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Municipal solid waste management in the interface between commercial and non-commercial repair: Lessons from Denmark and Sweden

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ABSTRACT

Repair initiatives are experiencing a revival, increasingly attracting attention as a potential player for addressing circular sustainability challenges. A wide range of actors conducts repair on a commercial and non-commercial basis. However, the discussion regarding product circularity is often framed from a production and business model perspective. Less evident is scientific analysis concerning the growing number of actors engaged in repairing objects in the interface between commercial and non-commercial repair, including how municipal solid waste management companies engage in repair as part of waste prevention or preparing for reuse (PfR). This article investigates and gathers knowledge about the practice and collaborative dynamics of repair related to the waste sector, specifically focusing on the role of waste management companies. In the EU Waste Framework Directive, repair is stated as a strategy to prevent waste and as a strategy to prolong the life of products and their components, after they have become waste (Directive EU 2018/98/EC on waste, §9 & §11). However, the Directive is open to interpretation, leaving room for the individual waste management company to assess which items handed in or collected as waste may be repaired. In this paper, different priorities and practices among waste management companies are considered and taken as a new point of departure. Three waste management companies in Denmark and Sweden form the cases in this paper. Two conceptual models are developed to qualitatively analyze their different practices and strategies – the Doorstep Waste model and the Collaborative Dynamics model. Fourteen open-ended and semi-structured interviews, follow-up questions, and meetings during the available timeframe for this research (2018–2021) were initiated. Results revealed different approaches to repair. First, repair schemes focus on product repair at different stages from prevention to the stage, where waste can potentially return to product life. Second, initiatives take on different approaches to commercial and non-commercial strategies. Third, scopes vary from 'short-term solutions' prolonging the lifetime of consumer products to long-term waste prevention strategies. From a collaborative and networking perspective, a persistent character in the three cases is the waste management companies' ability to create formal and informal collaboration with other stakeholders, including citizens, NGOs and the private sector. As a result, relational links created feedback loops and new communication channels, expanding reuse and repair activities, and creating a broader social value. However, the expanding role of municipal waste managenemt comapanies also reveals a dilemma since their activities border commercial repair and thus may lead to unfair competition on the market for repaired or reused products.

1. Introduction

Repair is a suggested critical step in circular economy strategies to extend the life of products and their components, as repair holds the potential to address various sustainability challenges (Hielscher and Jaeger-Erben, 2021). For example, a decline in repair contributes to shorter product replacement cycles (Bakker et al., 2014), and repairing a product requires less energy and material than remanufacturing or new production (Cooper and Gutowski, 2017). Further, repair is suggested as a 'key sector' regarding 'benefit from employment' through transitions to the circular economy (CE) (Rogers et al., 2021). Together, this makes repair of broken and faulty products that would otherwise end up as waste an essential element in the strategies of the circular economy model (Russell et al., 2018). From a waste management perspective, for reuse to be possible, it is required that the submitted waste products are processed and prepared for reuse. 'Preparing for reuse'

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aims at prolonging the product life of end-of-life products (Directive EU 2018/98/EC on waste, Art.11). This may, for example, involve checking, repairing, or cleaning (Milios and Dalhammar, 2020). Waste management in the European Union (EU) is defined in the Waste Framework (2008/98/EC), as amended by Directive (EU) 2018/851, which outlines the rules and conditions by which all waste management operations and planning is taking place in the EU Member States. The EU Waste Hierarchy is the central principle of EU waste management, expressed in Article 4 of the Waste Framework Directive. It addresses prioritizing waste management options according to environmental and resource efficiency aspects (Milios and Dalhammar, 2020). More explicitly, waste management operations with negative environmental impacts are considered undesirable and should be substituted by waste management operations that are considered more resource-efficient and environmentally sound (European Commission, 2008). The waste hierarchy includes the following waste management operations: (a) waste prevention; (b) preparing for reuse; (c) material recycling; (d) energy recovery from waste; and (e) landfills. Once products have become waste, preparing for reuse is considered the first option. Thus, repairing products spans a business strategy, an employment strategy, a waste prevention strategy, and a strategy to prolong product life after they become waste.

1.1. The state of repair

These years, repair has experienced a revival (Terzioglu, 2021), particularly in industrialized countries. Explanations include the global economic crisis together with increased environmental awareness (Ghisellini and Ulgiati, 2020). A slight increase is registered in the number of repair enterprises in the EU, in the wake of a period when the United States and Europe have experienced a decline in repair enterprises (Lechner et al., 2021). In addition, different institutional initiatives have recently emerged in frontrunner France to encourage circular and cooperative economies. For example, a new law (Law n◦ 2020–105 of 10 February 2020) encouraging repair and reparability, stating more straightforward access to spare parts, and introducing a product reparability index to make reparability a criterion of consumer choice. Efforts in the EU are a process where new initiatives, including rules promoting repair, are continuously coming.

Further, community repair movements have expanded just over the last decade (van der Velden, 2021), including a growing number of grassroot movements (Dewberry et al., 2016) and repair initiatives such as Repair Cafes (Graziano and Trogal, 2017; Keiller, 2014; Moalem and Mosgaard, 2021). Expectations are that grassroot innovations can motivate citizens to become more sustainable consumers and be active in the repair process (Gobert et al., 2021). Despite a diversity of reuse and repair solutions, repair initiatives generally fail to attract a broader range of citizens (Gobert et al., 2021). According to Gobert et al. (2021), one explanation is that there needs to be more alignment between stakeholders and possible users, as the type of citizen commitment assumed by the stakeholders occurs only at marginal levels. Another explanation is that consumers' habits and tendencies are counterproductive to repair and reuse deployment.

1.2. Defining repair

Repair is a way to restore functions to enable the reuse of second-hand objects or objects whose life has been extended without a change of owner (Gobert et al., 2021). Repair activities are performed at the product level, enabling the continuance of the product's life where only the worn and damaged parts need to enter the waste stream, rather than discarding the entire product (Russell et al., 2018). *Repair* is defined as "returning a faulty or broken product or component to a useable state" in British Standard BS8887–2–2009 (BSI, 2009).

From a domestic consumer perspective, repair does not hold a clear definition. For example, Gregson et al. (2009:248) identify a range of 'restorative acts' related to domestic repair, ranging from quick-fix repair to the more thorough-going restoration (Gregson et al., 2009). Furthermore, (Terzioglu, 2021) categorizes repair depending on the skill level of the person carrying out the repair.

From a waste management perspective, repair does not have a separate definition in the EU waste directive. Instead, repair is embedded in the term 'preparing for reuse,' which includes 'checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be reused without any other pre-processing' (EU 2018/851 §3).

However, observing the holders of repairing initiatives and the inhabitant's commitment to repair, Gobert et al. (2021) found that each type of stakeholder had his representation of the same object and, above all, his way of considering if it is worth repairing.

Thus, although the British Standard provides a formal definition of repair, different conceptual understandings and approaches exist. These span from quick fix acts to repair-type activities requiring advanced skills and knowledge.

1.3. Repair in the waste sector

Product repair, refurbishment, and remanufacturing are all considered reuse operations (Ijomah and Danis, 2012). They are often environmentally preferable to material recycling and manufacturing of new products as they save material resources and energy and reduce greenhouse gas emissions (Sundin and Lee, 2012). For reuse to be possible, in some cases, it is required that the submitted waste is in some way processed or prepared for reuse. This may, for example, involve checking, repairing, or cleaning (Milios and Dalhammar, 2020). From a waste management perspective, the volume of waste submitted to recycling centers is steadily increasing, and so are the possibilities for the preparing for reuse of various products (Avfall, 2018; Milios and Dalhammar, 2020).

