Full length article

Challenges and opportunities for scaling up upcycling businesses – The case of textile and wood upcycling businesses in the UK

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ABSTRACT

Upcycling is a process in which used or waste products and materials are repaired, reused, repurposed, refurbished, upgraded and remanufactured in a creative way to add value to the compositional elements. It has been part of human life throughout history, and the past few years have seen its revival, driven by multiple factors including growing concern for the environment and resource scarcity. Upcycling increases quality and lifetimes of materials and products, reduces wastes, creates employment opportunities, and encourages sustainable consumer behaviour. Despite such benefits and increasing interest, upcycling is largely considered as a niche practice. One of the important gaps in the current state of knowledge on upcycling is a lack of systemic understanding about challenges and success factors relating to scaling up upcycling businesses. This paper aims to address this gap by employing a broad range of methods for reaching its goal, including literature review, stakeholder analysis, semi-structured interviews, group model building, development of causal loop diagrams, and a workshop with stakeholders and experts to validate causal loop diagrams and discuss promising interventions and how to proceed. The results identified potential actors for the success of upcycling businesses, key challenges and success factors, causal linkages among the challenges and success factors, key system mechanisms, and interventions for scaling up upcycling businesses. Collaboration across the upcycling value chain involving a wide range of actors is also discussed.

1. Introduction

Upcycling is a process in which products and materials that are no longer in use, or are about to be disposed, are instead repurposed, repaired, upgraded and remanufactured in a way that increases their value. This contrasts with recycling, where value is often at least partially lost.

Upcycling, understood as repurpose and repair, has long been a part of human life. Up until the 19th century 'everything one owned was cherished, taken care of, and used to the very limits of its utility' (Fromm, 1976). Then the logic of mass production gradually took over, introducing new virtues of exchangeability, replaceability and throw-away mentality, all in the name of gearing production towards economies of scale (Hawkins, 2001). What followed was a new type of consumption that replaced the traditional long-term engagement with a product by frequent serial replacement of products with new versions and subsequent reduction in product quality and consumer expectations about product performance. At the same time, with the arrival of the consumer society many useful skills, including the skill of maintenance and repair, have largely been lost in the western world (Salvia et al. 2015).

However the past few years have seen a revival of the upcycling trend, driven by multiple factors, such as growing concern for the environment in general and specifically for resource availability and waste volumes (Farrant et al. 2010). There is also growing environmental awareness about the urgency with which we need to address environmental challenges and increase understanding about governance mechanisms for sustainability, requiring engagement of different actors in the transition to a more resource-efficient society. The revival and increase in interest in the circular economy as a concept and practice is attracting the attention of mainstream companies, start-up SMEs and creative industries. Upcycling is regarded as a strategy that aims to reduce environmental impacts by combining circular material flows with slower throughput of products and materials and slower cycles of consumption.

Upcycling is being heralded as a way to increase the quality of materials and products in value chains (Fletcher and Grose, 2012) and counteract the planned and premature obsolescence trend (Sung, 2017). This can create value from post-consumer products and thereby reduce and avoid waste. Upcycling in the manufacturing and creative industries promises to facilitate economic diversification and has potential to create employment opportunities (Khan and Tandon, 2018) and encourage more sustainable consumer behaviour (Harris et al. 2016).

Although research on upcycling is relatively recent, the past decade has seen surge of publications on upcycling, in disciplines ranging from engineering and management to consumer studies, and the body of literature is growing. Research shows that upcycling has a role to play in slowing and/or closing material cycles (EMF, 2013), along with other benefits, such as creating economic opportunities, stimulating entrepreneurship, supporting the culture of prosumerism (Seravalli, 2016), and advocating reuse over recycling (Sung, 2017). More importantly, some studies show that upcycling may not only help reduce environmental impacts associated with production and consumption of clothes, but may also help reduce production of new clothes (Farrant et al. 2010).

