same time - could have allowed interviewees to elaborate more in-depth on their answers. Even though the restricted time allocated to the interviews (30 min) would not have allowed further elaboration by the interviewees, the answers were sufficiently insightful for the analysis of this research. Another limitation has been found in the consistent quality of the answers collected as some companies were more prone to dialogue and discussion than others. The quantitative data collection method also presents some limitations. The product datasheets were directly filled by the companies; therefore, their accuracy is unknown and not verifiable. The MFA is built upon those uncertain data that might consequently show uncertain results. Nevertheless, even

though the data might have been inaccurate throughout the analysis, the final outcome of the research still holds some relevance.

Finally, another limitation of the study concern is represented by the number of companies chosen for the investigation as including more companies in the study would have strengthened the outcomes of the research.

Further research can be derived from this study to explore the objective of the study through a different lens of investigation or in more depth. For instance, further studies could implement a consumer behaviour perspective in order to understand what role consumers play in the adoption of circular strategies by circular textile SUs. Further research could also be carried out by analysing more countries belonging to different or more continents than Europe and Asia at the same time to get different insights from different regulatory contexts. Moreover, further research could include data concerning energy consumption and water usage to give a more complete overview of circular practices put into place by a textile company.

8. CONCLUSION

The current study's purpose was to understand how circular SUs in the textile industry are adopting circular practices considering the regulatory context they are embedded in. The research goal was narrowed down to two subquestions that guided the development of the analysis:

- *What are the key elements that characterise SUs as circular in the textile industry?*

- *What barriers raised from their local regulatory context have SUs encountered in the implementation of circular practices in the textile industry?*

To fulfil the purpose of this study and answer the questions leading it, six companies located in two different countries were analysed with a hierarchical mixed methods approach. A framework specifically created for this study aiming at determining the circular strategies, practices and barriers of each company was applied. First, desk research using scientific and grey literature was conducted to describe the current local regulatory context of the companies. Second, interviews were performed, transcribed, and then coded with the use of NVivo software in order to gain insight into the practices of the companies and perceived barriers raised from their legislative context. Third, a Material Flow

Analysis was carried out in order to visualize the state and changes of the material flow in a system by calculating the mass balances between the steps of production and therefore identify the source of waste generation. Lastly, each company was framed into a BM described by the work of Coscieme et al., (2022) to integrate the findings on opponent factors dependent on a specific BM.

From the analysis, it emerged that circular SUs in the textile industry tend to implement practices that lead to decreasing pressure on the textile industry. Companies focused mainly on the minimization of waste, giving new life to waste through upcycling or recycling, recirculation of clothing, and extending the lifetime of garments. Circular SUs in the textile industry also tend to show particular care and attention to incorporate social issues in their mission. Thus, they tend to collaborate with local communities, NGOs or charities, having also particular care of their employees. Nevertheless, each of these practices exhibit some flaws indicating that there is still room for further improvements in order to achieve deeper levels of circularity.

The analysis also showed that the local legislative context has an impact on circular SUs in the textile industry. Barriers emerging from the policies and regulations have different nuances that depend on how mature and integrated the concept of circularity is in the specific legislative context. Overall, poor involvement, lack of regulations, incentives, and standards for easing the path to circularity were found as the main barriers stressed differently among the two contexts considered. A common opponent factor was found in the lack of sufficient funding.

This research through the analysis of the chosen companies has highlighted i) circular practices in the textile industry implemented by circular SUs stressing the gaps in knowledge and accuracy of CE performance; ii) that the regulatory contexts play a role in the implementation of circular practices and strategies, often creating challenging environments for circular textile SUs. The introduction of innovations has been identified as one of the most effective ways to achieve circularity by circular SUs in the textile industry, not only at the technical (new technologies) but also managerial (different Business Models) and social (involvement and interest in social issues) levels. Besides that, the study suggests that innovations alone might not be sufficient and companies in this field should develop orchestration and coordination features to reach a deeper level of circularity. The local legislative context could help in easing the path for circular SUs and eventually other not-yet-circular companies within the textile industry to achieve a deeper level of circularity by applying a systemic vision.

