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Who are the value transformers, value co-operators and value gatekeepers? New routes to value preservation in a sufficiency-based circular economy

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ABSTRACT

Value preservation is key for the transition from a linear economy to a sufficiency-based circular economy. However, to keep the value of products and materials at the highest level possible over time, different actors such as businesses, designers, consumers, and policymakers must know when value is reduced during a product's lifetime, and how to capture and preserve this value.

This study results in a comprehensive mapping of factors with a negative impact on the perceived value of products from a consumer's perspective and suggests new routes to value preservation, as a way of turning the negative factors into positive changes. Next, the paper presents a conceptual model for value preservation. The model identifies new key actors: value transformers (product developers), value co-operators (consumers), value gatekeepers (businesses), and value accountants (policymakers) and suggests important changes to their linear practices, which are needed for the sufficiency-based circular economy paradigm to flourish.

1. Introduction

In today's world, the production and consumption of new products generally follows a linear pattern. Producers create new products, consumers buy, use, and ultimately dispose of them and finally, disposed products are handled by waste managers. Driven by quick economic transactions, there are many ways in which the use value of products is reduced or even destroyed (Bocken et al., 2013). Early replacement of still-functioning products with more attractive or newer devices is perhaps one of the clearest examples of non-preservation or destruction of value (Bakker et al., 2014; Jaeger-Erben and Proske, 2017; Van den Berge et al., 2021). The use value of the products is also lost if products are not timely maintained, repaired, or circled for reuse.

The consequences of wasting value in a linear economy are manifold: from increased material scarcity and greenhouse gas emissions due to the redundant production of new products to the generation of excessive amounts of waste. For example, electronic products alone created 12 Mt of waste in Europe in 2020, with an annual growth of 3–5 % in waste (Forti et al., 2020). Future scenario studies indicate that worldwide

yearly waste from electronic products will grow from 58 Mt in 2021 to 75 Mt in 2030, and 112 Mt in 2050 (Parajuly et al., 2019).

The aim of the circular economy (CE) is to preserve the value of products and materials for as long as possible either by lengthening the lifetimes of product and their components or by recycling the product's materials back into the production system with an aim of reducing overall material consumption (Ayres, 1994; Stahel, 2019). These circular strategies can be visualized as "loops" (see Fig. 1). But even if CE models suggest preserving as much value as possible in every loop, innovation in business practice has mainly focused on the outer loop of CE, particularly that of recycling (Allwood, 2014; Bocken et al., 2017). This has encouraged several researchers to argue that a focus on the inner loops of CE is needed as well. For example, Vanegas et al. (2018) found that recycling can only be a secondary part of the transition to a CE, as it only limits the value destruction. When products are recycled, not all materials can be recovered successfully and in addition, there are energy and transportation requirements associated with these cascade loops. Recycling does not motivate the manufacturers to explore new business models but allows to continue in the same models as it mainly

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affects the post-consumer phase of the products. By moving to the inner loops of a CE value is better preserved, resulting in reduced environmental impacts. In these inner loops, products are either maintained, repaired, refurbished, or remanufactured (Mugge et al., 2017).

In this study, we, therefore, focus on value preservation in the “inner loops” of the CE framework and define “value preservation” as *keeping the use value of the products at the highest level possible during the product lifetime, to limit obsolescence and to extend the lifetime as much as possible*. A product’s lifetime is defined by Den Hollander et al. (2017) as the period starting from when the product is released for use after production to when the product becomes obsolete either functionally, psychologically, or economically. In other words, it is the total period where the product will be in use. This also entails that we define value as the perceived value of the product in the eyes of its consumer.¹ This is not to imply that the consumer is solely responsible for the value preservation. Rather it might be the designers and developers of the product, the businesses

who market it, retailers, repairers, waste managers, or policymakers, who are either directly or indirectly responsible for the value degradation or for not creating opportunities for value preservation. Yet, the *perception* and practices of consumers is often highly influential on the actions of the other actors. Therefore we define value from the perspective as well as the product-related practices of consumers.

Shifting the focus to the inner loops and the consumer perception of value and their value-related practices also has consequences for the scope of research. While recycling is an issue that largely relies on technological and business solutions and the activities of economic and industrial actors, strategies like reduce, reuse, share, and repair also require the engagement of more actors, particularly consumers, but also service providers. These strategies also require more interaction and at least some basic form of cooperation between different actors as well as better understanding of everyday consumption of goods and services (Greene et al., 2024). For example, consumers that share products need