However, the waste streams entering waste companies' recycling centers can be heterogeneous and vary depending on the season. Thus, even the commercial value of the waste may vary, hence also the interest from external actors (Milios and Dalhammar, 2020). In addition, the types of products received also affect the value of the waste. For example, products with a high commercial value will probably not be left at a recycling center (although this is sometimes the case) (Milios and Dalhammar, 2020). According to Hultén et al., 2018a, residual value can be harnessed *if* the recycling center is connected to repair services. However, products with a low purchase price received at recycling centers reflect a low value in the secondary market. So, repairing and selling these products is not economically attractive (Milios and Dalhammar, 2020).

Repair is included in the European Waste Framework that sets the basic concepts and definitions related to *waste* management (EU, 2008; EU, 2018). In the directive, repair is stated as a strategy to prevent waste[1] and as a strategy to prolong the life of waste products and their components.[2] According to the directive, the EU Member States shall take measures to *prevent* waste generation and, at a minimum: "encourage the reuse of products and the setting up of systems promoting repair" (Article 9). Further, "Member States shall take measures to promote preparing for reuse activities, notably by encouraging the establishment of and support for preparing for reuse and repair networks"

[1] 'Prevention' means measures taken before a substance, material, or product has become waste that reduce: (a) the quantity of waste, including through the reuse of products or the extension of the life span of products; (b) the adverse impacts of the generated waste on the environment and human health; or (c) the content of harmful substances in materials and products.

[2] 'Preparing for reuse' means checking, cleaning, or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be reused without any other pre-processing.

(Article 11). Moreover, EU Member States are obliged to increase preparing for reuse and the recycling of municipal waste to a minimum of 65% by weight by 2035. The amendments indicate a transition from traditional waste management by giving more attention to repair and the circular economy. Thereby, municipal waste management companies may come to play a critical role concerning future repair.

1.4. Actors conducting repair

A range of different actors conduct repair. On a non-commercial basis, actors conduct repair informally (Russell et al., 2018) by the customer (home repair) or organized through civic organizations such as Repair Cafés (Bracquene et al., 2019). On a commercial basis, actors are professional repairers conducting repair as an established part of the global economy (EMF, 2016), ranging from independent repairers at the consumer level and industrial repairers to manufacturers, retailers, and after-sales service (Bracquene et al., 2019). According to (Laitala et al., 2021), the repair industry is complex and includes large companies where repair is a small part of their business and small one-person businesses where repairs can be, but are not always, an essential part of the business. From a waste management perspective, municipalities are responsible for collecting household waste and for establishing recycling centers where citizens can leave waste not collected from households. Municipal waste management companies are also obliged to prepare the waste for reuse, including repair, before any other waste treatment. An important parameter when designing a recycling center is the embedded legal framework concerning waste management and associated re-use activities (Milios and Dalhammar, 2020). The European Waste Framework Directive states:

> Member states shall facilitate proper implementation of the waste hierarchy, including taking appropriate measures to encourage the use of products and components of products that are suitable for multiple use, that are technically durable and easily reparable and that are, after having become waste, suitable for preparing for reuse, without compromising the free movement of goods in the internal market. (EU 2018/851, §20).

From a legal perspective, however, where to draw the line concerning the internal market is interpreted differently among actors (reuse, repair, refurbishment) (Moalem et al., 2023). Moreover, the public and private sector boundaries have become more fluid over the years, according to the Danish Ministry of Finance (FM, 2017). Finally, studies in the social sciences field suggest that people's consumption processes link closely to product circularity (Brand, 2010; Gobert et al., 2021; Rosner and Ames, 2014; Selvefors et al., 2019) and those citizens, therefore, should be more closely integrated into the process of waste management, including repair (Gobert et al., 2021; Selvefors et al., 2019). On this basis, waste management companies entering, or intensifying, repair-related activities tap into an organizational system where existing actors hold different purposes and goals for repair. Therefore, waste management companies may face a dilemma on how to best fit into the repair agenda without causing negative impacts on existing repairers.

In this contribution, we investigate different priorities and practices among waste management companies for prolonging the life of products and the waste management option "preparing for reuse." Questions include how the repair practice unfolds, how waste management companies collaborate with other actors, and what comes out of it from a sustainability perspective. For this study, we qualitatively analyzed repair in the Danish and Swedish waste sectors and the different strategies that municipal waste management companies develop.

The paper builds on previous studies that have identified the potential for increasing preparing for reuse of municipal waste, suggesting waste management companies are critical to realize higher reuse rates (Zacho et al., 2018; Messmann et al., 2019; Milios and Dalhammar, 2020). Adding to these studies, we investigate how to realize the potential in practice. Moreover, social science studies suggest a user perspective when exploring new opportunities for prolonging the useful life of products, including integrating citizens more closely into waste management (Gobert et al., 2021). However, this integrative arrangement is limited in literature and practice; at least, that is the case at the product level (Moalem, 2022). Thus, more attention is needed to generate a deeper understanding of how and with whom waste management companies establish collaboration. On this basis, we examine how three municipal waste companies' approach repair, prepare for reuse, and develop local solutions that aim at prolonging the life of products.

The paper is outlined as follows: Section 2 presents the methodology and the conceptual framework on which the analysis is based. Next, Section 3 presents the case companies and their approaches to repair. Section 4 discusses the results concerning the concrete experiences and the existing literature. Finally, section 5 presents the conclusion, limitations, and suggestions for further research.

2. Methods and materials

The content presented and discussed in this paper results from an explorative and iterative process that has included theoretical considerations and practical experiences over several years. The research in this paper is part of the project 'Fremtidens Intelligente Energi-og Ressourcesystemer' (FUTURE), a three and a half-year project (spanning Feb. 2018 to Aug. 2021). Behind the initiative are Region Skåne, Sweden, the Capital Region, and Region Zealand, Denmark. The goal was to experiment with and develop solutions that can be transformed into new practices in future resource systems. More specifically, waste management companies investigated new practices related to prolonging the life of products with stakeholders. This also included testing the legal framework conditions for municipal waste management practices related to the upper levels of the waste hierarchy, preparing waste for reuse.

For this paper, a qualitative analysis of the organizational dynamics of 'repair' was conducted in three selected waste management companies: Lund Renhållningsverk (LRV), Sweden, Affald Plus (A+) and Vendsyssel Affaldsselskab (AVV)[3], Denmark. Case studies were performed to gather information on the different types of repair practices that occur in the waste sector, and to assess how these activities relate to other sectors conducting repair. Case studies are especially useful when there is a need to perform in-depth analysis of a complex phenomenon in its real-life context and to address 'how' and 'why' type questions (Yin, 2003).

In-depth qualitative interviews were conducted with field practitioners to understand perceptions, attitudes, motivations, and experiences (Yin, 2003) with ways to extend product lifetimes and close resource loops at different stages concerning a generic product lifecycle from sourcing to end of life (Selvefors et al., 2019). Semi-structured interviews were considered the most appropriate way to conduct this research, as they allowed for exploring new issues during the interviews. Therefore, an interview guide was developed and used to structure the interviews. See Appendix A: Table 1. Key practitioners were engaged from the start, and more contacts were added through the 'snowballing' method in which practitioners proposed other practitioners. Fourteen open-ended and semi-structured interviews, follow-up questions, and on-site field investigations were initiated during the available timeframe for this research (2018–2021). See Table 2 and Table 3 an overview (Appendix A). Secondary data consisted of internal company reports and knowledge obtained from attending webinars and waste conferences on the topic (preparing for reuse and repair) in Denmark and Sweden and from systematic literature review resulting in an overview of state-of-the-art literature on 'Preparing for reuse' (PfR) (Moalem, 2022).