Although the importance of upcycling practice is growing, academic literature on upcycling remains fragmented (Paras and Curteza, 2018). Previous research focused mostly on textiles and fashion (e.g. Han et al. 2015), while upcycling of other product groups, such as furniture and wood products, remained largely unexplored. A recent literature review of upcycling of textiles (Paras and Curteza, 2018) was among the first of its kind. Other research on fashion upcycling focused on conceptualisation of the research field, development of textile upcycling processes and design guidelines, and on exploration of consumers' intentions to purchase upcycled fashion products. Extensive work by Sung (2017) explored the business side of the upcycling business, and roles and challenges faced by different stakeholders in upcycling value chains. Direct linkages could be observed between the challenges and success factors identified by individual stakeholders (Sung et al., 2017a,b).

Uncertainty remains about the relations between challenges and success factors across upcycling value chains, the underlying causal mechanisms that are responsible for these challenges, and how these challenges could be systematically approached. Research also confirms that upcycling practices are typically small-scale operations, often run in niches. To date, there has been little research on scaling them up as a way to facilitate transition to sustainability.

Scaling up upcycling businesses requires sound insights into different sets of challenges and success factors. The aim of this study is to improve understanding of the systemic nature – interlinkages and interdependencies – of factors relevant to scaling up upcycling businesses in the UK. Three research questions are posed:

- What are the general challenges and success factors encountered for upcycling industries, based on a literature review?
- What are the main challenges and success factors for scaling up upcycling businesses in the UK, as perceived by main actors in the upcycling value chain?
- What are some of the key systems that could enable scaling up the upcycling businesses in the UK?

We explore these research questions by analysing stakeholders in two types of value chains: textiles and furniture.

The next section reviews the current status in mainly academic literature on upcycling of textiles and furniture, and highlights the gaps in knowledge addressed in this study. In Section 3 a range of methods used to answer the research questions are described. The results presented in Section 4 show the perceived challenges and success factors for upscaling textile and furniture upcycling businesses in the UK, which are then linked through cause and effect relationships into causal loop diagrams. Section 5 discusses key interventions for scaling up upcycling businesses and the role of different stakeholders in implementing them, both individually and in a concerted action. Conclusions are drawn in section 6.

2. Literature review

2.1. Upcycling in textiles and furniture sectors

Upcycling is an emergent area of academic inquiry and practice. Literature on upcycling is extensive, spanning not only academic disciplines, but also a broad range of grey literature. There are differences in how upcycling is understood in industrial terms (Cassidy and Han, 2017), as conducted by SMEs and creative entrepreneurs (Fletcher and Grose, 2012), and if performed by individuals and households (Bridgens et al., 2018). This explains the difference in definitions proposed by scholars and used by practitioners, some of which equate upcycling with improved recycling, while others only include activities that repurpose and reuse products and *"materials that are either discarded, or are not being used anymore"* (Fletcher and Grose, 2012) to create a higher-value product (Janigo and Wu, 2015) or, as expressed by EMF (2013), to create *"cradle-to-cradle 'metabolisms' that enable materials to maintain their status as resources and accumulate intelligence over time (upcycling)"* (EMF, 2013: p. 23).

One sector that features prominently in literature on upcycling is fashion and textiles, e.g. (Earley, 2011). This can be explained by several fast-changing trends in the fashion industry, such as high consumption rates and shortening of life-spans, increasing the amounts of textile waste (Dissanayake and Sinha, 2015). Research on upcycling in fashion ranges from process-oriented studies exploring best options for upcycling certain fibres and materials (Paras and Curteza, 2018) to studies investigating consumer attitudes towards upcycled products (Kamleitner et al., 2017; Bhatt et al., 2018) and the role different actors play in upcycling (Sung, 2017).

It has been argued that upcycling requires actors in the textile industry to "rethink the role and value of fashion product" (Fletcher, 2013: 108). With growing consumer awareness about environmental and social impacts of fashion products, upcycling and personalising fashion products has become a new prosumption trend (Goldsmith, 2009). Actors in value chains are exploring opportunities and challenges generated by this change in consumer attitudes, which is affecting their often traditional business models that follow the take-make-waste logic (Gardetti and Torres, 2017). This type of research usually focuses on supply chains of large textile and fashion industries, but neglects the value chains of creative entrepreneurs and upcycling SMEs (Sung, 2015).