By raising attention to the current practices adopted by circular SUs in the textile industry, this study ultimately has set the baseline of what has been achieved so far that might inspire entrepreneurs for further improvements. Moreover, by investigating the local legislative context, this research added a

perspective that has not been extensively analysed in the textile industry but has shown to be relevant to a company's paths towards circularity.

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APPENDIX 1

Table 3. Company analysed

COMPANY	TYPE OF BUSINESS	MAIN ACTIVITY	MAIN CIRCULAR ACTIVITY	WHERE
BUSINESS A	Business-to-business	Suppling of garments for European and Australian brands	Use of organic cotton; Reuse of water in the cleaning process; Production on demand	India
BUSINESS B	Business-to-business and business-to-consumer	Renting clothing for every occasion	Garments rental	India
BUSINESS C	Business-to-consumer and non-for-profit organization (Social enterprise)	Designing and reselling bags, computer sleeves and wallets	Manufacture of HRP (handmande recycled plastic); Use of HRP for their products	India
BUSINESS D	Business-to-business and Non-for-profit (social enterprise)	Repairing broken garments supplied by other brands	Repair of clothes; Provision of work and training for refugees' workers	The Netherlands
BUSINESS E	Business-to-business	Collecting used clothes and textiles; Reselling in second-hand shops or recycling facilities	Collection of used textiles; Resell of second hand textile; Upcycle or down cycle of textiles	The Netherlands
BUSINESS F	Business-to-consumers and non profit	Collecting used clothes and reselling them in their second-hand shops	Resell of second-hand clothes	The Netherlands

Table 4. Relevant definitions used for characterizing circular SUs for the interviews.

Type of business	Definition	Author
Access-based model	Renting, leasing and sharing of garments Goal = Lowering resource utilization and increasing the use rate of the product	Coscieme et al., (2022)

Collection and resale	Second-hand retail, collection and resale to the market for reuse and recycling Goal = Extending the useful life of textiles after the first user.	
Longevity and durability	Customized production, offer repair and maintenance services and focus on design for repair. Goal = Extending the lifetime of garments, reducing the need of purchasing new ones and allowing for various modes of reuse.	
Recycling and reuse of materials	Reusing parts and cuts of fabric, producing recycled fibres for re-spinning Goal = Repurposing textile waste, creating new raw material and ultimately new textiles.	
Design-based	Introduction of technological innovation, digital feature, innovative fabrics, new ways of production, new ways of conceptualize garments and textile Goal = Increase usage efficiency and reduce resource inputs (pre-market phase).	Herny et al., (2020)
Waste-based	Repurpose unexploited waste through innovative process solutions Goal = minimizing waste production	
Platform-based	Trading or sharing of products, knowledge, infrastructure or services. Goal = B2B, B2C or C2C marketplaces for tackling the excess of resources.	
Service-based	Personal ownership is replaced by the provision of tangible and intangible services Goal: better controllable usage efficiency	Henry et al., (2020) + Ostemann et al., (2022)
Product-based	Waste reuse for new materials by processing and recycling, use of renewable sources and resources Goal = Design with higher fibre performance and durability and less environmental impact.	Ostermann et al., (2022)

Table 5. Definition used for characterizing the legal form of companies in the interviews

Legal Form	Definition
For profit	main goal is to maximize economic values.
Not-for-profit	limited creation of economic value for controlling stakeholders
Non-profit	economic value is entirely retained by the organization for the achievement of its mission

Question Guide

1. Could you describe your company goals in a few words?

2. Based on the definition of Circular Economy – a system that prologues the life (restorative) or gives new birth and purpose to parts of a product (regenerative) with the goal of minimising waste and closing the loop by improving the design and material choice (Korhonen et al., 2018; Morseletto, 2020) - do you consider your company circular and if so, why?

3. Suarez-Visbal et al. (2022) outlined specific R-strategies for the textile and apparel industry. Based on the table below where do you position your company?