[3] In 2022, AVV merged with another municipal waste management company and changed its name to 'Nordvaerk'.

By examining the existing and common representation of PfR through interviews and secondary data, it became apparent that waste management companies interpreted the term differently: from an operation of pure waste management to an act of waste prevention - or a mix. Thus, PfR seems socially constructed in practice. Moreover, citizens are keys in a circular transition as *'users decide when and how to obtain, use, not use, and rid themselves of products'* (Selvefors et al., 2019., p.1015). Further, whether products designed for long life are used for longer or more frequently depends on the people using them (Selvefors et al., 2019). This suggested a need for a new representation, including a more profound understanding of the practicalities of PfR, including linkages to social practices and sustainable consumption. Therefore, on-site field investigations complemented the interviews to better understand the daily practices of waste management companies' handling of product waste and the user representation in those flows, such as social practices and sustainable consumption related to the repair. See Table 3 (Appendix A). Together, this resulted in a conceptual framework model of 'Door-step-waste' considering how municipal waste management companies' various repair practices seem constructed in a gray area between products and waste (refined into Fig. 1 in this paper) and presented in the following (2.1).

Finally, preliminary project investigations (FUTURE) found that the participating municipal waste management companies interpreted and prioritized repair efforts differently, leading to different approaches to networking and collaborating with various actors. Previous research has dealt with the diversity of initiatives and organizations promoting reuse (Gobert et al., 2021) and points to repair as a process that links "a wide range of organizations and individuals: professional repairers and volunteer repairs, third sector organizations, retailers and manufactures" (p.317), but without addressing waste management companies and understanding stakeholder collaboration and networking. Therefore we developed 'Collaborative dynamics model,' considering collaborative aspects of municipal waste management companies' various repair practices, to address this gap (refined into Fig. 2 in this paper) and presented in the following (2.2).

2.1. Conceptual framework of 'Door-step waste'

As a framework for describing and analyzing the municipal waste management companies' various practices around repair, we introduce the concept of *Doorstep Waste* as a designation for objects in the gray area between products and waste. Doorstep Waste are objects that consumers or private entities consider disposing of or have disposed of as waste at reuse stations, which municipal waste management companies must then assess according to whether items can be prepared for reuse or will end up as waste for material recycling, incineration, or other. Simple Doorstep waste are functioning products that only need a quick shining up to be saleable. Demanding Doorstep waste must be repaired to regain functionality. 'Pre-Doorstep' includes initiatives where objects are not (yet) defined as waste but are on the fringe to be considered so by the holder. See Fig. 1.

The management of Doorstep waste is not without challenges due to economic and market aspects (Milios and Dalhammar, 2020; Moalem and Kerndrup, 2023; Moalem et al., 2023). For example, an important aspect to consider in municipal sales of goods prepared for reuse is that a municipality must not conduct, for instance, sales activity that can distort or impede private competition, stated in the Competition Act (*LBK* nr 869 af 08/07/2015). Moreover, municipalities must consider that all operations must have a public interest purpose. Municipal waste management companies do not have special resources for repairs and repairs therefore take place within the existing financial framework. However, municipal waste management companies can employ people in job training who are paid by the municipality through unemployment benefits and obtain extra income through the sale of reused products in municipal-owned second-hand shops or sales to other actors for further resale. By operating second-hand stores, a municipal waste management company becomes a player in the market, affecting the competitive situation for reusable goods.

On the prevention side (pre-doorstep), citizens have several options to shift to circular consumption patterns prolonging the life of products (Gobert et al., 2021; Selvefors et al., 2019). If the decision is to keep the product, the user can continue to use it, care for it, and do self-repair. In contrast, if the decision is to dispose of the product, a different path can be considered, e.g., donating, or second-hand selling (Selvefors et al., 2019). On the other hand, despite a diversity of existing solutions, repair and reuse activities still need to be improved due to social, institutional, and technical lock-ins (Gobert et al., 2021). Often, options are considered impractical and challenging, as they require more time, effort, and planning than disposing of them as waste or storing the products away (Selvefors et al., 2019). The latter can lead to prolonged storage, which indicates a fine line between utilizing and managing products (waste prevention) and disposal (product becomes waste). On this basis, preliminary analysis in this paper points to three archetypal waste management company to repair: focus on pre-Doorstep, simple Doorstep waste, or demanding Doorstep waste. The approaches are discussed in Section 3 through our three cases.

2.2. The 'collaborative dynamics' conceptual model in the repair sector

As a framework for analyzing collaborative aspects of the repair cases, we constructed a 'collaborative dynamics' model to conceptualize collaborative or network dynamics between stakeholders. In addition, the model serves as a tool to assess and visualize the collaborative dynamics between the actors related to the repair. The aim is to contribute to existing literature concerning an increased understanding of stakeholder collaboration and networking, from a waste management perspective, at the product level. E.g., adding to the existing literature on user perspective on product circularity as a range of exchange agent enablers are needed for this process to happen (Selvefors et al., 2019), discussions concerning misalignment between stakeholders and possible users (Gobert et al., 2021) and finally contributing to the existing research on PfR (Bovea et al., 2018; Coughlan and Fitzpatrick, 2020; Dalhammar et al., 2021; Gusmerotti et al., 2018; McMahon et al., 2019; Messmann et al., 2019; Milios & Dalhammar, 2020; Pini et al., 2019; Rizzi et al., 2020; Zacho et al., 2018).

A particular focus is on municipal waste management companies conducting repair and their relation to other actors conducting repair, i.e., the private sector performing professional repair or integrative arrangements with simple repair facilitated by Repair Cafés and executed by citizens. The collaborative dynamics model is depicted in (Fig. 2).

Fig. 1. Doorstep waste: a designation for objects in the gray area between products and waste.

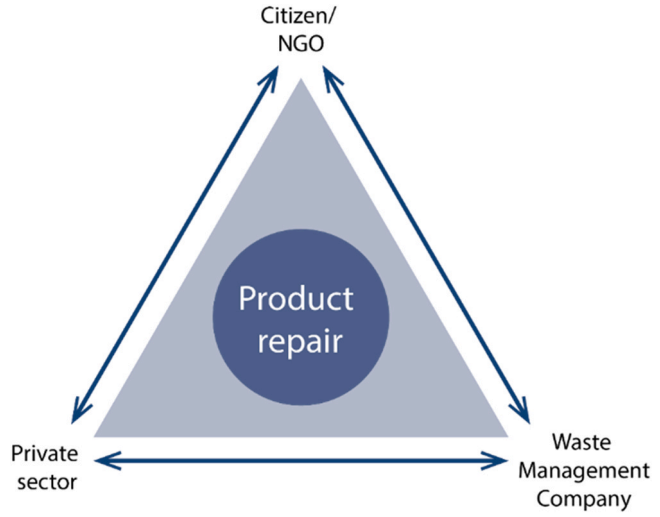

Fig. 2. Conceptual 'Collaborative dynamics' model illustrating the collaborative dynamics between actors in the repair arena.

3. Results

This section presents the results from interviews, observations, and document studies on repair activities conducted by municipal waste management companies in the interface between commercial and non-commercial repair. First, there is a brief introduction to the case companies Lund Renhållningsverk, A+, and AVV, followed by a presentation of the archetypal approaches they represent (focusing on pre-doorstep, simple doorstep waste, or demanding doorstep waste). The second part of the result section presents the collaborative dynamics identified in the cases.