Another sector that has much in common with the fashion and textile industries in terms of upcycling practices is furniture and wood. However, little research has been conducted that explores small businesses and creative entrepreneurs engaging in upcycling of furniture from management and organisational perspectives (Guiot and Roux, 2010). Many studies explore the technical side of upcycling furniture and wood (e.g. Wang et al., 2018). The main methods for furniture upcycling seem to be repainting, repurposing and refurbishing. According to Hjelmgren et al. (2015), the possibility to use waste products is greater in the furniture industry than in the textile sector because of more localised and flexible production. Studies that explore driving forces for furniture upcycling highlight environmental awareness about growing waste volumes and high residual value of discarded furniture as the main factors (Sung, 2017).

2.2. Challenges for scaling up

Perhaps the biggest challenge for upcycling is summarised by Hirscher et al. (2018), who observe that upcycling necessitates "systemic changes to the linear fashion scheme, which is currently driven

by fast, cheap and low quality production that fosters easy disposal or replacement, due to the low product value for the customer/user".

Sung et al. (2017a,b) presented a set of five more specific challenges for scaling up upcycling activities currently faced by small-scale upcycling businesses in the UK.

The first challenge was difficulty of sourcing sufficient and appropriate quality of used materials. Unlike the large volumes of uniform resources and materials available for linear production from by-products and production waste, as well as returned defect products or unsold items from stores (Aus, 2011), upcycling businesses are struggling to secure a predictable flow of materials and products of similar or consistent quality. Here, the distinction between industrial upcycling and upcycling done in SMEs by creative entrepreneurs and households is critical. Storing used materials for later upcycling was also mentioned as a challenge (Sung et al., 2017a,b); this may be due to the small scale of operations and consequently small facilities used by the upcycling businesses in the UK. The cost of renting or owning premises also plays a role.

Upcycling is often a time-consuming activity (Coote et al., 2010), which is not usually reflected in the price (Sung et al., 2017a,b). Individually upcycled items often have relatively high price, which becomes a barrier to establishing a successful upcycling business (Zhao et al., 2013; Das and Dutta, 2015). It has also been reported that it is more difficult to develop profitable business models for the upcycling of low-priced products than high-value items (Larsson, 2018).

Marketing of one-off upcycled items is also mentioned as a challenge that requires much time (Sung et al., 2017a,b). It is not always easy to position such products on the market or even to find a suitable channel or marketplace, although with the general growth in the number of online platforms and offline outlets, this seems to be a relatively minor challenge.

Space for work is a challenge for those upcycling entrepreneurs and businesses who work from home, but also for those who rent space and often have to pay high rent (Sung et al., 2017a,b). In addition, upcycling operations often require specialist skills, equipment and tools (Coote et al., 2010).

Only a small number of consumers seem to be interested in upcycled products, with most consumers having a clear preference for mass-produced goods (Sung et al., 2017a,b). Reasons for the lukewarm interest of consumers in upcycled products include suspicion towards reused materials and products and fear of product failure. In the textile sector, for example, upcycling cannot offer the full range of sizes, so can only cater to a small group of consumers (Aus, 2011).

2.3. Success factors for scaling up

Sung et al. (2017a,b) identified five success factors for scaling up upcycling businesses. Favourable consumer attitudes toward upcycled products and upcycling businesses in general, and understanding the importance of upcycling in the transition towards sustainable society, have been identified as the most important success factor for upscaling upcycling businesses (Sung et al., 2017a,b). Indeed, capitalising on the potential of creative upcycling to reconnect people with materials may lead to the re-establishment of the culture of making (Bridgens et al., 2018). One study shows that scaling up of upcycling might be more easily achieved if it is targeted at a specific group of users; in this case the potential target group for scaling-up in the UK was people in art and design aged 30 years or older (Sung, 2017).

The second success factor is, unsurprisingly, financial and business management support to upcycling businesses. This includes different types of grants and loans as well as favourable conditions for acquiring equipment (Sung et al., 2017a,b).

Support with marketing and sales of upcycled products have been identified as success factors (Sung et al., 2017a,b). Both online marketplaces and offline traditional physical stores and pop-up shops can

be used to sell upcycled products, and increase their visibility and competitive advantage.