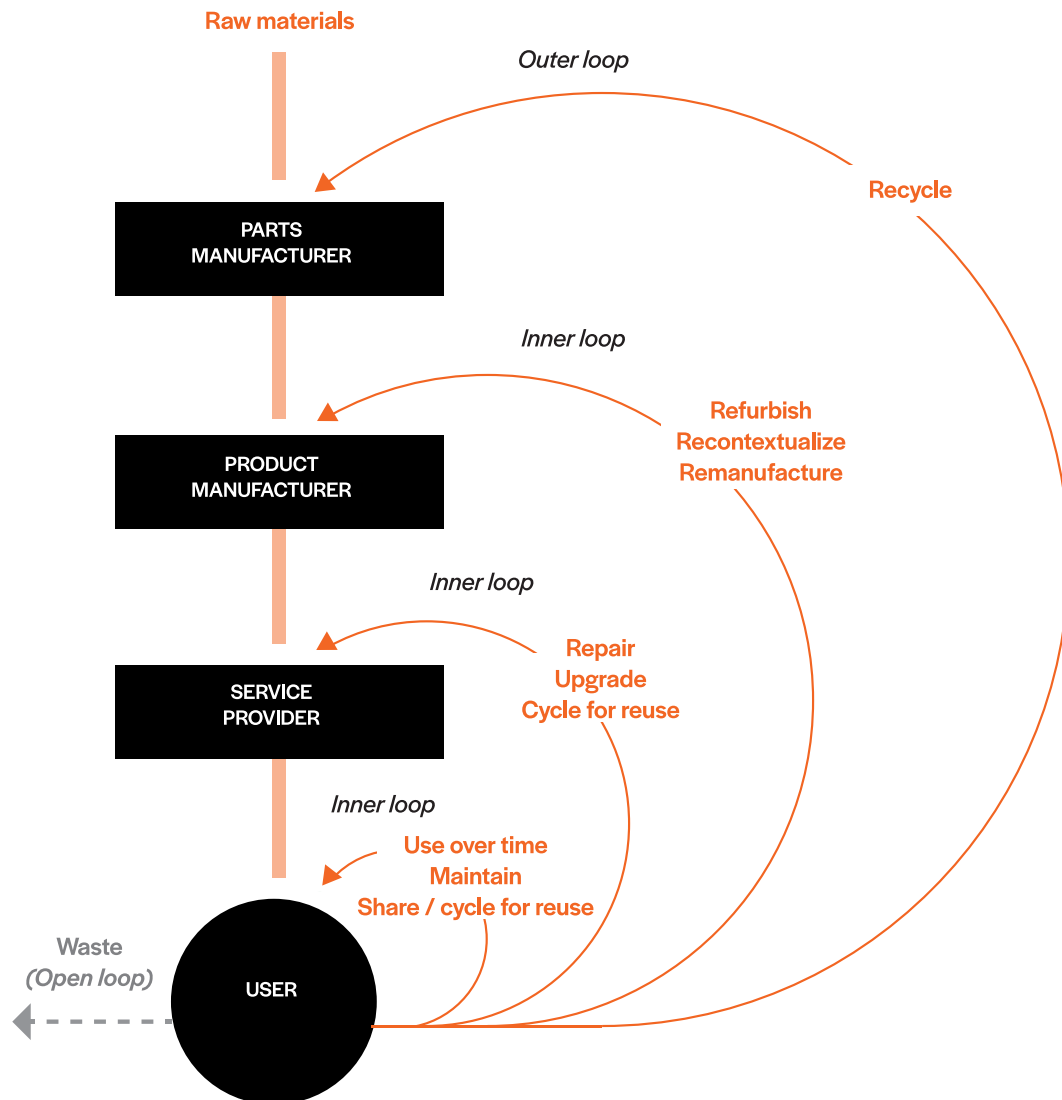


Fig. 1. Circular economy strategies at the product level visualized as inner and outer “loops”. Based on the Ellen MacArthur Foundation (2013).

¹ In this article, we use the word consumer, but in addition to purchasing and using products, we also consider practices such as maintaining, repairing, and caring for products etc. if we speak of consumers.

to find mutual agreements and repair professionals need to exchange with users about the history of the product failure. While the transition to a CE means increasing communication and collaboration in general, this becomes a more stringent prerequisite when working with the inner loops. Taking more actors into account in the process of facilitating

value preservation comes with the need to better understand their different concepts of value. Value is not a static and inherent characteristic of products or materials, it is produced and reproduced by practices of “doing value” (Hipp and Jaeger-Erben, 2023). Consumers for example show a great variety of practices of care and maintenance or neglect to reproduce the value they apply to a product, likewise, recycling facilities differ in the intensity they decompose a product to extract its material values. Sociological valuation studies have shown the huge variety of ways in which value is negotiated and (re)produced in everyday lives and different cultural settings (e.g. Hutter and Stark, 2015) which stands in sharp contrast to the scope of economic theories of value (Mazzucato, 2018). Also, CE research seems to have settled on a marginalist utility theory, where value is usually equated with the price of a product or service. Even though value is often the focus of CE research, the associated value concepts are very limited in their scope. Thus, to identify strategies of value preservation we need to better understand how value is not only “assigned” to a product (e.g. by giving it a price) but also “produced” in product-related social practices. We need to better understand the sector- and actor-specific practices of “doing value” to be able to design processes and procedures or systems of provision to preserve the diverse spectrum of values.

Upon this, we can build the argument that sufficiency, defined as getting exactly the value that is needed with as few resources as possible, is enabled by value preservation. The sufficiency-based economy principle draws on the perspective of sufficiency, or “making do with less” (Alexander, 2012; Niessen and Bocken, 2021). It is a preventive approach where products are reused, maintained, and repaired over time, and unnecessary consumption is avoided (Bocken and Short, 2020). A sufficiency-based economy requires a shift from optimizing production to optimizing the utilization of objects. This entails a reduction in consumption, extensions of product lifetimes, a limitation of planned obsolescence, and optimized product usage (e.g., through the sharing economy, and product service systems). It also includes a radical shift in the way of doing business to focus on long-term value creation and re-creation rather than on a high volume of sales (Bocken et al., 2022b; Beyeler and Jaeger-Erben, 2022). Overconsumption across sectors is especially a problem in the most developed countries dominated by unsustainable volume-over-value business models (Bocken and Short, 2020), whereas in more developing and emerging nations it is about elevating the standard of living to a sufficient level (Bocken et al., 2022b).

