

RE³Tex – a project to enhance circular economies in the textile and clothing industry

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Abstract:

- Purpose - RE³Tex is a project funded by the German Federal Environmental Foundation and realised by the Center Textile Logistics (CTL) in Mönchengladbach, Germany. RE³Tex stands for repair, reuse and recycle and aims at transforming business models in the (outdoor) fashion industry to promote a conscious and sustainable approach to the use of resources in the textile and clothing industry. The project aims at the development of a manual to inform about parameters that influence the potential for a circular textile value chain in garment production and the development of guidelines for a recirculation of outdoor fashion in terms of repair and recycling including a business model and logistics concept.
- Methodology - The project comprises a collection of data about currently offered repair and recycling services of outdoor garments by retailers.
- Findings – Current challenges for manufacturers and retailers exist in the collection of the required minimum quantities of used textiles of their own brands which are necessary for good recycling strategies. The development of own take-back systems for used textiles offers the advantages of material knowledge, however the business model must be profitable and accepted by customers.
- Originality - A specific feature of RE³Tex is the transfer of theoretical concepts into practice by the help of partners from the industry.
- Research limitations/Implications - The focus of the project is laid on the outdoor fashion industry and exemplifies the findings in this use case. However, the findings about circularity potential in this project could be transferred to other segments such as technical textiles or home textiles.
- Practical implications - In order to promote circularity in the clothing industry, the various participants along the textile chain must cooperate, e.g. in form of sharing information about the material composition of their manufactured clothes.

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Keywords: circularity, recycling, repair, sustainability, outdoor fashion

1.0 Research Gap addressed:

Today problems arise when clothing items show signs of damage in the course of use that cannot be repaired or can only be repaired to a very limited extent due to the manufacturing method. Hence the recyclability is limited. The textile and clothing industry is one of the biggest polluters, e.g. accounting for around 10 % of the world's pollution, ways and means to reduce resource consumption must be taken (Niinimäki et al., 2020). By the implication of brands' own take-back systems, the realisation of repair and refurbishment work can be implemented, which will reduce the environmental influences of the textile and clothing industry. Many recycling strategies are still in a phase of research and development and therefore cannot be implemented on a large-scale yet. Especially for chemical recycling processes, the knowledge of the exact fibre composition is essential. The resulting need for exact material identification methods and take-back systems of "own" material of clothing manufacturers and retailers led to the project idea of RE³Tex.

2.0 Key Findings:

The data collection has shown so far:

- The main obstacles for clothing manufacturers and retailers exist in collecting the required quantities and qualities that recycling companies demand to create new recycled fibre material on a profitable basis.
- Customers must be involved by education and information supply, most likely this will not be enough to change the industry.
- Recycling can be simplified through brand's own take-back systems, since knowledge of the exact material composition is available.
- The recyclability of textile products can be increased by unmixed fibre material and reducing the number of ingredients and finishes.
- New digital methods of traceability (e.g. QR-codes or NFC-technologies) may help to improve the information supply among the involved parties of the textile chain about material composition and quality and therefore offer valuable hints for further repair and recycling processes.
- Reparability and recyclability must already be taken into account during the design and product development phase, so that textile products can be repaired and recycled with as little effort as possible.

3.0 Method /Experiments

In order to get a fundamental overview about the status quo of textile recycling and circular economy in the clothing industry, an intensive data collection is conducted in the beginning. It comprises a document analysis (literature research) about existing repair services and possibilities, recycling methods and take-back options for used textiles. The state of the art of the industry serves as foundation for the following expert interviews. Multiple specialists of different categories (clothing manufacturers and retailers, textile recyclers and data service providers, associations of the textile and clothing industry) are interrogated by the help of guided interviews. Furthermore, end consumers are involved by an online survey. Finally, a digital workshop took place, where all different stakeholders are invited. The workshop provided a platform for discussion and understanding the various perspectives. The results of the data collection serve for the development of a digital handbook about textile reprocessing and recovery to help as many interested stakeholders as possible of the industry to learn about circularity in the textile and clothing industry. It will include multimedia content for example in the form of images and videos for explanation.