Since ensuring a predictable and stable flow of reused materials and products of consistent quality is a challenge for upcycling businesses, quality assurance of sourced materials becomes an important factor for success of upcycling operations. Securing work facilities and the possibility to borrow, rent or lease professional tools are also important factors for the prosperity of upcycling businesses (Sung et al., 2017a,b).

Creating and maintaining networks among upcycling entrepreneurs and businesses allows sharing of skills and expertise (Seravalli, 2016), but also sharing of work as a way to deal with workload peaks (Sung et al., 2017a,b). Collaboration with large-scale companies that can provide access to large volumes of discarded products from their operations (e.g. corporate wardrobe or textiles used in production process) can be also a critical factor for ensuring a steady flow of material supply for upcycling project (Bridgens, Powell et al. 2018).

Another factor reported is timeless design and high quality materials to ensure the longevity of upcycled products (Woolley, 2010).

3. Methodology

3.1. Literature review

The literature review process follows well-established guidelines for literature analysis (Okoli, 2015). The review started with the Web of Science database, but most sources on upcycling came from engineering and technical design journals. A decision was therefore made to use a Google Scholar search, which covers a broader range of academic journals and conferences.

To obtain a general understanding of the current status of research on upcycling, we started by conducting a title search based on the search terms 'upcycling' and 'upcycle'. This resulted in an initial set of 213 articles. Articles of relevance to this study were then selected manually. The retrieved articles were analysed on the basis of title, abstract, and keywords. The two main selection criteria were (1) the match to the concept of upcycling or upcycle, and (2) the focus on the textile/fashion and furniture/wood sectors. A paper was excluded from the review if the notion of upcycling was only briefly mentioned and was not the main focus of the paper or had not been considered using a valid methodology (i.e. a framework or model, case study, survey, interview, or literature review). In cases of doubt, the paper was selected for a full-text analysis. The process resulted in 21 articles for further review.

3.2. Stakeholder analysis

Fig. 1 provides an overview of the research design and different methods employed in this study at different stages.

We began by conducting a stakeholder analysis to identify key actors active in existing upcycling value chains in the UK. Expert interviews with six academics in design, business, waste management and consumer studies at Nottingham Trent University as well as keywords-based literature review and online search were conducted to identify relevant actors. The following actors were identified as being involved in upcycling value chains: suppliers, upcycling designers and makers, retailers, consumers, research networks, public authorities, industries and supporting organisations.

In this study we focused on the following key actors: suppliers, upcycling designers and makers (i.e. upcyclers), retailers, consumers and research networks. We consider the rest of the actors as being part of the landscape regime affecting the key actors in the upcycling value chain, but not directly involved in the value chain as such. A number of actors and consumers were contacted, with an invitation to participate in the study. Table 1 shows the demographic information about the
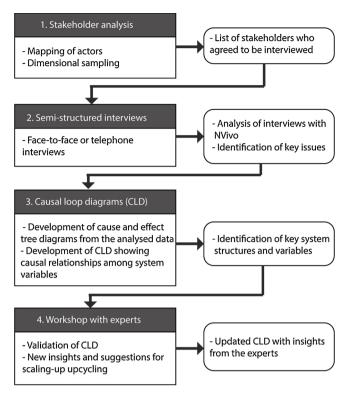
Fig. 1. Stages in the methodology employed in this study.

Table 1
Socio-demographic characteristics of interview participants.

Interviewee characteristics		Frequency	
		Practitioners (n = 22)	Consumers (n = 7)
Gender	Female	16 (72.7%)	4 (57.2%)
	Male	6 (27.3%)	3 (42.8%)
Age group	Under 35	2 (9.1%)	2 (28.6%)
	35 to 54	11 (50%)	3 (42.8%)
	55 and over	9 (40.9%)	2 (28.6%)
Nationality	British	17 (77.3%)	7 (100%)
	Italian	2 (9.1%)	0 (0%)
	Australian	1 (4.5%)	0 (0%)
	Danish	1 (4.5%)	0 (0%)
	Irish	1 (4.5%)	0 (0%)
Education	Secondary	3 (13.6%)	0 (0%)
	Further	1 (4.5%)	0 (0%)
	Higher	18 (81.8%)	7 (100%)
Occupation / study areas	Art and design	13 (59.1%)	2 (28.6%)
	Business	9 (40.9%)	1 (14.2%)
	Construction	0 (0%)	2 (28.6%)
	Miscellaneous[a]	0 (0%)	2 (28.6%)

[a] Miscellaneous occupational or study areas were sustainable development and occupational therapy.

stakeholders interviewed in this study.