Circular strategies for textile and apparel (Suarez-Visbal 2022)	Definition	
Redesign	*Designing apparel with a life- cycle mindset by using DfD (design for disassembly) or DfEoL (design for end of life)*	☐
		☐
Reduce/resource recovery	*Includes on-demand produc- tion and incorporation of circular supplies such as recycled yarn, close loop dyes etc.*	☐
Rental	*A product life extension strategy. Refers to paying a fee for using a garment. It includes luxury, well-known brands, local designer and selected vintage items*	☐
Resale	*A product life extension strategy. It includes second- hand and vintage items sold online or on brick-and-mortar store*	☐
Repair	*A product life extension strategy. It includes onsite in-house, repair tours, third- party repair and DIY kits*	☐
Remanufacture	*Using parts of a discarded product to create a product with same function [64]. Also include the so-called upcycling fashion under- stood as "clothing con- structed by using reclaimed fabrics, which can either be post-industrial or post-consumer waste and were the quality of the remanu- factured fashion clothing is equal or better than brand new fashion clothing"*	☐
		☐
		☐
Recycle	*Includes all the process from the collection of textiles to sort to actual recycle. It can be mechanical or chemical (the latter one still very new and it is linked directly to the resource recovery or cir- cular supplies)*	☐
Recover	*Once final sorting is done, the scrap left over is then used as feedstock for energy recovery*	☐

Table 1a

4. How would you define the circular approach of your company (Table 2), and which legal form does it have (Table 3)? More options and personal answers are possible.

Circular approach	Definition	
Access-based model	Renting, leasing and sharing of garments Goal = Lowering resource utilization and increasing the use rate of the product	☐
Collection and resale	Second-hand retail, collection and resale to the market for reuse and recycling Goal = Extending the useful life of textiles after the first user.	☐
Longevity and durability	Customized production, offer repair and maintenance services and focus on design for repair. Goal = Extending the lifetime of garments, reducing the need of purchasing new ones and allowing for various modes of reuse.	☐

	Reusing parts and cuts of fabric, producing recycled fibres for re-spinning Goal = Repurposing textile waste, creating new raw material and ultimately new textiles.	☐
Recycling and reuse of materials	Reusing parts and cuts of fabric, producing recycled fibres for re-spinning Goal = Repurposing textile waste, creating new raw material and ultimately new textiles.	☐
Design-based	Introduction of technological innovation, digital feature, innovative fabrics, new ways of production, new ways of conceptualize garments and textile Goal = Increase usage efficiency and reduce resource inputs (pre-market phase).	☐
Waste-based	Repurpose unexploited waste through innovative process solutions Goal = minimizing waste production	☐
Platform-based	Trading or sharing of products, knowledge, infrastructure or services. Goal = B2B, B2C or C2C marketplaces for tackling the excess of resources.	☐
Service-based	Personal ownership is replaced by the provision of tangible and intangible services Goal: better controllable usage efficiency	☐
Product-based	Waste reuse for new materials by processing and recycling, use of renewable sources and resources Goal = Design with higher fibre performance and durability and less environmental impact.	☐

Table 2a

Legal Form	Definition	
For profit	main goal is to maximize economic values.	☐
Not-for-profit	limited creation of economic value for controlling stakeholders	☐
Non-profit	economic value is entirely retained by the organization for the achievement of its mission	☐

Table 3a

5. You've been asked to provide data on the steps of your production system to visualize and understand where the main flux of waste is produced.
   What was the process of measuring the required data?

6. To what extent do you think that innovations (both technical or social) are essential for the improvement of your company?
   Technical = technological invention
   Social = adoption of solutions or processes that aim at tackling social concerns.

7. What difficulties or challenges have you found at the initial stage of the creation of your company considering that the firm belongs to a rising circular trend and market?
   Difficulties/challenges = anything that created obstacles for a smooth start of the company. For instance, lack of consumer interest, lack of cooperation in the value chain, high initial investment, limited examples of frontrunners, …
   - If difficulties/challenges were found: how have you adapted your business in order to work around those difficulties?
   - If no difficulties/challenges were found: could you elaborate on why do you think your company was well set from the beginning?