Regardless of the development context, sufficiency requires a radical rethink of the concept of value of products. It requires a value shift that involves a different view on the roles of actors who influence whether the value is preserved or destroyed during a product’s lifetime. By moving from a linear economy to a sufficiency-based circular economy, actors will interact with objects in different and innovative ways. At present, the roles of actors strongly relate to their activities and behaviours in a linear economy. For example, the producer *produces* new goods, whereas the consumer *consumes* these until the value is wasted. Hence, we argue that a radically different perception of the actors and their roles is needed both on the supply side and the demand side, as preservation of value entails that actors start to see themselves differently, learn new behaviours, and perform new types of interaction.

This study contributes with a comprehensive mapping of the factors, that lower the consumers’ perceived value of the product during the product lifetime and suggests new routes to value preservation, by showing how the negative factors can be reversed or avoided. It delivers an important perspective on reducing value loss during the product lifetime and contributes with a discussion on how a renewed focus on value preservation can be a key driver for the transition from a linear economy to a sufficiency-based circular economy.

The research questions driving the study are:

- What are the factors with negative influence on value preservation in the linear economy and what are the new routes for value preservation leading to a sufficiency-based circular economy?
- What are the roles of key actors in a sufficiency-based circular economy and how should these actors behave and engage to preserve value during the product lifetime?

The study is divided into three major parts. First, we conduct a literature review to identify the factors with a negative impact on value preservation during a product’s lifetime and propose new routes to value preservation, by turning the negative factors into positives. Secondly, we conceptualize a new model for value preservation, that also redefines the key actors’ roles in a sufficiency-based circular economy. Finally, we discuss the model and the contribution of this research, including implications for practice, along with avenues for future research.

2. Materials and methods

The factors with a negative impact on the perceived product value are identified through a literature review. This creates a solid basis for conceptualizing new routes to value preservation and to identify new roles for the key actors. In the literature review, which aimed at identifying the negative factors on perceived product value, a scoping review methodology was applied (Peters et al., 2020). This was done to ensure that the wide and open nature of the research question could be addressed and the many relevant fields of research such as design, production, engineering, business, management, and consumer behaviour, could be included. At the same time, the search was limited to results that would point to the perceived value of the product in the eyes of its consumers, as this was central to our definition of value preservation.

2.1. Literature review

The literature review was performed in three comprehensive databases: Scopus, Web of Science, and Google Scholar. The first searches clearly showed that the term “value preservation” did not provide a usable set of results, as not many relevant studies were identified. Therefore, it was decided to use keywords that describe the valuation of products in the eyes of the consumer and that would be relevant in respectively design, production, engineering, business, management, and consumer behaviour. The list of keywords included: *product attachment, person-product relationship, slow consumption; product obsolescence, and product durability*.

The search in the three databases, limited to the period of 2003 to August 2023, resulted in 25.538 articles. This called for a further selection of the results. After a review of some sample articles, we found that articles that included the term ‘*product use*’ turned out to convey information on perceived product value from the consumer perspective, whereas those that did not include this term mainly provided conceptual or strategic results with little reference to consumers’ perceptions or behaviours. Therefore, we decided to limit the search to those that included one of the search terms: *product attachment, person-product relationship, slow consumption; product obsolescence, product durability, and the term ‘product use’*. Furthermore, we decided to include only journal articles written in English. After removing duplicates, we ended up with 1.171 articles, that were then selected for relevance based on an abstract review. Finally, 136 articles were included in the study.

2.2. Data-analysis: use stages

The 136 articles were analysed and mapped into different product use stages. The use stages defined by Shi et al. (2022) were used as a framework for mapping the articles, as this work aligns well with the scope of this article and focuses on the consumers’ perception of value. According to Shi et al. (2022), there are five different use stages in which

the consumer assesses the product value. The five use stages are 1) pre-acquisition, 2) early-use, 3) middle-use, 4) late-use, and 5) pre-disposal. Each stage is described by the product's condition and consumer-product relationship. An important point from [Shi et al. \(2022\)](#) is that a product's value for the consumer changes over time and is not necessarily linked to the physical condition of the product. Hence it is not only in the predisposal stage that products may be disposed of. It can also happen in all the other use stages if the perceived or experienced value of the product is sufficiently low in comparison to the perceived value of a potential new replacement product. Consumers also assign a mental book value to products: this refers to the consumer evaluation and mental accounting of the value of the product and may lead to early replacement if the product has exceeded its expected lifetime and thus has provided the expected value over time ([Van Den Berge et al., 2021](#)). Consumers may then perceive it is time for a new product ([Magnier and Mugge, 2022](#))

2.3. Data-analysis: types of value

The next level of sorting and categorizing the 136 articles, was into different types of value in each of the use stages that were recognized in prior research. Value in the eyes of the consumer can relate to the product's:

- **Economic value.** That refers to the value for money, i.e., making a financially beneficial choice ([Borg et al., 2020](#); [Laukkanen and Tura, 2022](#))
- **Functional value.** That refers to the physical performance and perceived utility of the product),
- **Social or Sign value.** That refers to a product's ability to enhance a social self-concept, such as feelings of belonging to a social group ([Laukkanen and Tura, 2022](#); [Sweeney and Soutar, 2001](#))
- **Emotional value.** That refers to the extent to which the product generates feelings or affective states, such as pleasure or excitement.
- **Epistemic value.** That refers to a product's ability to evoke feelings of curiosity and novelty ([Van den Berge et al., 2021](#))

These different types of values and perspectives were all included in the data analysis. The use stages and the different types of value within each use stage were used as a framework for mapping and identifying the factors with a negative impact on perceived product value during a product's lifetime as these were uncovered in the included articles.