3.1. Case introduction

The case company Lund Renhållningsverk (LRV), Sweden, is responsible on behalf of the City Council for waste management in Lund Municipality. Waste prevention is a high-priority issue for the company which is reflected in the various experiments initiated by the company on this matter. For this research, two experiments were singled out. The first relates to a practical experiment with the establishment of a municipal repair shop in the outskirts of Lund. The second case relates to an experiment with the building of a mobile repair bike. Both experiments relate to the project FixaTill, a time-limited repair shop initiated by The Lund Waste Management Agency in Sweden and funded by the Interreg project FUTURE (2018–2021).

The second case company, Affald Plus (A+) is a joint municipal waste management company in Denmark. A+ is responsible for waste management in its six-owner municipalities from where the company operates twenty reuse stations. Preparing waste for reuse is of high priority for A+. As an example, A+ holds the ownership of four reuse shops from where they sell items prepared for reuse. For this research, the case of the reuse shop PlusByg is singled out. PlusByg is a reuse shop from which a range of end-of-life products, i.e. reused building and garden products, white goods, and bikes are sold. Products originate from bulky waste, donations, or are saved out of the containers from the twenty reuse stations run by the company. PlusByg was an activity in the project 'Mærk Næstved – Sustainable Green Urban Development,' which received support from the EU Regional Fund.

Our third case company is the waste management company Vendsyssel Affaldsselskab (AVV). AVV is a joint municipal waste management company in the northern part of Denmark, responsible for waste management in its two-owner municipalities from where the company operates eighteen reuse stations. Preparing for reuse (i.e. reuse and repair) is a high priority for the company. This is reflected in the various experiments and projects initiated by the company on this matter. For this research, one initiative is singled out – a practical experiment with collecting, testing, repairing, and selling white goods collected at the reuse stations and in the bulky waste. The project was funded by the Nordic Council of Ministers (2018).

3.2. Repair practices developed by the case companies

3.2.1. The case of LRV: making repair facilities available for the public – Pre-doorstep approach

The case of Lund is an example of a Pre-Doorstep approach where repairing aims at waste prevention. LRV has made repair facilities available and established a space to repair products, open to the public. The overall aim was to make repair facilities available for self-repair, and to spread knowledge about reuse, repair, and sustainable consumption, as part of the transition towards a circular economy in the waste sector.

Apart from the physical repair space, a bike named 'UpCykla – a rolling repair shop' was created using a box bike to be driven out to different places around Lund municipality. The bike contains fold-out workplaces and has various tools such as a sewing machine, measuring tape, hammer, saw, staple gun – almost everything to get started on simple repairs. See Fig. 3.

Employees from the waste management company have toured around Lund to show the box bike and how it works. The aim was, in the first place, to inspire and spread the repair concept to other sectors and stakeholders, including citizens, private actors, and NGOs. The initiative may enable other organizations to focus on repair – and thus help minimize the number of products crossing the doorstep to a waste management company-driven recycling station and becoming waste.

3.2.2. The case of A+: simple repair and high-volume strategy – simple doorstep waste approach

In the PlusByg example of the case company A+, repair is the point of departure in preparing for reuse. PlusByg functions as a reuse shop, storage, and holds a repair space. The purpose of PlusByg is to extend the life of products and materials – to give them new life in, for instance, a new construction project. Items sold in the shop include a broad range of discarded items such as doors, windows, white goods, bikes, furniture, and garden equipment. Items come from their reuse stations, bulky waste, and donations.

From interviews, we learned that A+ has experienced an increase in the number of items that are handed in as waste but are still fully functional. In contrast to before, the company therefore shifted to a 'simple repair and high-volume' strategy. This includes spotting, cleaning, and shining up a large number of reusables, rather than conducting a more thorough repair of a smaller number of items. Within the limited resources available, this strategy allows for a high number of waste items to return to the use phase.

3.2.3. The case of AVV: professional repair of waste electrical and electronic equipment (WEEE) products – demanding doorstep waste approach

AVV initiated an experiment with the collection, testing, repair, and sale of white goods, since 15–20% of these items handed in as waste are fully functional or their life can be extended with minor repairs which is, however, more demanding than simply cleaning and shining up the items. As a part of the process, AVV hired a professional repairer to conduct the repair of the waste items. The repaired white goods still represent a certain value and are sold in AVV's second-hand shop and online – all with a 6-months warranty.

Fig. 3. Mobile repair bike, enabling the repair workshop to meet citizens in their neighborhoods. Innovated by the waste management company, Lund Renhållningsverk.

AVV is the first waste company in Denmark to launch a web shop exclusively stocked with repaired white goods for reuse. The ambition is to present a natural alternative to consumers who can now easily buy professionally repaired second-hand white goods for reuse instead of buying new products. The repaired white goods cross the waste threshold and return to product life, and in combination with visible marketing, products return to their use phase, entering and influencing the market for white goods. However, the waste company is now accused of breaking the rules by repairing and reselling, for example, washing machines and dryers, which citizens have handed in at the reuse station and have been repaired at the waste company's workshop. According to the director for white goods manufacturers (APPLIA), AVV creates unfair competetion which does not align with the legislation.

3.3. Collaborative dynamics – how municipal waste management companies collaborate with other actors around repair

3.3.1. The case of LRV – collaborative dynamics in making repair facilities available to the public

In the case of FixaTill, different new collaborations around repair have evolved. For example, early experiences showed that citizens (visitors) often needed help repairing electronics. However, the staff hired by the waste management company lacked skills in electronic repair. This resulted in the establishment of a new collaboration between the waste management company and the local Repair Cafe, which then conducted workshops and guided citizens on repairing electronics. Moreover, a neighboring humanitarian organization, 'Ugglan Secondhand Shop,' started using the repair facilities to repair donated items in need of repair. The previous practice was to dispose of items in need of repair.

Finally, the innovation of 'UpCykla' enables the waste management company to create new cross-sectoral relationship links between private businesses and NGOs as the mobile repair shop enabled other companies or organizations to engage in repair in various ways. The 'UpCykla' only managed to roll out four times before Covid-19 stopped it. Nevertheless, the interest in the mobile repair shop has been high. For example, IKEA has shown interest in the possibility of renting the bike for various events/campaigns. Furthermore, the local library and a local real estate company have also demonstrated interest. Therefore, a probable scenario is that the bike will be stationed at another location organized by the waste company, with a rolling schedule, and rented/lent to interested parties.

Based on the above, the collaborative dynamics approach of FixaTill, making *repair facilities available to the public,* is based on a non-profit approach to extending product life locally.

3.3.2. The case of A + : collaborative dynamics in a simple repair and high-volume strategy

A + has chosen a simple repair and high-volume strategy, where they clean up many items, making them attractive to buyers rather than spending time on extensive repairs on a few items – the simple doorstep approach. As a part of this 'high volume strategy,' private companies can deliver surplus products, e.g., high-quality building materials such as doors, windows, tools, bricks, flooring, and quality wood, to the reuse station without paying waste fees. In return, A + can sell the items in their reuse store. Based on this strategy, the municipal waste management company has included private businesses as direct suppliers and created new relationship links in the organizational system with positive feedback loops, increasing the local reuse of products and materials. In this way, the waste company collaborates with private companies that supply building products and materials that require a minimum of handling.