4.0 Results & Discussion

The methodological development of the digital handbook is based on the workshop conducted, the interviews with stakeholders and the survey. RE³Tex also includes on-site visits by the CTL team to industry partners in order to learn from their practical experience. All impressions are to be recorded in terms of the development of a business model and logistics concept for a take-back system of used textiles in order to promote an enhanced product lifecycle and circular approaches in the industry. The concepts will be manually transferred into practice by the project partners and then critically reflected upon. The results will serve as the basis for the subsequent development of a publicly available guidelines for the return of textiles and clothing for repair, reuse and recycling purposes. It will contain information about parameters that influence the repair and recycle capability of used garments.

In the context of a circular economy and the associated objective of conserving resources, this project focuses on two measures: On the one hand, to extend the use phase of the textiles already on the market and, on the other hand, to imply high-quality recycling at the end of their

use phase. The extended use phase is achieved by expanding repair and processing options as a service for consumers. As a longer product lifecycle (through reuse and repair) might lead to less consumption of new clothes, which does not seem profitable for the industry at first sight. So, a reconstruction of the added value is necessary to be able to cope with the changed framework conditions. To realise a high-quality textile recycling to close the loop, more transparency about material mixtures, ingredients and finishing is necessary. Further on, recycling technologies must also be further developed. So far, most of the recycling takes place in the shredding department. It must be taken into account that the tearing process has a negative impact on the fibre length and thus makes high-quality processing of yarn re-spinning difficult. Especially for the chemical recycling processes, most of which are currently still in development, knowledge of the exact composition of the material is necessary. This may be realised by the help of digital solutions (QR-codes or NFC-tags). Many clothes that undergo recycling procedures consist of mixed fibre materials, whereas the recycling of pure (unmixed) fibre material would be more advantageous for the production of new clothes. In order to close the textile cycle, as part of the extended circular economy (reuse, repair, recycle), further innovations for recycling, consumer education to change the behaviour and changes in production are required. Further legal regulations might eventually be necessary to promote fibre-to-fibre recycling by setting minimum requirements of shares of recycled fibres used in the production of new clothes.

5.0 Theoretical Background

The processes of the textile and clothing industry cause various environmental influences along the textile chain. These include, for example, high water consumption, the use of a wide range of chemicals, water pollution or greenhouse gas emissions. While clothing production has approximately doubled from 2000 to 2015, the clothing utilisation has fallen by around 36 % worldwide (Ellen MacArthur Foundation, 2017). Manufacturing processes have been developed in recent years and decades, among other things, to the effect that they were supposed to become simpler, cheaper and more functional. Also, fashionable and aesthetic aspects of fast-paced fashion consumption were included in the development. The value chain of the textile and clothing industry is often very globalised and decentralised. Process stages and the materials are adapted to diverse end products so that there are diverse value chains. A basic distinction is made between natural fibres and synthetic fibres (Muthu, 2014). The circular economy is understood as a model of production and consumption of resources. It describes a material cycle of resources drawn from nature, which are used as long as possible (Oehlmann, 2017). The circular economy model addresses the waste of resources and pollution and supports action to prevent climate change (Lehmacher, 2016). A major challenge of a circular supply chain is the transformation of the economy in order to relieve its negative impact on the environment or ecosystems, so that its regeneration is made possible (Blood-Rojas, 2017). Within the circular economy, the longest possible useful life of any product group is sought. With the help of textile recyclers, the lifespan of textile waste is extended in the form of reuse, a further processing or material recycling. The current supply chain of the clothing industry, with its linear orientation, causes large quantities of used textiles. Consumed water, chemicals and pesticides negatively impact the environment. With the introduction of a circular textile economy, resources can be saved, and the consumption of chemicals, pesticides and other resources may be reduced. The aim is to start the textile chain from the beginning by recycling used textiles in order to close the loop (Ellen MacArthur Foundation, 2017). With the Waste Framework Directive of the EU, a separate used textile collection will be required from 2025 (Directive (EU) 2018/851, 2018). According to the aim of the directive the careful use of resources as well as the protection of the environment and society are addressed, including the efficient use of resources for a circular economy.

Author Contribution: I.B. and N.B. developed the project idea and applied for the funding at the German Federal Environmental Foundation with an official project proposal. They acquired and convinced all project partners and supporting associations to participate in the project. I.B. and N.B. both examine all work packages, including the data collection, the development of the digital handbook and manual with all

concepts, they accompany the practical implementation from research perspective and develop the final digital handbook. I.B. coordinates the project work. M.M. acts as supervisor.

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Conflict of Interest: n/a

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