About half of practitioners were sole traders (n = 10, all upcyclers), six were limited companies (1 material supplier, 4 upcyclers and 1 retailer), five registered charities (2 material suppliers, 1 upcycler and 2 retailers) and one partnership (material supplier). Their size of business was mostly micro (n = 20), one was small size (number of employees: 34), and another was medium size (number of employees: 110). Annual turnover of micro businesses ranged between £1000[1] and £500,000, with the average of £70,000. The small business' turnover was

£650,000 and the medium-sized business' was £5,000,000.

3.3. Semi-structured interviews

In the next stage, the groups of stakeholders identified in the stakeholder analysis were approached with a request for interviews. A total of 98 material suppliers, 134 upcycling enterprises and 70 retailers were contacted via email. For the recruitment of consumers, convenience sampling (based on convenient accessibility and proximity to the researcher (Robson, 2011) was used.[2] No criteria other than a quota for age and gender (at least one female and one male in the age groups of between 18 and 34 years, between 35 and 54 years, and between 55 and 64 years) was used for sampling. Twenty-two practitioners and seven consumers agreed to be interviewed for this study. Semi-structured interviews were held with these stakeholders to collect data on challenges and success factors for upcycling businesses in the textile and furniture sectors in the UK. The interviews were conducted and fully audio-recorded with the consent of all the participants and none of the interviewees reported any conflict of interest. No compensation was provided for the interviewees.

Table 2 shows the questions that guided the interviews. The interview data was analysed using QSR Nvivo 10® to identify key system variables. NVivo is one of the Computer Assisted Qualitative Data AnalysiS (CAQDAS) packages to facilitate quick, easy and consistent coding with a substantial amount of qualitative data (Robson, 2011). Among all CAQDAS packages, NVivo is known to be the preferred option for qualitative data analysis as it includes systemic handling of codes (Robson, 2011; Silver and Lewins, 2014).

3.4. Group model building

In the next stage, group model building was employed to map the interlinkages between stakeholder perceptions about upcycling value chains. Group model building is a process where various stakeholders exchange their perceptions of an ill-defined or messy problem, its underlying causes, and potential solutions (Vennix, 1996, 1999). Some of the pervasive characteristics of messy problems include stakeholders' narrow view of the problem, often limited to their immediate concerns, which in turn leads to multiple perceptions of similar situations by different stakeholders (Vennix, 1999). These stakeholders therefore fail to view the overall problem and the solutions to the problem. Some of the challenges facing upcycling emanate from the current alignment of activities or business routines carried out by these stakeholders, while the underlying causes of other challenges lie in the sociotechnical regimes within which the upcycling activities take place.

As illustrated in Fig. 2, an upcycling value chain involves several stakeholders.

3.5. Causal loop diagram (CLD)

Once the interlinkages between stakeholder perceptions about upcycling value chains had been identified, we then employed a systems modelling technique, causal loop diagrams (CLD), that enable a qualitative exploration of variables and their interrelationships in a system (Andersen et al., 2007; Laurenti et al., 2016). CLD constitutes a step to evaluating a problem and identifying its solutions via a relevant system structure containing an influence diagram (Laurenti et al., 2016). In this study, CLD is used to bring together variables that are often treated in isolation by different stakeholders, and to identify key causal and feedback mechanisms in the upcycling value chains.

In a CLD, variables are connected by an arrow and an assigned positive ('+') or negative ('-') polarity to represent causal relationships

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[1] Based on part-time hobby business.

[2] The 2nd author contacted her acquaintances and put recruiting advertisement hard copies at the several spots in Nottingham Trent University.