Moreover, the waste company is considering strengthening community relationships, including the arrangement of repair workshops for citizens to engage in repair. For this task, the waste company is in dialogue with the local Repair Cafés, as employees in the waste management company do not hold such competences. The repair considerations are related to their role in the future organization of the waste sector. Based on interviews, A + is still working to find its footing in a new waste agreement based on a new national (Danish) waste prevention and management plan ["Action plan for circular economy. National Plan for Waste Prevention and Management 2020–2032″] which requires that waste management companies make reusables 'available' to organizations and private actors. Here, the waste sector lacks a revised executive order on waste to set out directions for what is allowed and what is not allowed.

Based on this, the collaborative dynamics approach of A + is in this case of simple repair and high-volume strategy for the reuse of items collected at the municipal reuse stations and delivered by businesses, based on a mixture of 'non-profit' and 'alternative profit' (for example social benefits) approaches to extending product life, locally.

3.3.3. The case of AVV – collaborative dynamics in professional repair on WEEE products

In the case of AVV, experiences around collaborative dynamics stem from a practical experiment on the repair and refurbishment for reuse of white goods collected at municipal reuse stations. AVV actively enters the repair and sales market to promote the reuse of end-of-life items or items that are otherwise likely to become waste because they are not functional – the demanding doorstep approach. For this, AVV has entered a contractual public-private partnership with a professional repairer to conduct the repair, as AVV lacks the professional expertise to ensure quality. Thus, the waste management company has engaged in a formal partnership with actors from the private sector. This formal relationship link contributed to the project gaining acceptance from the collective compliance schemes. Moreover, the waste management company collaborated with the local job center, providing local employment for people on the margins of the labor market, contributing to social aspects of sustainability.

Key learning from this experiment was that public and private actors together play a vital role in the circular transition process as cooperation between them makes it possible to build sustainable business models that involve all three dimensions of sustainability, i.e., private partners ensure quality to gain acceptance from the collective schemes and helped bring products to the market. In contrast, the municipal party ensured environmental goals and local employment for people on the margins of the labor market. Finally, the collection and development of gentle logistics for the white goods necessitated the involvement and active participation of municipalities/waste companies. The process was, however, far from easy. A rigid legal framework and old

dogmas are stumbling blocks for conversions of this type. In particular, the division between private and public and challenges related to distorting the domestic market. Thus, the collaborative dynamics approach of AVV, applied in this experiment for creating a market for professionally repaired white goods collected at municipal reuse stations, is based on a mixture of a 'profit' and 'alternative profit' approach to extending product life locally.

3.3.4. Summing up the results

Repair initiatives initiated by municipal waste management companies resulted in different repair schemes. All cases focus on extending the life of products. However, the schemes vary, for example, activities related to different stages in the product's life cycle – from waste prevention in the use phase (reuse, maintenance, and repair) to end-of-life strategies (preparing waste for reuse). Moreover, strategies span from commercial to non-commercial value and include different types of repair-related profit: for-profit, non-profit, and alternative profit, such as ensuring environmental goals and local job creation.

From a collaborative perspective, the waste companies' ability to create both formal and informal relationship links with other stakeholders related to reuse and repair in the organizational system was a persistent characteristic in all cases. As a result, relationship links created feedback loops for new communication channels, expanding reuse and repair activities and a broader social value, framed as Alternative profit. Relationship links comprised a broad network of stakeholders spanning cross-sector collaboration (citizen/NGOs and the private sector). See Fig. 4.

As illustrated by the position of the three cases in Fig. 4, the different approaches focusing on pre-doorstep, simple doorstep waste, and demanding doorstep waste can be related to market perspectives. Lund and A + represent strategies based on avoiding or 'laying low' vis-à-vis the commercial market. AVV, on the other hand, decisively tries to establish a commercial reuse market for repaired items. The three cases singled out are examples – and thus, not fully representative of all repair-related activities among waste management companies. However, the cases illustrate the wide range of how municipal waste management companies interpret their role in the circular transition.

4. Discussion: repair and the three elements of sustainability

As resources and resource deficiency are climbing higher up the political agenda, it is vital to learn from operational experiences. That is particularly true for learning through, for instance, experiments and implementation at the local (niche) level (Loorbach, 2010). Moreover, breakthrough development can evolve as these experiments and performances are sheltered from the standard processes at higher (regime) levels (Geels, 2002), like legislation. This section discusses municipal waste management companies' engagements in-and opportunities to engage in- repair-related activities, and thereby adapt their practices towards a sustainable circular transition. In addition, and as suggested by (Brand, 2010; Gobert et al., 2021; Rosner and Ames, 2014; Selvefors et al., 2019), a user perspective is brought into the discussion to contribute to a more profound understanding of the practicalities of circularity.

From an *environmental sustainability perspective*, waste prevention and reuse are generally considered better environmental options than other waste treatments (Milios and Dalhammar, 2020), e.g., repairing a product requires less energy and material than remanufacturing or new production (Cooper and Gutowski, 2017). Nevertheless, according to Gobert et al. (2021), there is a weak (if growing) tendency to repair but a low frequentation of dedicated spaces making a discrepancy between the repair services offered and citizens' expectations, providing initiatives such as 'Fixa Till' necessary. In the case of FixaTill, the waste company provided material infrastructure to increase local repair opportunities, which included a repair space, tools, and repair assistance. As a result, FixaTill attracted almost 5000 visitors to attend activities in the repair shop from the beginning of September 2018 until December 2020. However, as with Repair Cafés, not all types of products are

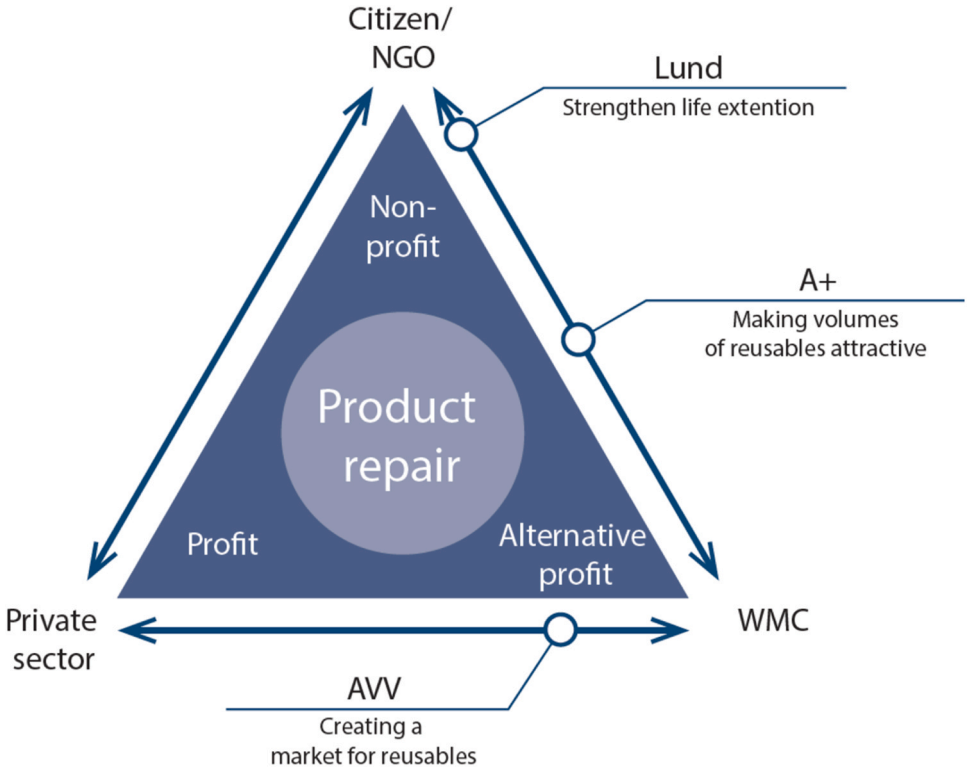

Fig. 4. Three approaches to repair networking from a municipal perspective.

repaired as types of repairs depend on what is brought in by the visitors, the expertise of the staff supporting the repairs, and the available tools (Moalem and Mosgaard, 2021). Nevertheless, based on the number and types of repairs, the total carbon dioxide savings were estimated to be 9.2 tons.