2.4. Conceptualization: new routes to value preservation

Once the mapping of the factors with a negative impact on the perceived product value in every use stage was in place, we started to conceptualize new routes for value preservation. This was done by a workshop in the team discussing how each negative factor could be turned into a suggestion for positive future action. Hence, a list of new routes for value preservation was conceptualized. This list is not meant to be complete but is based on input from all the authors on the paper, who represent experts in the various fields of research within CE, including business, consumer behaviour, sociology of consumption, design, life cycle assessment, and sustainable planning. In those cases, where the suggested new route for value preservation was inspired by specific research, this was indicated by references.

The new routes for value preservation were categorized based on the actors, who play a significant role in implementing this route in practice. In this process, we applied the definition of the four key actors with direct influence on product lifetime ([Jensen et al., 2021](#)) – namely: 1) product developers, 2) consumers, 3) businesses (incl. producers, retailers, repairers, service providers, waste managers, etc.), and 4) policymakers.

2.5. Conceptualization: new roles for the key actors

The implementation of the new routes for value preservation is addressed as a last step in the conceptualization process. As [Kaufman et al. \(2021\)](#) argue, any kind of sustainable transition requires change in routines and practices in the consumption and production system. Hence, the implementation of the new routes to value preservation requires changes in the routinized behaviour of product developers, consumers, businesses, and policymakers. Successful behaviour change also demands changes in the key actors' beliefs and social meanings, including their understanding of their role in the production and consumption system ([Senge, 1990](#)).

In the "roles" labelled product developers, consumers, businesses, and policymakers, there are understandings, practices, and expectations, that derive from a linear economy - including obsolescence strategies ([Rivera and Lallmahomed, 2016](#)). These are a barrier to implementing the new routes for value preservation. Therefore, it was decided to conceptualize new roles for the key actors to support the implementation of the new routes to value preservation. To conceptualize these new roles, the authors participated in a LEGO serious play workshop (facilitation guide by: [Møller and Tollestrup, 2013](#)) in which the problems of the linear actor roles were taken as a starting point. By discussing these problems and the different needs related to value preservation, several new roles were devised and discussed. Via an iterative process and by collecting input from all authors and their relevant domains, a final set of new key actor roles was created.

3. Results

In this study, we have made a comprehensive mapping of the factors, that lower the customers' perceived value of the product during the product lifetime and suggest new routes to value preservation, by showing how the negative factors can be reversed or avoided. In this section, the result of the study will be presented. The presentation will follow five use stages: 1) pre-acquisition, 2) early-use, 3) middle-use, 4) late-use, and 5) pre-disposal. First, there will be a description of the respective use stage, followed by an overview of the factors with a negative impact on perceived product value in this use stage—along with the new routes to value preservation.

3.1. Negative factors and new routes to value preservation in the (pre)-acquisition stage

In the **(pre)-acquisition** stage, the product is brand new. Even though the consumer-product relationship is not yet developed, the consumers will evaluate the product based on its appearance and other attributes and form expectations concerning its lifetime ([Day et al., 1991](#)). The expectations will influence use behaviour at later stages and how fast product value may decline over time, and thus the actual product lifetime ([Evans and Cooper, 2010](#)). For instance, if consumers purchase a cheap product, they may infer that this product is not intended for a long usage period, resulting in a lack of care behaviours ([Ackermann et al., 2021](#)) and a fast decline in product value. In this use stage, the factors with a negative impact on the perceived product value are unfolded in [Table 1](#) along with new routes for value preservation.

3.2. Negative factors and new routes to value preservation in the early use-stage

In the **early-use** stage, the product is almost new and has no signs of wear. The consumer continues evaluating the product and starts getting familiar with the product. Furthermore, the consumer starts cultivating product use habits, such as neglecting maintenance or doing it regularly ([Evans and Cooper, 2010](#)). The building of a consumer-product relationship is now possible, but not guaranteed. [Table 2](#) reviews the factors with a negative impact on the perceived product value in the early-use

Table 1

Factors with a negative impact on the value perceived by consumers in the pre-acquisition stage and new routes to value preservation.

Factors with negative impact on perceived product value in the (pre)-acquisition stage	New routes to value preservation, (pre)-acquisition stage
Functional value Unclearified consumer needs, that leads to 'wrong purchase' (Haase and Lythje 2022) Companies' application of product obsolescence strategies leads to lower consumers' expectations for product lifetime (Cooper, 2004; Echegaray 2016)	Consumers esist impulse purchases and apply thorough investigation of needs, product expectations, and potential negative behaviour before purchase (inspiration from Haase and Lythje, 2022).
Emotional/ Epistemic/Mental book value The product purchase price is low, which results in low-performance expectations from the consumer. Ackermann et al. (2018), The consumers' expectation of product quality is low, which lowers its mental book value (Scott and Weaver, 2014a; Van den Berge et al., 2020) The joy, fun, pride, nostalgia, etc. that consumers expect from product use is low (Raghunathan and Irwin, 2001; (Soukhathammavong and Park, 2019)	Consumers prioritize durability and long-term functionality rather than short-term immediate social or sign value. Product developers know consumers' reasons for devaluing and evaluating products, and design products that allow long-lasting product-user fits (inspired by Haase and Lauersen, 2023).
Social or Sign value The product's appearance is inferior compared to similar products (Mugge et al., 2018) The consumer replaces well-functioning products to display social images (e.g., fashion consciousness or technology savvy) or wealth or social status (Cruz-Cárdenas and Arévalo-Chávez, 2018; O'cass and Frost, 2002)	Businesses avoid product obsolescence strategies and help consumers overcome barriers for value preservation throughout the entire product lifetime (inspired by Rivera and Lallmahomed, 2016) Policymakers make consumers responsible for the products they acquire e.g. by implementing "consumption corridors", delimited by a lower limit and an upper limit to consumption, and within this "corridor" a safe and just consumption space (inspired by Fuchs et al., 2021) Policymakers enhance product transparency in terms of environmental impact (e.g., lifetime label) so that consumers can evaluate the environmental benefits of one product against another.

stage along with new routes to value preservation.