8. Is your business supported by any of these grants/incentives/funds (table 4) or any other grants/incentives/funds not listed below?

PROGRAM	
Entrepreneurship Action Plan	☐
Innovation credit	☐

Dutch Good Growth Fund	☐
SU box (online tool that helps you to identify the suitable Dutch government funding instrument)	☐
network *Social Enterprise NL*	☐
WBSO and **RDA** subsidies	☐
Vamil (Willekeurige Afschrijving Milieu-Investeringen	☐
Milieu Investeringsaftrek	☐
Milieulijst (Environmental List)	☐
Innovatiekrediet (Innovation Credit)	☐
grants the Ministry of Economic Affairs	☐
ITERREG	☐
HORIZON EU	☐
LIFE 2021-2027	☐
EUROSTAR	☐
s4fasion – Sustainability for Fashion Industry	☐
CirCoAX by CircularInnoBooster	☐
Small But Perfect	☐
Fashion for Change	☐

Table 4a. SU= start up; SME = small medium enterprise THE NETHERLANDS

PROGRAM	
Credit Guarantee Fund Trust for Micro and Small Entreprises (CGTMSE)	☐
Modified Special Incentive Package Scheme (M-SIPS)	☐
Startup India Seed Fund	☐
Startup leadership program	☐
Startup India Initiative	☐

Table 4b: SU = startup; SME = Small medium enterprises INDA

9. How easy or difficult has it been for your company to get access to regional or national grants/incentives/funds for circular businesses?

10. According to you, what do you perceive as a barrier for the implementation of circular practices?

11. Can you think of an example of what you consider a successful circular business in the textile sector and what characterize it?

12. Based on your own experience, how difficult is it to build a profitable business for SU with a circular strategy compared to other SU? Why?

Codebook

CODE	STRATEGY USED	DESCRIPTION	EXAMPLE
1.Barriers	Deductive	Obstacles that companies have	"...*money.*

				found in their path that cannot be directly solved by them	*You know, there are some technical advances that you could make, but there's not being enough money to invest it in it"*
		1.1 Regulatory system	Deductive	Barriers caused by the regulatory system	*"…producer responsibility, the law coming out, which basically should, uh, for producers of clothing and textile to make sure that it gets collected the right way and gets recycled. But in practice it's really hard because it affects us as textile collectors and recyclers"*
		1.2 Funds	Deductive	Obstacles caused by issues related to fund's eligibility and accessibility	*"it's just really it's so difficult and it takes so much time up to uh to explore all the fonts and to apply"*
2.Challenges			Deductive	Obstacles that companies might have found in their path that can be directly solved by them	*"formalizing keeping up the quality"*, *"understanding how things work"*, *"working with the informal sector"*
		2.1 Technical	Inductive	Challenges raised by practical internal issues	*"Finding a location in […] that can fit the amount of machines that we need in order to grow"*
		2.2 External	Inductive	Challenges depending on external factors than the company's functioning per se	*"hire the people that we're targeting […] sometimes is not very straightforwards, needs to be via collaboration with the municipality"*
3.Company			Deductive	Description of the company	*"[BUSINESS C], we're, uh, building our platform for upcycled products. So we create, we also export them…"*
		3.1 Goals	Deductive	Company's goals and its eventual evolution from the incipit	*"creating opportunities for employment for people with distance to the labor market"*
		3.2 Company's activity	Deductive	What the companies do	*"we train waste workers and artisans to use technologies*

					we've created", "construction of garments and the reparation of garments"
		3.2.1 R strategies	Deductive	The different circular strategy between the one listed by Suarez et al. (2022) for the textile industry	"reparation", "upcycling", "reuse", "recycling"
		3.2.2 Business Model & Legal form	Deductive	The companies' Business Model approach and the legal form they have (for profit, no-profit, non for profit)	*"Social enterprise, but we have a nonprofit legally […] and a for profit company"*
	3.3 Company perceptions		Inductive	Insights from companies regarding the textile world and perceived barriers	*"consumers are becoming much more self aware of the choices that they do", "there is still no idea about like why circularity is important"*
		3.3.1 Innovation	Deductive	Companies' opinion on role of innovations in the textile industry	*"there's always room for change. There's always room for improvement. There's always room for innovating in this area", "blockchain solution for transparency"*