In the case of AVV, the launch of a web shop for reused whitegoods is, according to the company's director, a way to reach a customer group who prioritize quality and who are not willing to compromise on sustainability, and is, therefore, a push in the right direction for a lower impact on the environment. Moreover, this provides an opportunity for people on low incomes to buy used quality products.

From a *social sustainability perspective*, the social effects of reuse concern mainly increased employment and inclusiveness (Milios and Dalhammar, 2020). Traditionally, non-profit second-hand businesses provide a workplace opportunity for some people who find it difficult to enter the labor market in any other way (Milios and Dalhammar, 2020). The FixaTill repair shop is like Repair Cafés, known for having a robust social function (Pesch et al., 2018), providing a place to meet, and a space for socializing (Pesch et al., 2018). Furthermore, it provided a place for people to bring broken products free of charge, avoiding the cost of repairs and including low-income people (Pesch et al., 2018). Moreover, A+ and AVV reuse shops allow citizens to buy second-hand items, which are attractive to low-income people. According to Milios and Dalhammar (2020), there are social effects on customers who buy second-hand products. A growing secondary market would positively affect households as they gain greater access to affordable products (Milios and Dalhammar, 2020).

Finally, in all three cases, the results revealed that waste companies collaborated with the local job center, providing local employment for people on the margins of the labor market and assisting in learning new skills. This supports the idea that repair is a crucial sector for benefiting from employment through CE transitions (Rogers et al., 2021).

From an *economic sustainability perspective*, the cases provided examples of how municipal waste management companies may conduct repair in the interface between commercial and non-commercial repair to address the economic issues. At the same time, activities contribute to social and environmental sustainability aspects.

For example, the FixaTill repair shop, making repair facilities available to the public, is based on a non-profit approach to extending product life and engaging citizens in a long-term prevention strategy. However, a challenge was for the waste company to find ways to continue financing the repair shop when project funding ended.

On the other hand, A+ chose a Simple Doorstep approach based on a simple repair and high-volume strategy to reuse end-of-life items collected at the municipal recycling stations, based on a mixture of Non-profit and Alternative profit approaches to extending product life.

Finally, AVV has opted for a Demanding Doorstep strategy with a public-private partnership to repair and refurbish white goods collected at municipal reuse stations, using a mixture of Profit and Alternative profit approach to extending product life.

From a legal perspective, an important parameter when designing a re-use center is the embedded legal framework concerning waste management and associated re-use activities (Milios and Dalhammar, 2020). In all cases, companies are alert and aware that repair activities may border or cross-border existing repair activities, leading to unfair competition and distorting the domestic market. Challenges arise somewhere along the line between 'alternative profit' and 'profit.' (see Fig. 4**)**.

From a *collaborative perspective,* collaboration is a key principle of the circular economy, as collaboration between actors in the system is necessary for achieving goals (BSI, 2009). This emphasis on collaboration is something the circular economy has in common with the sustainability concept (Geissdoerfer et al., 2017). However, the repair sector is characterized by a need for more synergy between stakeholders (Gobert et al., 2021). For this paper, waste management companies mobilized a range of stakeholders along the process. They created formal and informal relationships with other stakeholders, including citizens, NGOs, and the private sector. For example, AVV entered a contractual partnership with a professional repairer. In contrast, A+ partnered with local businesses to supply surplus and Endof Life products and materials for reuse. LRV, on the other hand, focused on community repair and community relationships by entering informal relational links with local charity organizations, Repair Cafés, and local professional repairers. Finally, A+ is considering hosting repair workshops for citizens to strengthen community relationships. The latter is in collaboration with local Repair Cafés.

This supports the need for a more integrative arrangement in which citizens are integrated more closely into the repair process (Selvefors et al., 2019) and waste management (Gobert et al., 2021).

According to Gobert et al. (2021), the setting up of material infrastructures or specific spaces cannot stand alone but *'must be accomplished by work to change people's perceptions of the possibility of using them'* (p.10). In the case of Fixa Till, the project's purpose was to spread knowledge about reuse, repair, and sustainable consumption, as part of the transition towards a circular economy rather than 'just' providing 'material infrastructure.' To increase people's perceptions of the possibilities of using the repair workshop and to integrate new practices into their daily lives, the waste management company arranged workshops in the location of FixaTill with a broader theme of sustainability, including reuse and waste prevention. Workshops were carried out in collaboration with local sustainability initiatives, continuously, e.g., Zero Waste initiatives or Repair Café Lund, arranging workshops in electronic repairs. The waste company initiated the pilot with a local survey on social indicators, including citizens' attitudes towards reuse. A follow-up survey on social indicators revealed that the FixaTill project impacted attitudes toward repair- and reuse in a positive direction. This case illustrates how waste management and user perspective on product circularity can be combined, as Gobert et al. (2021) suggest.

To make the repair even more accessible and to further spread and convey Fixa Till's message, "UpCykla," - a rolling repair workshop was built and tested. The mini workshop was built on a box bike to be driven to various locations around Lund municipality to reach a broader range of citizens, as requested in the literature. For example, Gobert et al. (2021) stress that repair initiatives generally fail to attract the broad range of citizens committed to repairing. However, as mentioned in the result section, IKEA has also shown interest in renting the rolling repair workshop for various events/campaigns. Furthermore, the local library and real estate company have also demonstrated interest. Thus, this is a new way to expand the diversity of stakeholders and an attempt to increasingly attract repair initiatives as a potential player for addressing circular sustainable challenges from a long-term waste management – and waste prevention perspective.

4.1. Summing up the discussion

If obtaining new products and disposing of them as waste in a linear way is not an option, waste management companies can play essential roles as change agents who facilitate or enable the exchange of products between users in tight loop multiple cycles or as a facilitator of different repair initiatives integrating citizens more closely into the process of waste management. The social science research on the topic requests this. Further, waste management companies engage in stakeholder collaboration and networking, linking various organizations and individuals related to the repair. Together this contributes to the EU waste framework directive, requesting all member states to "encourage the reuse of products and the setting up of systems promoting repair" (Article 9) and to "promoting preparing for reuse activities, notably by encouraging the establishment of and support for preparing for reuse and repair networks" (Article 11) (EU, 2018).

5. Conclusions

The main goal of this paper was to investigate the practice and organizational dynamics of repair related to the waste sector. Fourteen open-ended and semi-structured interviews, follow-up questions, and meetings during the available timeframe for this research (2018–2021) were initiated. Moreover, on-site field investigations complemented the interviews to better understand the municipal waste management companies' daily practices and the users involved. Repair is addressed in varying ways in Pre-Doorstep, Simple Doorstep, and Demanding Doorstep approaches in the three cases, which provided a unique opportunity to obtain a more nuanced understanding of how waste management companies engage in repair, providing us an opportunity to glimpse where repair in the waste sector may head in the future. This mainly concerns the role of waste management companies as a circular initiative and how waste management practices, including repair, may translate into a broader sustainability context.

Overall, results revealed three different approaches to repair from a municipal waste management company perspective. First, repair schemes focus on product repair at different stages of the product's life, from the use phase (prevention) to disposal and end-of-life strategies (preparing waste for reuse). Second, initiatives take on different approaches to commercial and non-commercial strategies. Third, scopes vary from 'short-term solutions' prolonging the lifetime of consumer products to long-term waste prevention strategies.