3.3. Negative factors and new routes to value preservation in the middle-use stage

In the **middle-use** stage the product still functions well but might have some wear marks or minor problems. The consumer has owned the product for a while and may have developed a closer relationship with the product. Furthermore, this stage might include two new product use behaviours: hibernation (dead storage period) and temporal sharing with friends, family, or the like, but still owned by the consumer (Murakami et al., 2010). Table 3 reviews the factors with a negative impact on the perceived product value in the middle-use stage along with new routes to value preservation.

3.4. Negative factors and new routes to value preservation in the late-use stage

In the **late-use** stage, the main function of the product has deteriorated, resulting in the malfunctioning of the product. At this stage, the product might still be repairable, and the consumer can decide to find out whether and how the product can be repaired and retain it, thereby maintaining the relationship with it. In this use stage, the factors with a negative impact on the perceived product value and new routes for value preservation can be seen in Table 4.

Table 2

Factors with a negative impact on the value perceived by consumers in the early use stage and new routes to value preservation.

Factors with negative impact on perceived product value in the early-use stage	New routes to value preservation, early-use stage
Economic Value Consumer regret due to missed better alternatives after purchase (Lee and Cotte, 2009) The switching cost to an alternative, new product is low or expected to be low (Burnham et al., 2003)	Consumers' mental book value of products is extended to slow down the mental accounting process in which products lose value because consumers expect them to break soon (inspired by (Van Den Berge et al., 2021))
Functional value Mismatch between product function and consumer needs or lower product performance than expected. Cox et al. (2013); Cruz-Cárdenas and Arévalo-Chávez (2018); Spiteri Cornish (2020) Consumers' lack of product knowledge on lifetime, correct use or maintenance (Burke, 2013; Evans and Cooper, 2010; Ackermann et al., 2018)	Consumers commit to products in use, if not by themselves then to a second consumer, to ensure high product use frequency, either by reselling or sharing. Product developers create renewable designs that allow for upgrades and that accommodate new features to keep the product relevant (inspired by Haase et al., 2023)
Emotional/ Epistemic/Mental book value The product holds "faultless forms and surfaces" that seem too pretty to be used (Guittinan, 2009; Wu et al., 2017; Buechel and Townsend, 2018)	Product developers design products for several user and use stages, and thereby bring value and meaning over time because of ownership and continued usage.
Social or Sign value Rapidly vanished meanings (e.g., fashion image) from the product (Cooper, 2005 Lang et al., 2013; Cox et al., 2013; Cruz-Cárdenas and Arévalo-Chávez, 2018) The product holds undesired symbolic meanings (Romani et al., 2012)	Businesses provide take-back and reuse systems for products that do not fit consumer needs and act as retailers of reused products. Policymakers encourage the extension of actual lifetime for example via tax reductions ('easiest' to determine by basing this on best in class, rather than planned obsolescence). Policymakers inform consumers about expected product lifetime, for example via lifetime labels on products (inspired by Van Den Berge et al., 2021)

3.5. Negative factors and new routes to value preservation in the pre-disposal stage

In the **pre-disposal** stage, the product is broken beyond repair. The consumer cannot use it any longer to perform its original function and is unable to recover this functional value. In this stage, it takes a lot of effort for the consumer to retain the product's value and though upcycling is possible, this typically only happens if the product-user relation is substantially strong. Table 5 shows the factors with a negative impact on the perceived product value in the predisposal stage, and new routes to value preservation.

4. New conceptual model for value preservation in a sufficiency based circular economy

4.1. Value preservation: key actors and their behaviours

In this study, we argue that radical changes are needed to preserve value in the inner loops of a sufficiency-based circular economy and that one important step to make this economy flourish is to take a radically different view on the roles of key actors. Tables 1–5 indicate that the factors with a negative impact on the perceived product value are influenced by more than one actor, and in all the five use stages, several actors play an important role. If we consider the current descriptions of the actors as product developers, consumers, businesses, and policy-makers, it is evident that their roles and behaviours are characterized within the linear economy where value is regarded radically differently from value in a sufficiency-based circular economy. Planned

Table 3

Factors with a negative impact on the value perceived by consumers in the middle-use stage and new routes to value preservation.

Factors with negative impact on perceived product value in the middle-use stage	New routes to value preservation, middle-use stage
Economic Value Deals, trade-in programs, and subscription models for new products reduce the experience of the remaining value of the owned product(s) (Wieser and Tröger, 2018; Van den Berge et al. 2021) The product is perceived as obsolete due to new technology, new features, new models etc. (Hipp and Jaeger-Erben, 2023; Wilson et al., 2017) and often ends up hibernating in cupboards (Poppelaars et al., 2020) Functional value The product has lost the original performance, has software problems, or lacks software updates (Magnier and Mugge, 2022; Van den Berge et al., 2023) Consumers' perception of the product as having low eco-efficiency leads to early replacement. Guillard et al. (2023) Consumers' lack of time and skills to perform regular product maintenance leads to decreasing product performance (Ackermann et al., 2018) Emotional/ Epistemic/Mental book value The product no longer represents the identity of the consumer and is associated with undesired memories (e.g., after a divorce). Trudel et al. (2016); Madon (2022) The emotional bond between consumer and product is weak or the use frequency is low (Schifferstein and Zwartkruis-Pelgrim, 2008; Goodman and Irmak, 2013; Etkin, 2016; Simpson et al., 2019; Van den Berge et al., 2021) Social or Sign value The product appearance is damaged, it is dirty or old in comparison to those of family/friends and implies social images of poverty or incompetence (Magnier and Mugge, 2022; Philp and Nepomuceno, 2020)	Consumers consider environmental benefits as one way to signal wealth, competence, or social status. Product developers include services that give access to alternative usage situations that do not require the full value or performance of the product (useful degradation). Product developers design for product - consumer attachment (Mugge et al., 2007) Product developers take potential software obsolescence into account and have evasive strategies in place (inspired by Möller et al., 2021) Businesses consider possible countereffects from services deals and trade-in programs and oppose these. Businesses avoid obsolescence strategies. Businesses continuously provide information on their products to enable alternative usage situations that do not require the full value or performance of the product or provide services for circles use. Businesses see themselves as part of an eco-system where producers, retailers, repairers, waste managers support each other with the aim of preserving value and finding alternative ways of earning money (inspired from Hedstrom, 2019) Policymakers encourage avoidance of private hoarding of products. Policymakers encourage circled use e.g., through tax reduction or by developing a collective system for handling after-use products and secondary or even tertiary consumers rights.