Table 6. Excel sheet of products flow given to companies

	Name of the product line selected	material composition	name of material	name of Suppliers for product line selected	Location of suppliers for product line selected (country/region)	Amount of purchase (meters, units, kilograms, boxes) PER YEAR	Frequency of purchase (year)	Current stock (meters, units, kilograms, boxes)
Line 1 selected (example):	T-shirts	material 1:	organic cotton			€ 1.25 million, annually 1,00,000 or lesser	Two seasons	Made to order. No stock. Stock kept of only regularly used products
		material 2:						
		material 3:						
		material 4:						
		material 5:						
		add more lines if needed						

Line 2 selected:		material 1						
		material 2						
		material 3						
		material 4						
		material 5						
		add more lines if needed						
Line 3 selected:*		material 1						
		material 2						
		material 3						
		material 4						
		material 5						
		add more lines if needed						

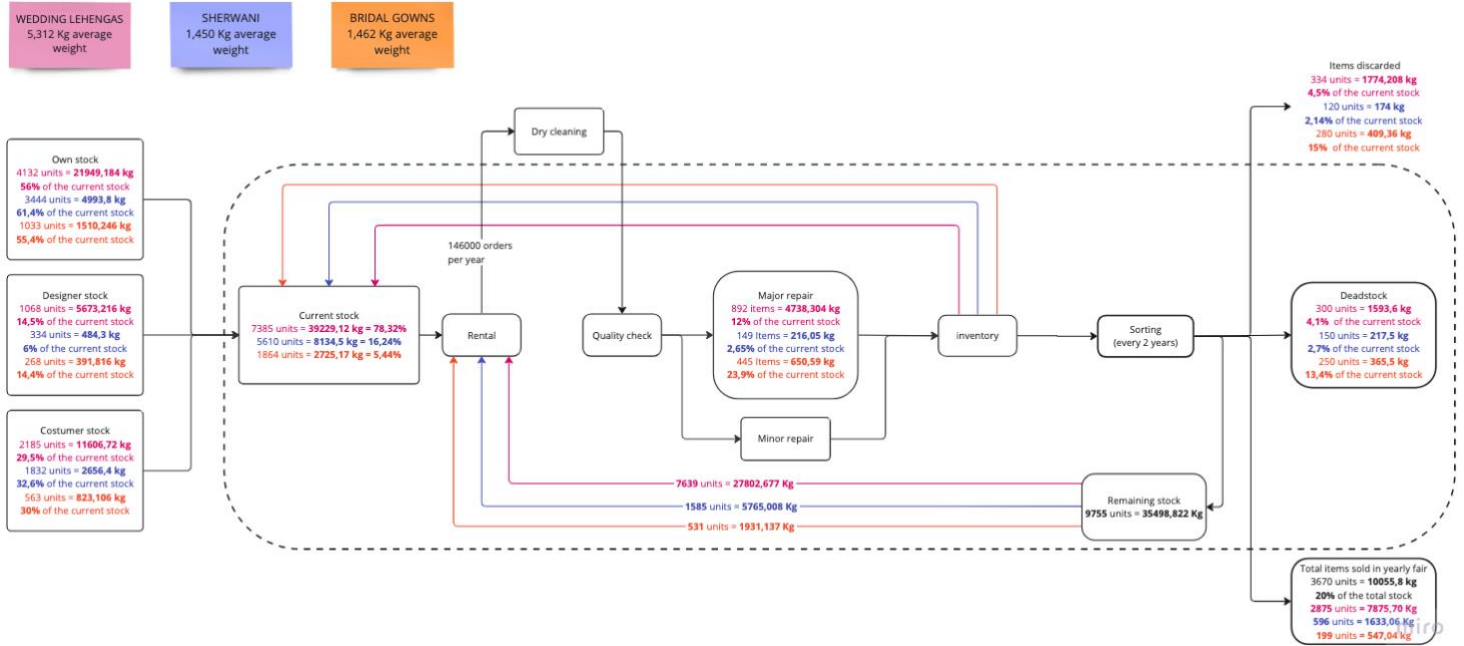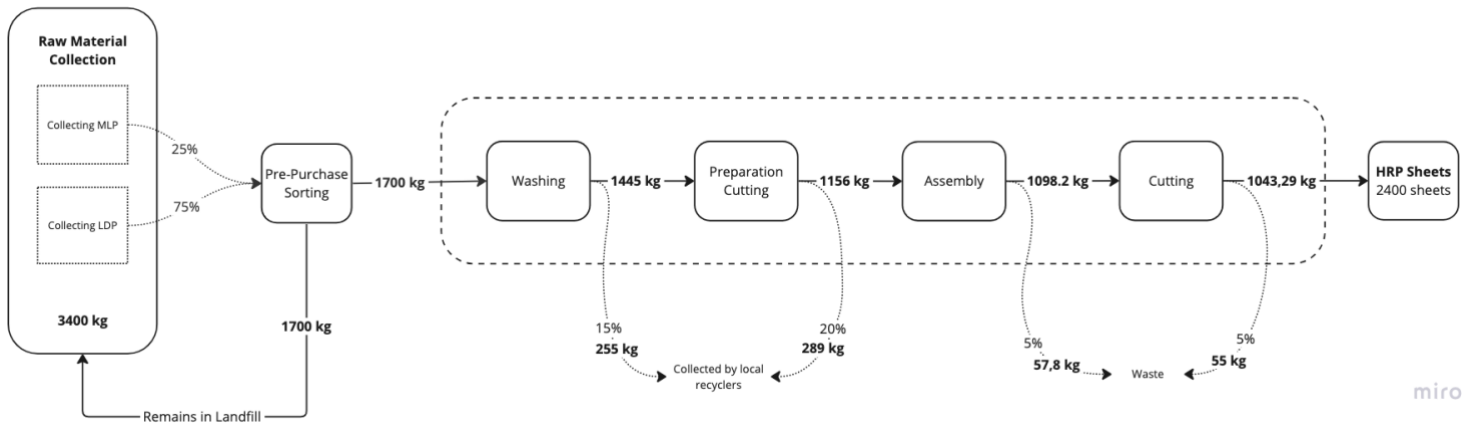# APPENDIX 2