From a collaborative and networking perspective, a persistent character in the three cases was the waste management companies' ability to create formal and informal relationships with other stakeholders in the organizational system. As a result, relationship links created feedback loops for new communication channels, expanding reuse and repair activities and a broader social value. In addition, relationship links comprised a broad network of stakeholders, including citizens, NGOs, and the private sector. These results may therefore contribute to the literature suggesting that a lack of synergy between stakeholders characterizes the repair sector.

Finally, the purpose of repair is addressed in various ways, supporting all three aspects of sustainability to varying degrees, meaning that waste management companies have the potential to play different roles in a sustainable circular transition. This indicates a willingness to develop repair activities and create synergies between initiatives, thus opening a wide range of possibilities to expand repair networks and activities in the waste sector. This links waste management to social sciences and broadens the idea of integrative arrangements. However, it also questions the future role of waste management companies in a sustainable circular transition. The 'waste' products market is unique, and dilemmas include upscaling preparing for reuse activities. Furthermore, it is essential to clarify how far municipal waste management companies may expand their activities to avoid unfair competition.

From a consumer perspective, it is worth noticing that consumer rights to repair are under transition. For example, the EU Commission proposed standard rules to promote the repair of goods (March 2023). With the proposal, the Commission wants consumers to have more accessible and cheaper options to repair products within and outside the legal guarantee.

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Data Availability

All data is shared in the paper.

Declaration of Competing Interest

The authors declare no conflicts of interest.

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Appendix A

see Appendix Tables 1 2 3.

Table 1
Interview guide, objectives, and key questions.

Objectives	Key questions
Understand the kinds of repair practices that municipal waste management companies conduct themselves or engage in	What types of repairs are conducted? Who conducts the repair – and where? How is the repair limit defined by the waste company? What is the company's take on the revised Waste Directive concerning repair? Has it led to acting differently?
Understanding negotiation between stakeholders to obtaining possible agreement favoring 'all'	Have the company experienced challenges related to other actors in the field concerning conducting repair activities? If so, what has the company done to meet divergent interests, if anything?
Understanding stakeholder collaboration and networking	Does the company collaborate with other actors on repairs? If so, what relationships have been created and with what results?

Table 2
List of interviews, follow-up questionnaires, and meetings.

Respondents and location	Date	Organization
Denmark		
1	15 Dec.2018	Waste Management Company
2	15 Dec.2018	Private Repairer
3	11 May 2019	Political NGO
4	6 Feb. 2020	Waste Management Company
5	10. Jun 2021	Waste Management Company
6	10. Jun 2021	Humanitarian NGO
7	24 Sep. 2021	Waste Management Company[a]
8	24 Sep. 2021	Waste Management Company[a]
9	12. Oct. 2021	Waste Management Company**
Sweden		
10	28 Nov. 2018	Waste Management Company
11	29 Nov 2018	Humanitarian NGO
12	16 Dec. 2019	Waste Management Company
13	17 Dec. 2019	Humanitarian NGO
14	24 Sep. 2021	Waste Management Company[a]

[a] Follow-up questions **Follow-up meeting (conducted on-line)

Table 3
On-site field investigation (2018–2019).

Location	Date	Organization
Denmark		
1	15 Dec. 2018	Waste Management Company
2	17–18 Jan. 2019	Waste Management Company
3	11 May 2019	Repair Café
4	11–13 Dec. 2019	Waste Management Company
5	13 Sep 2020	Repair Café
Sweden		
5	28–30 Nov 2018	Municipal Repair Shop
6	16–19 Dec 2019	Municipal Repair Shop

References

Avfall Sverige, 2018. Swedish Waste Management 2018. Retrieved from ⟨https://www.avfallsverige.se/fileadmin/user_upload/Publikationer/Avfallshantering_2018_EN.pdf⟩ (Accessed 30.02.2023).

Bakker, C., Wang, F., Huisman, J., den Hollander, M., 2014. Products that go round: exploring product life extension through design. J. Clean. Prod. 69, 10–16. https://doi.org/10.1016/j.jclepro.2014.01.028

Bovea, M.D., Ibanez-Fores, V., Perez-Belis, V., Juan, P., 2018. A survey on consumers' attitude towards storing and end of life strategies of small information and communication technology devices in Spain. Waste Manag. 71, 589–602. https://doi.org/10.1016/j.wasman.2017.10.040

Bracquene, E., Peeters, J.R., Burez, J., De Schepper, K., Duflou, J.R., Dewulf, W., 2019. Repairability evaluation for energy related products. Procedia CIRP 80, 536–541. https://doi.org/10.1016/j.procir.2019.01.069

Brand, K., 2010. Social Practices and Sustainable Consumption: Benefits and Limitations of a New Theoretical Approach. Springer, Netherlands, pp. 217–235. https://doi.org/10.1007/978-90-481-8730-0_13

BSI , 2009. Design for manufacture, assembly, disassembly and end-of-life processing (MADE) (First published 2009 ed.). BSI.

Cooper, D.R., Gutowski, T.G., 2017. The environmental impacts of reuse: a review. J. Ind. Ecol. 21 (1), 38–56. https://doi.org/10.1111/jiec.12388

Coughlan, D., Fitzpatrick, C., 2020. Trialling the preparation for reuse of consumer ICT WEEE in Ireland. J. Clean. Prod. 256, 120512. https://doi.org/10.1016/j.jclepro.2020.120512

Dalhammar, C., Wihlborg, E., Milios, L., Richter, J.L., Svensson-Höglund, S., Russell, J., Thidell, Å., 2021. Enabling reuse in extended producer responsibility schemes for white goods: legal and organisational conditions for connecting resource flows and actors. Circ. Econ. Sustain. 1 (2), 671–695. https://doi.org/10.1007/s43615-021-00053-w

Dewberry, E.L., Saca, L., Moreno, M., Sheldrick, L., Sinclair, M., Makatsoris, C., Charter, M., 2016. A landscape of repair. The centre for sustainable design. Univ. Creat. Arts.

EMF, 2016. Empowering Repair. The Circular Economy 100 (CE100). Ellen MacArthur Foundation.

EU, 2008. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives, (2008). ⟨http://data.europa.eu/eli/dir/2008/98/2018–07-05⟩.

EU, 2018. Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste, (2018). ⟨http://data.europa.eu/eli/dir/2018/851/oj⟩.

FM, 2017. *Fair og lige konkurrence*. The Danish Financial Ministry. Rosendahls a/s, Denmark. ⟨www.regeringen.dk / fm.dk / oim.dk / em.dk⟩.

Geels, F.W., 2002. Technological transitions as evolutionary configuration processes: a multi-level perspective and a case-study. Res. Policy 31 (8), 1257–1274.