obsolescence strategies dating back to the early 20th century have had a significant influence on current business practices product development practices as well as consumer behaviour (Rivera and Lallmahomed, 2016). Obsolescence strategies are embedded in the business-as-usual activities, perceptions, and methodologies. This also means that in the linear economy, where value is created and added, until the product is sold, only to decrease fast, to make room for a new product, may consciously or unconsciously be part of the roles of, product developers, consumers, businesses, and policy-makers. Hence, we suggest a redefinition of the roles of key actors in the sufficiency-based circular economy and a shift from product developers to 'value transformers', from consumers to 'value co-operators', from businesses to 'value gate-keepers' and from policymakers to 'value accountants'. The redefinition of the roles helps us define new practices and behaviours, in favour of value preservation, and allow us to consider how to reduce the influence of the obsolescence strategies.

4.2. From product developers to 'value transformers'

Product developers include designers and engineers who influence the physical product in the development process. They make choices regarding the product's materials, durability, technical solutions,

Table 4

Factors with a negative impact on the value perceived by consumers in the late-use stage and new routes to value preservation.

Factors with negative impact on perceived product value in the late-use stage	New routes to value preservation, late-use stage
Economic Value The cost of repairing the product is high compared to the price of new products (e.g., cost of repair service and spare parts) (King et al., 2006; Jaeger-Erben et al., 2021) Short-term product warranties (Michaud et al., 2017) Functional value Product usability is decreased due to repair (Scott and Weaver, 2014b) The product does not allow repair (e.g., integrated product architecture) or seems non-repairable (Van Nes and Cramer, 2005; Mashhadi et al., 2016) Emotional/ Epistemic/Mental book value Consumers' lack of skills, lack of positive repair experience, knowledge on repair or there is not a recognizable repair process. Ackermann et al. (2018); Diddi and Yan (2019); Harmer et al. (2019); Svensson-Hoglund et al. (2022); Bracqué et al. (2021) Replacement services are more convenient than repair services (Van den Berge et al., 2023; Jaeger-Erben et al., 2021). Social or Sign value Consumer concern for the association between repairing activity/repaid product and economic hardship/poverty. (Terzioğlu, 2021)	Consumers are committed to maintaining, upgrading, and repairing products, and consider these activities as an act of the common good and be deliberate about the environmental benefits. Product developers design products that make repair economically beneficial and make a convenient and easy repair process accessible. Product developers design ways to identify fault indications and diagnosis on the product (inspired by Gonzalez-Arcos et al., 2021) Businesses develop convenient repair services as an integrated part of their business model, they identify and empower a business eco-system to stimulate repair Businesses explore collaboration with other companies, e.g., in terms of standardized spare parts in an eco-system. Businesses collaborate with local manufacturing companies to ensure local accessibility to repair services (Haase et al., 2023) Policymakers promote a legal system for spare parts access and reasonable pricing, encourage repair, for instance by providing a "voucher" that consumers could use to repair a product each year, and support local repair and refurbishment companies.

Table 5

Factors with a negative impact on the value perceived by consumers in the pre-disposal stage.

Factors with negative impact on perceived product value in the pre-disposal stage	New routes to value preservation, pre-disposal stage
Economic Value The monetary upcycling cost (e.g., price, availability, tools) of a product is high compared to purchasing a new product. Functional value The predicted usability of upcycled products is low (Coppola et al., 2021) Emotional/ Epistemic/Mental book value The behavioural upcycling cost is high (e.g., time, effort, upcycling skills) (Sung, 2017)	Consumers consider products, parts, and materials as something valuable and preserve them at the highest level possible. Product developers design or redesign for upcycling possibilities. Businesses include upcycling services and take-back systems that enable remanufacturing as an integrated part of their business model.

aesthetics, etc. (Jensen et al., 2021).

In the current literature, the role of product developers (or designers or engineers) is typically described in terms of 'delivering value' to the consumers through products and services (e.g., Osterwalder et al., 2011) This role is closely related to the linear economy which stops at the point of sale where the ownership and responsibility of the product is conveyed to the consumer. However, to preserve value, product developers need to have a different role, namely, to maintain value in the product for as long as possible. To achieve this, products and services need to cater changing needs of consumers over a longer period. Accordingly, product developers could be considered as 'value transformers' who design products that can be changed or transformed during their lifetime, for instance, products that are designed for repair and

multiple renewals. In this framework, designers will need to make products with high durability, stable quality, and product information, and ensure repairability and upgradability, and incentives for reusing the products—not only at the end of their product life but during the different stages of use. As such ‘value transformers’ accommodate a sufficiency-based circular behaviour and a new role for design and business development from a value preservation perspective.