Table 2
Interview questions for each stakeholder group.

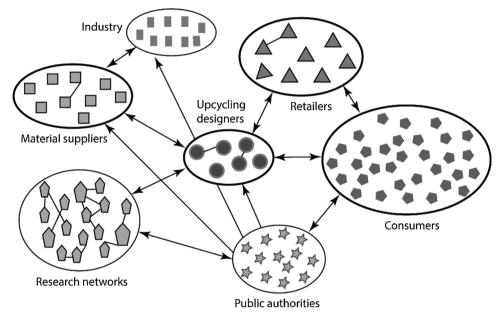| Category	Question	Stakeholder
Challenges	What are the challenges to increasing supplies of suitable materials for customers (upcycling businesses)?	Material suppliers
	What are the challenges for expanding/growing your business?	Upcycling designers and makers
	What are the challenges to selling more upcycled products?	Retailers
	What are the challenges about buying more upcycled products?	Consumers
Key challenges	Which challenge is the biggest one?	All stakeholders
Success factors	What help do you need to increase supplies of suitable materials for customers (upcycling businesses)?	Material suppliers
	What would you need to expand your business?	Upcycling designers and makers
	What could encourage more people to buy upcycled products?	Retailers
	What could encourage you to buy more upcycled products?	Consumers
Suitable actors	Who needs to act?	All stakeholders
Key success factors	Which help/idea/solution would be the most important one?	All stakeholders

Fig. 2. An overview of relevant actors across the upcycling value chain.

among the variables. A positive polarity indicates that both variables move in the same direction (increasing or decreasing) in response to a change in the variable, and vice versa. CLDs facilitate qualitative understanding of interrelationships among variables in a system through feedback loops. Feedback loops in a system can be of two types – reinforcing and balancing. In this study, the group model building process was adapted because the stakeholders participated in the study at different times and places. The coded interview data was employed to identify key problem variables, their causes and consequences or effects (see Fig. 3). These interrelationships were presented in cause and effect tree diagrams. Cause tree diagrams represent the underlying causes for a variable and effect tree diagrams represent various effects or consequences of a variable.

3.6. Workshop with stakeholders and experts

A workshop with five invited stakeholders (representing actors identified in section 0) and seventeen experts (representing researchers and academics in business, consumer behaviour, design, engineering, fashion and policy) was arranged, to validate the CLDs developed from the coded interview data. The stakeholders included three practitioners from small businesses (1 sole trader and 2 micro businesses) and two consumers[3]. The experts were from De Montfort University,

Loughborough University, Nottingham Trent University and University of Bristol in the UK. The participants were fourteen males and eight females. Fifteen were British, two Indians, one Danish, one German, one Korean, one Iranian and one Italian. The aims of the workshop were to discuss and validate the causal loop diagrams and gain new insights and suggestions for scaling up upcycling businesses in the UK and beyond. The workshop participants were provided with the coded interview data in advance and were asked to prepare for the workshop.

The participants worked in groups and discussed interventions that are crucial for scaling up upcycling SMEs in the UK and identified actors who should implement them. They also addressed the question of how to make actors work together for the common goal, since it is known that multiple actors should be involved in planning and implementing interventions for scaling up.
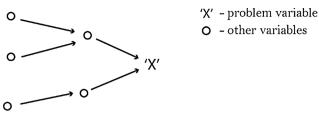
4. Analysis and discussion

In this section we present outcomes of analysis of data about upcycling businesses in the UK.
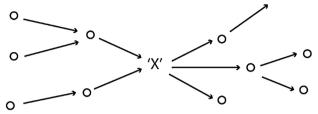
4.1. Potential actors for the success of upcycling businesses

In order to address the challenges to and improve success factors for scaling up upcycling businesses, stakeholders in the upcycling value chain were asked to identify actors who they felt play important roles in upscaling upcycling business in society (Table 3). Material suppliers
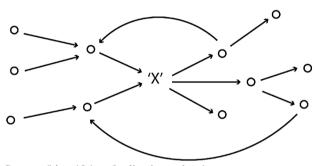
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[3] Invitations were sent to the interviewees and these five workshop participants were the ones who accepted the invitation.