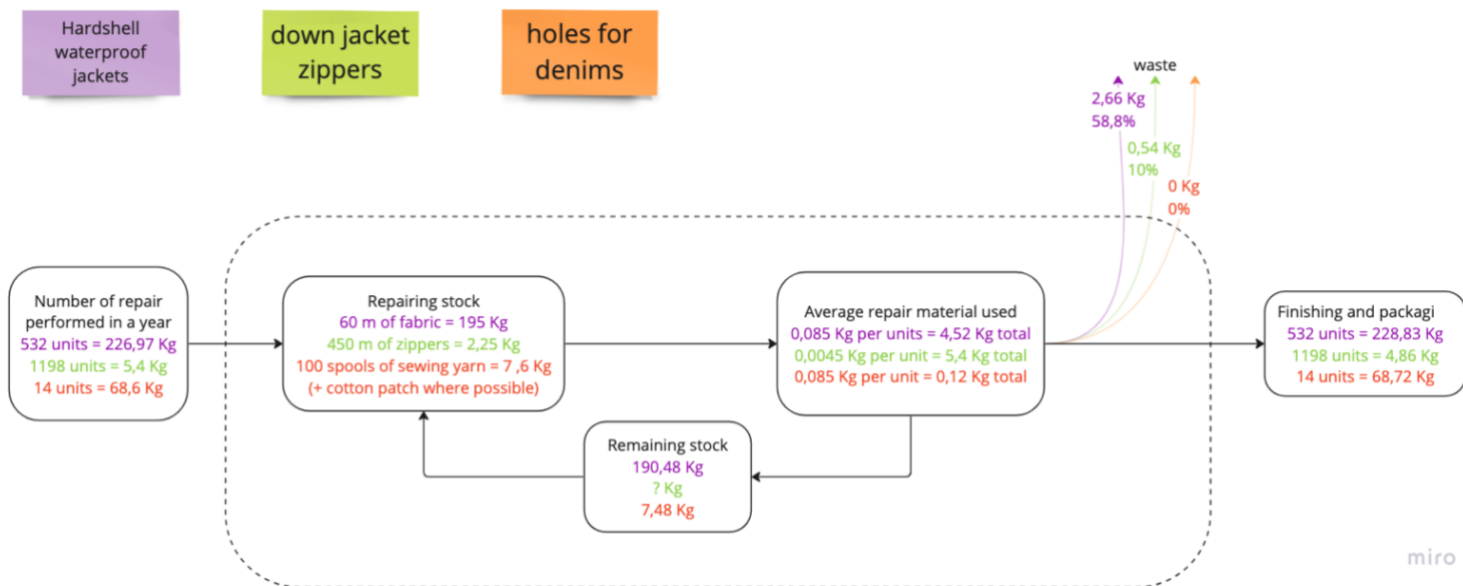Fig 5a. MFA Business A
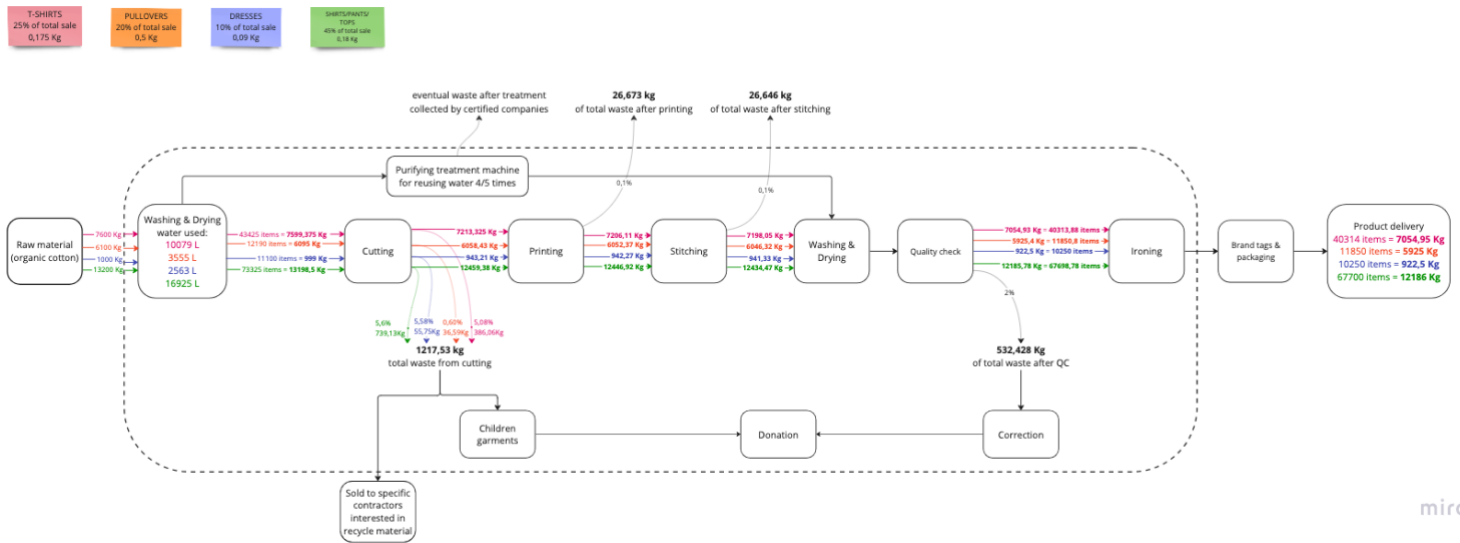
Fig 7a. MFA Business B