4.3. From consumers to ‘value co-operator’

Consumers typically refer to the buyers and end-users of a certain product. Consumers are responsible for the use, maintenance, and repair of the product after purchase, which means that their attitudes and mindset towards their products have a significant influence on the product’s lifetime (Van Nes and Cramer, 2005). The term ‘consumer’ indicates a role of ‘consuming value’ which is associated with the linear economy and the take-make-dispose behaviour (Stahel, 2019). Yet in the circular economy, a caring attitude towards products and materials is needed, as every consumer can be assigned some responsibility to lower the environmental impact. Thinking circular economy in terms of a “circular society” includes a more active, engaged and structurally supported role of product users in value creation (Greene et al., 2024; Jaeger-Erben et al., 2021b). Considering consumers as ‘value co-operators’ indicates a different type of role that supports a caring attitude where objects and materials are interacted with, and value is recreated again and again through this interaction. It might entail a shift from ownership to partnership, which supports the circular strategy of selling performance rather than products. This is an important circular strategy that could ensure maximum utility of products and increases value preservation instead of dead storage or premature disposal. As such, considering consumers as ‘value co-operators’ supports the caring attitude that is needed to achieve value preservation in a sufficiency-based economy.

4.4. From businesses to ‘value gatekeepers’

In the linear paradigm, a central role of a business is to optimize the supply chain up to the point of sale, and thus ‘adding value’ to the production (Stahel, 2019) to maximize profit. A main challenge is that a longer use period of products means fewer sales, smaller production volumes and higher unit costs which might not be attractive to many businesses within consumer products but is seen within professional equipment for industry and energy production. Accordingly, businesses (including producers, repairers, service providers, waste managers, etc.) need to find new ways to earn money from selling fewer and longer-lasting products. To preserve value, businesses play an important role in the ecosystem namely, to be the ‘value gatekeepers’ who will be the providers of circular options to the consumers and thus ensure that products and materials are kept in use for as long as possible. This could for instance be achieved through take-back services, prolonged warranties, access to repair options for reasonable prices, renting models, or other product-life extension strategies. This also means that businesses also take over a more caring role, that focus and take care of the everyday life needs of consumers (Beyeler and Jaeger-Erben, 2022) and how they are fulfilled by the product’s different forms of values and not only by buying and owning a product.

4.5. From policymakers to ‘value accountants’

The last group of actors is policymakers who can make regulations and govern the initiatives that can promote a more circular practice, for instance through changes in taxation or repair subsidies. While there are already examples of different initiatives to regulate the longevity of products, such as “Extended Warranty”, ban against planned obsolescence and “Right-to-Repair”, the primary focus is still on the technical aspects (such as handling waste of hazardous products like batteries and

electronic products) that secures a closed loop. Considering this stakeholder group as ‘value accountants’ defines policymakers’ responsibility to ensure that new regulations and governance initiatives will enhance value preservation, and thus set a direction for a sufficiency-based economy in the future. For instance, it is possible to oblige manufacturers to take back their products or components to be remarketed, to stimulate consumers’ circular practice through ecolabels that inform them about products’ environmental impact, implement lifetime labels to influence the expected value from products or to stimulate eco-systems or collective initiatives such as collective take-back process, developing a collective plan for handling after-use products or developing a system for handling secondary and even tertiary consumers.

4.6. New model for value preservation in a sufficiency-based economy

The new roles of value transformers, value co-creators, value gatekeepers, and value accountants also call for new types of actions, practices, and behaviours. The new routes for value preservation can be a starting point in this sense (see Fig. 2 on the following page). In Fig. 2, we have combined the new roles and new routes to value preservation. The model is by no means comprehensive but should be taken as a starting point for future research in value preservation.

5. Conclusion

In this study, we have explored the concept of value preservation as a route away from our current linear patterns of production and consumption with challenges such as over-consumption, premature disposal of products, and growing amounts of waste. The study aimed to identify the factors with a negative impact on the product value perceived by consumers throughout the product lifetime as well as to identify new routes for value preservation and redefine the roles of key actors. This has resulted in a comprehensive mapping of what may lead to a product’s devaluation in the eyes of its consumer in different use stages. The mapping revealed that value preservation is a complex affair with many influencing factors and actors. The study showed, that in all five use stages (pre-acquisition, early use, middle use, late use, and pre-disposal) both product developers, businesses, consumers, and policymakers should play an important role in preserving product value which calls for new practices from all stakeholder categories.

This study contributes to the identification of new roles for key actors and new routes to value presentation, by suggesting that:

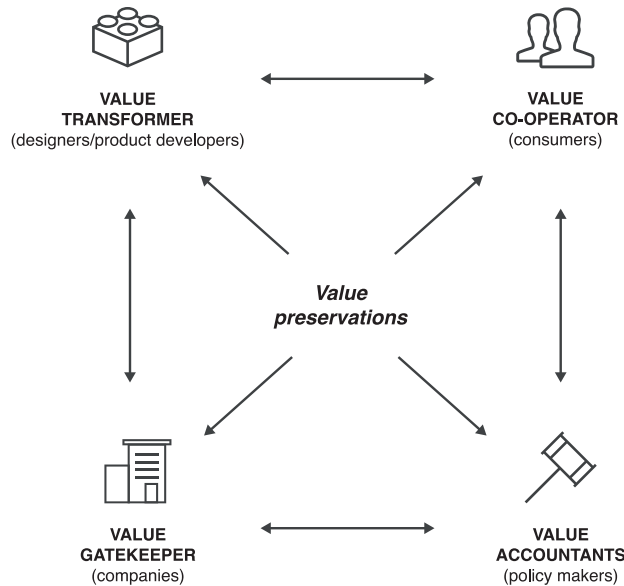
- **Product developers become value transformers**, who cater for consumers’ changing needs over a longer period and design products that can be changed or transformed during their lifetime for multiple renewals.
- **Consumers become value co-operators**, who ensure maximum utility of products and value preservation through multiple use loops.
- **Businesses become value gatekeepers**, who provide circular options to the consumers and thus ensure that products and materials are kept in use for as long as possible and are produced and marketed in a way that enables this.
- **Policymakers become value accountants**, who ensure that new regulations and governance initiatives enhance value preservation, and thus set a direction for a sufficiency approach to production and use.