'X' – problem variable
○ – other variables

Step 1. Identifying a problem variable and its causes

Step 2. Adding effects or consequences of the variable

Step 3. Identifying feedback mechanisms

Fig. 3. Stepwise process of developing cause and effect tree diagrams. Adapted from (Vennix, 1999).

identified individual activists and volunteers, such as scrap stores, and national organisations such as Reuseful UK to provide legal and legislative support and to liaise among material suppliers. They also identified local councils because of their responsibility to support lease and rent of their place, while various companies can play a role of financial supporters.

Upcycling designers and makers saw themselves as actors who were responsible for bringing about change. Retailers, on the other hand, identified social media, celebrities, consumers and volunteers as important actors for effective marketing and education of the public, by spreading the word about upcycling and for increasing awareness and appreciation of the skills and time involved in upcycling.

According to the interviewed consumers, businesses should be responsible for transforming their normal business practices to more sustainable ones, for example by incorporating upcycling as part of their manufacturing or analysing whether upcycling would bring benefits. Consumers also considered the media to have an important role in disseminating information about upcycling. They saw governments as having a role of providing financial support, such as grants and fiscal incentives or offering tax reductions for upcycling organisations. Consumers wanted local councils to become funders and supporters of local upcycling SMEs. They also recognise their own role in being responsible consumers.

4.2. Challenges and success factors for upcycling businesses

Interviews with stakeholders (based on the questions presented in Table 2) in the upcycling value chain helped identify challenges faced by these stakeholders when considering scaling up upcycling businesses (Table 4). Stakeholder views on challenges to upcycling varied considerably within as well across the four stakeholder groups – material suppliers, upcycling designers and makers, retailers, and consumers. This is mainly due to their linear view of the challenges that concern issues immediate to them.

Fig. 4 provides an overview of the challenges faced by the stakeholder groups. Challenges for material suppliers in the textile and wood upcycling sectors include lack of availability of materials, complex legislation, lack of funding, risks and financial difficulties. Challenges for upcycling designers and makers mainly concern a lack of affordable resources, such as working space, equipment, time, skilled labour and raw materials needed to carry out upcycling activities, marketing of upcycled products, and consumers' negative perception of upcycled products. Retailers identified challenges

Table 3
Stakeholder perspectives on potential actors who could support the upcycling business value chain.

Stakeholders	Product sector	
	Textiles	Wood
Material suppliers	- Businesses - Activists and volunteers - Local councils - National organisations	- Activists, volunteers and users - Local councils - National organisations - Businesses
Upcycling designers	- Upcycling entrepreneurs	- Upcycling entrepreneurs - Government - Volunteers - Local councils
Retailers	- Entrepreneurs and employees - Social media - Celebrities - Consumers - Volunteers	- Upcycling entrepreneurs - Companies - Consumers - Academia - Government
		Upcycled products
Consumers		- Designers and makers - Government - Businesses - Media - Local councils - Consumers

Table 4
Stakeholders' perspectives on challenges and success factors for upcycling businesses in the textile and wood sectors in the UK.

	Material suppliers to source materials	Upcycling designers / makers	Retailers selling upcycled products	Consumers buying upcycled products
Challenges:	• Lack of availability of materials (8) • Complex legislation (3) • Lack of funding (3) • Risks and financial implications (3)	• Lack of affordable resources (space, time, equipment, skills and materials) (17) • Expensive marketing of upcycled products (13) • Lack of materials with suitable quality and quantity (8) • Lack of motivation to expand business (3) • Consumers' negative perception of upcycled products (2)	• Lack of resources for suitable marketing of upcycled products (12) • Outreach of upcycled products (7) • Consumers' perception of upcycled products (4) • Financial constraints (3) • Availability of good-quality upcycled products (1)	• Availability of good-quality products (4) • Availability of affordable products (3) • Accessibility of affordable products (2) • Positive perception of upcycled products (2)
Success factors:	• Raising awareness for material donation (4) • Legislative support (4) • Provision of financial support (2)	• Availability of critical resources, e.g. skilled staff (7) • Financial support for skills development, work environment and marketing (8) • Greater marketing of upcycled products (5)	• Effective marketing (15) • Consumer awareness (7) • Improved quality of products (5)	• Awareness about upcycled products (5) • Better purchasing experience, e.g. availability of upcycled products (4) • Lower price of upcycled products (2)

caused by lack of resources for effective marketing and outreach of upcycled products, lack of funding opportunities, and consumers' perception of upcycling products as overpriced. Customers identified the main challenges to buying more upcycled products as lack of availability, affordability and accessibility of good quality upcycled products. This overview of stakeholder perceptions of challenges also enabled insights on interlinkages among these challenges (presented in Section 4.2).