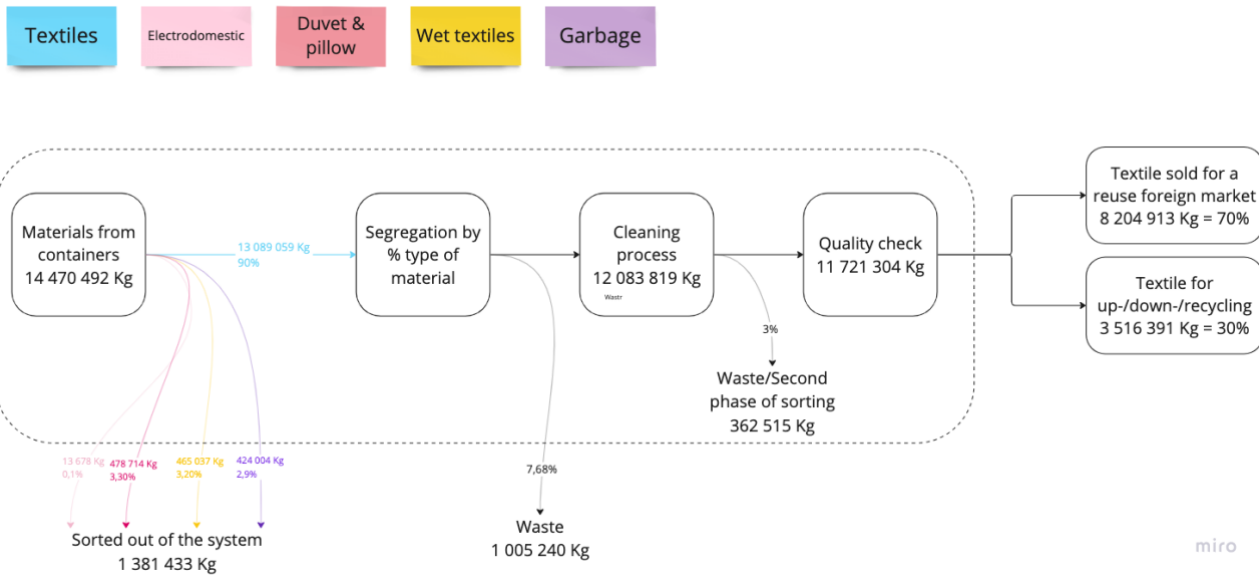Fig 9a. MFA business C

Fig 11a. MFA Business D

Fig 13a. MFA Business E

Legend: Textiles | Electrodomestic | Duvet & pillow | Wet textiles | Garbage

Materials from containers
14 470 492 Kg

13 089 059 Kg / 90% → Segregation by % type of material

13 678 Kg / 0,1% | 478 714 Kg / 3,30% | 465 037 Kg / 3,20% | 424 004 Kg / 2,9%

Sorted out of the system
1 381 433 Kg

Cleaning process
12 083 819 Kg
Waste

7,68%

Waste
1 005 240 Kg

Quality check
11 721 304 Kg

3%

Waste/Second phase of sorting
362 515 Kg

Textile sold for a reuse foreign market
8 204 913 Kg = 70%

Textile for up-/down-/recycling
3 516 391 Kg = 30%

Fig 15a. MFA Business F

Legend: Material collected from containers | Material collected from onation in store | Material collected from donation from brands

Collection from containers — 4121974 Kg → Pre-sorting

Non-clothing items from containers sent to other recyclers
810775 Kg / 19%

Donation

Other second hand stores
9660 Kg

Re-wearable textiles
150406 Kg
3.65%

30000 Kg

135331 Kg

Sorting for stores

75319 Kg → Left in Inventory ← 1862 Kg

Distribution to other Stores (retail clothing to Reshare stores)

39601 Kg | 27562,2 Kg | 117367 Kg

10164 Kg / 3,22%
2437,8 Kg / 0,77%
10702 Kg / 3,39%

Sorting clothes for Reshare Deventer Store — 13077 Kg → Sold clothing

712534 Kg / 17%

Waste (incinirated)

2448259 Kg → Bulk (for foreign market) ← 8222,92 Kg

15662 Kg

7262 Kg / 2,3 %

Waste (incinirated)

141.88 Kg / 0,60%

Waste (inciniriment)