The new roles are further unfolded in Fig. 2.

This study delivers an important mapping of what it takes to reduce value loss during the product lifetime and contributes with a discussion on how a renewed focus on value preservation can be a key driver for the transition to a sufficiency-based circular economy.

- Know consumers reason for devaluing products, and design products that leads to long-lasting product-user fits.
- Create renewable designs, that allow for upgrades and that accommodate for new features
- Design products for several user and use stages
- Include services that give access to alternative usage that do not require the full performance (useful degradation)
- Design for product - consumer attachment
- Take potential software obsolescence into account.
- Design products that make repair economically beneficial and convenient and easy repair accessible.
- Design fault indications and diagnosis on the product
- Design or redesign for upcycling possibilities.

- Resist impulse purchases and applying thorough investigation of needs, product expectations and behavior before purchase.
- Prioritize durability and long-term functionality rather than short-term immediate social or sign value.
- Slow down the mental accounting processes
- Commit to products in use, or to reselling or sharing
- Consider environmental benefits as a way to signal wealth, competence, or social status.
- Commit to maintaining, upgrade and repairing products, and be deliberate about the environmental benefits.
- Consider products, parts and materials as something valuable and preserve it at the highest level possible.



- Avoid product obsolescence strategies and help user and others overcome barriers for value preservation.
- Provide take-back, and reuse systems for products that do not fit consumer needs.
- Provide information on products to enable alternative usage situations that do not require the full performance
- Be part of an eco-system where producers, retailers, repairers, waste managers support each other with the aim of preserving value and finding alternative ways of earning money.
- Provide standardized spare parts in an eco-system and ensure local accessibility to repair services.
- Include upcycling services and take-back systems.

- Make consumers deliberate and responsible for the products they acquire e.g. by implementing "consumption corridors"
- Enhance product transparency in terms of environmental impact (e.g., lifetime label)
- Encourage the extension actual lifetime
- Inform about expected product lifetime.
- Encourage avoidance of private hoarding of products.
- Encourage circled use e.g., through secondary or even tertiary consumers rights.
- Promote a legal system for spare parts access and reasonable pricing, encourage repair, for instance by providing a "voucher" for citizens' product repair.

Fig. 2. New model for value preservation in a sufficiency-based circular economy.

5.1. Implications for practice and future research

For practitioners, this study contributes with an overview of how and where value declines during the product lifetimes as well as point to, who can change this and what type of actions are needed. Our ambition is to make all actors aware of their responsibilities for value preservation and show how they can play a significant role in ensuring that the inner circles in the sufficiency-based circular economy are functioning.

From a research perspective, this study aspires to be among the first of many to focus on new routes for value preservation. As we have described in the methodology section, the list of new routes for value preservation is not complete. It can be extended by further research. Moreover, many of the suggested new routes to value preservation need to be unfolded, thoroughly developed, tested and experiences analyzed.

Likewise, the new roles of the key stakeholders also point to new avenues for further research. For instance: How can the roles of the key

stakeholders be thoroughly developed and tested? How can the transitions from product developers to value transformers, consumers to value co-operators, business to value gatekeepers, and policymakers to value accountants, be facilitated? And how does this influence the current business and consumption models?

Furthermore, we could assume from our analysis that the character of goods and products do change with a more comprehensive and value-oriented perspective: Products are not just 'passive material' that can be assigned different forms of value, they can also be seen as carriers of value that are constantly and dynamically transformed by a diverse set of circular practices (Jaeger-Erben, 2020). Another interesting observation from mapping is that the different types of value do not include an "environmental value", i.e. the use of a product and its materials to regenerate or restore the environment, as it is currently discussed in the context of regenerative design (Morseletto, 2020). This could be further explored in future studies.

From an implementation perspective, this study calls for more research into how actual product systems and business models are implemented in practice to secure value preservation. There is a need for new business models, where the different actors can gain a benefit from preserving the value of the products, but also retain value e.g. through reuse, take-back, and upgrade of products. This also calls for new forms of ownership of the products based on renting, buy-back, take-back, etc. can be distributed between the actors in ways for preserve the value of the products.

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CRediT authorship contribution statement

Louise Møller Haase: Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ruth Mugge:** Writing – review & editing, Validation, Supervision, Resources, Methodology, Investigation, Formal analysis. **Mette Alberg Mosgaard:** Writing – review & editing, Supervision, Resources, Methodology, Conceptualization. **Nancy Bocken:** Writing – review & editing, Validation, Supervision, Resources, Methodology, Conceptualization. **Melanie Jaeger-Erben:** Writing – review & editing, Supervision, Resources, Methodology, Conceptualization. **Massimo Pizzol:** Writing – review & editing, Validation, Supervision, Conceptualization. **Michael Søgaard Jørgensen:** Supervision, Resources, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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