Geissdoerfer, M., Savaget, P., Bocken, N.M.P., Hultink, E.J., 2017. The circular economy – a new sustainability paradigm? J. Clean. Prod. 143, 757–768. https://doi.org/10.1016/j.jclepro.2016.12.048

Ghisellini, P., Ulgiati, S., 2020. Circular economy transition in Italy. Achievements, perspectives and constraints. J. Clean. Prod. 243, 118360. https://doi.org/10.1016/j.jclepro.2019.118360

Gobert, J., Allais, R., Deroubaix, J., 2021. Repair and reuse: misalignments between stakeholders and possible users. J. Clean. Prod. 317, 128454. https://doi.org/10.1016/j.jclepro.2021.128454

Graziano, V., Trogal, K., 2017. The politics of collective repair: examining object-relations in a postwork society. Cult. Stud. 31 (5), 634–658. https://doi.org/10.1080/09502386.2017.1298638

Gregson, N., Metcalfe, A., Crewe, L., 2009. Practices of object maintenance and repair: how consumers attend to consumer objects within the home. J. Consum. Cult. 9 (2), 248–272. https://doi.org/10.1177/1469540509104376

Gusmerotti, N.M., Corsini, F., Borghini, A., Frey, M., 2018. Assessing the role of preparation for reuse in waste-prevention strategies by analytical hierarchical process: suggestions for an optimal implementation in waste management supply chain. Environ., Dev. Sustain. 21 (6), 2773–2792. https://doi.org/10.1007/s10668-018-0160-9

Hielscher, S., Jaeger-Erben, M., 2021. From quick fixes to repair projects: insights from a citizen science project. J. Clean. Prod. 278, 123875. https://doi.org/10.1016/j.jclepro.2020.123875

Hultén, J., Youhanan, L., Sandkvist, F., 2018a. Ökad återanvändning genom ökad samordning: Förstudie om en Återbrukshubb. Retrieved from ⟨<Fonterror-Segoe-UI>https://urbanmagma.se/wordpress/wp-content/</Fonterror-Segoe-UI>⟩ uploads/2018/06/%C3%85terbrukshubb-IVL-f%C3%B6rstudie-rapport-201801.pdf (accessed 20.12.2022).

Ijomah, W.L., Danis, M., 2012. 8 - Refurbishment and reuse of WEEE. Waste electrical and electronic equipment (WEEE) handbook. Elsevier Ltd, pp. 145–162. https://doi.org/10.1533/9780857096333.2.145

Keiller, S. a C., Martin, 2014. A study of member motivations and activities in hackerspaces and repair cafes. Sustain. Innov. 125–137 http://research.uca.ac.uk/2731/.

Laitala, K., Klepp, I.G., Haugrønning, V., Throne-Holst, H., Strandbakken, P., 2021. Increasing repair of household appliances, mobile phones and clothing: Experiences from consumers and the repair industry. J. Clean. Prod. 282, 125349. https://doi.org/10.1016/j.jclepro.2020.125349

Lechner, G., Wagner, M.J., Diaz Tena, A., Fleck, C., Reimann, M., 2021. Exploring a regional repair network with a public funding scheme for customer repairs: The 'GRAZ repariert'-case. J. Clean. Prod. 288, 125588. https://doi.org/10.1016/j.jclepro.2020.125588

Loorbach, D., 2010. Transition management for sustainable development: a prescriptive, complexity-based governance framework. Goverance 23 (1), 161–183. https://doi.org/10.1111/j.1468-0491.2009.01471.x

McMahon, K., Johnson, M., Fitzpatrick, C., 2019. Enabling preparation for re-use of waste electrical and electronic equipment in Ireland: lessons from other EU member states. J. Clean. Prod. 232, 1005–1017 https://doi-org.zorac.aub.aau.dk/10.1016/j.jclepro.2019.05.339.

Messmann, L., Boldoczki, S., Thorenz, A., Tuma, A., 2019. Potentials of preparation for reuse: a case study at collection points in the German state of Bavaria. J. Clean. Prod. 211, 1534–1546. https://doi.org/10.1016/j.jclepro.2018.11.264

Milios, L., Dalhammar, C., 2020. Ascending the waste hierarchy: re-use potential in Swedish recycling centres. Detritus 9, 27. https://doi.org/10.31025/2611-4135/2020.13912

Moalem, R.M., 2022. Preparing for Reuse: Towards Cooperation for the Inner Cycles and the Local Loops. Aalborg Universitetsforlag, Denmark. oai:pure.atira.dk:publications/559127eb-67ff-4cdc-9c19-e807db5a8848.

Moalem, R.M., Kerndrup, S., 2023. The entrepreneurial role of waste companies in transforming waste streams to value streams: Lessons from a Danish Municipal waste company. Waste Manag. Res. 41 (3), 620–634. https://doi.org/10.1177/0734242×221124048

Moalem, R.M., Mosgaard, M.A., 2021. A critical review of the role of repair cafés in a sustainable circular transition. Sustainable 13 (22), 12351. https://doi.org/10.3390/su132212351

Moalem, R.M., Remmen, A., Hirsbak, S., Kerndrup, S., 2023. Struggles over waste: preparing for re-use in the Danish waste sector. Waste Manag. Res. 41 (1), 98–116. https://doi.org/10.1177/0734242×221105438

Pesch, U., Spekkink, W., Quist, J.N., 2018. Local sustainability initiatives: innovation and civic engagement in societal experiments. European Planning Studies, 〈https://www.narcis.nl/publication/RecordID/oai:tudelft.nl:uuid:9e59e581–5af6–452c-b999–4b61f1da0e2c〉.

Pini, M., Lolli, F., Balugani, E., Gamberini, R., Neri, P., Rimini, B., Ferrari, A.M., 2019. Preparation for reuse activity of waste electrical and electronic equipment: environmental performance, cost externality and job creation. J. Clean. Prod. 222, 77–89. https://doi.org/10.1016/j.jclepro.2019.03.004

Rizzi, F., Gusmerotti, N., Frey, M., 2020. How to meet reuse and preparation for reuse targets? Shape advertising strategies but be aware of "social washing". Waste Manag. 101, 291–300. https://doi.org/10.1016/j.wasman.2019.10.024

Rogers, H.A., Deutz, P., Ramos, T.B., 2021. Repairing the circular economy: public perception and participant profile of the repair economy in Hull, UK. Resour., Conserv. Recycl. 168, 105447. https://doi.org/10.1016/j.resconrec.2021.105447

Rosner, D., Ames, M., 2014. Designing for repair?: Infrastructures and materialities of breakdown. Pap. Presente 319–331. https://doi.org/10.1145/2531602.2531692

Russell, J.D. , Nasr, N.Z. , & UNEP International Resource Panel. , 2018. Re-Defining Value - The Manufacturing Revolution: Remanufacturing, Refurbishment, Repair and Direct Reuse in the Circular Economy. United Nations Environment Programme. 10.13140/rg.2.2.31020.00640 https://search.datacite.org/works/10.13140/rg.2.2.31020.00640.

Selvefors, A., Rexfelt, O., Renström, S., Strömberg, H., 2019. Use to use – A user perspective on product circularity. J. Clean. Prod. 223, 1014–1028. https://doi.org/10.1016/j.jclepro.2019.03.117

Sundin, E., Lee, H.M., 2012. In What Way Is Remanufacturing Good for the Environment? Springer, Netherlands, pp. 552–557. https://doi.org/10.1007/978-94-007-3010-6_106

Terzioglu, N., 2021. Repair motivation and barriers model: Investigating user perspectives related to product repair towards a circular economy. J. Clean. Prod., 125644 *28*910.1016/j.jclepro.2020.

van der Velden, M., 2021. 'Fixing the World One Thing at a Time': community repair and a sustainable circular economy. J. Clean. Prod. 304, 127151. https://doi.org/10.1016/j.jclepro.2021.127151

Yin, R.K., 2003. Case Study Research: Design and Methods, Third ed.. Sage Publications.

Zacho, K.O., Mosgaard, M., Riisgaard, H., 2018. Capturing uncaptured values - A Danish case study on municipal preparation for reuse and recycling of waste. Resour. Conserv. Recycl. 136, 297–305. https://doi.org/10.1016/j.resconrec.2018.04.031