Stakeholders recognised a number of success factors for addressing the challenges (Fig. 5 and Table 4). The success factors were found to be closely linked to the challenges identified by the individual stakeholder groups. Key success factors recognised by material suppliers included raising awareness among industries for (waste) material donations, legislative support from local councils to collect and use discarded materials, and provision of financial support from the local councils for leasing and renting of space. According to upcycling designers and makers, financial support is required for developing upcycling skills, improving the work environment, and increasing marketing of upcycled products. Retailers identify effective marketing, consumer awareness and improved quality of upcycled products as success factors. Finally, success factors that might encourage consumers to buy more upcycled products include awareness about upcycled products, an improved purchasing experience (i.e. availability of a variety of upcycled products), and lower price of upcycled products.

4.3. Causal linkages among the challenges and success factors

Although direct linkages could be observed between the identified challenges and success factors mentioned by individual stakeholders, it was not clear 1) if and how these challenges and success factors were interrelated across upcycling value chain, and 2) which underlying causal mechanisms were responsible for these challenges and how they could be systematically approached. To address these, the interview data was further analysed to identify causal links among the challenges and success factors identified by the stakeholders in the upcycling value chain. The causes and uses trees provided information on causal interlinkages and feedback loops among various variables.

Fig. 6 shows causes and effect tree diagrams for 'consumer demand for upcycled product'. According to the interviews, consumer demand for upcycled products is directly dependent on 'access to consumers', which in turn depends on 'marketing expenditure' and 'consumers' intentions to buy the upcycled products', which further depends on 'price of upcycled products' (Fig. 6a). Similarly, 'consumer demand for upcycled product' affects 'price of upcycled products', further affecting 'consumers' intentions to buy the upcycled products' and 'customer demand' for raw materials, i.e. demand for material by upcyclers and designers (Fig. 6b). Similarly, Fig. 7 shows causes and effects diagram for 'sales of upcycled products'.

In the diagram, reoccurrence of variables such as 'availability of the upcycled products with high quality and variety' and 'consumers' intentions to buy the upcycled products' indicates the presence of a feedback loop among these variables. Based on these diagrams, various cause and effect relationships between different variables relating to challenges and supporting factors were identified (see Table 5).

Success of an individual stakeholder across the upcycling value chain is clearly interdependent with the other stakeholders, despite the stakeholders in the interviews only mentioning the issues immediate to them. This indicates a linear view of the stakeholders on the challenges as well as success factors relating to upcycling. To provide a holistic perspective on the inter-relationships among the challenges and success factors, the cause and effect relationships identified above were used to create a CLD illustrating various interlinkages among these factors (Fig. 8).
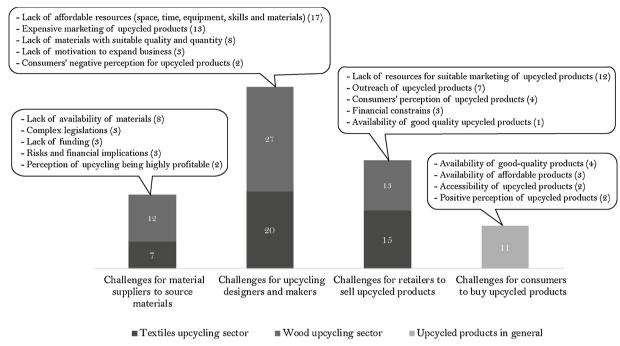
Fig. 4. Stakeholder perspectives on challenges to upcycling businesses in the textile and wood sectors in the UK[4].
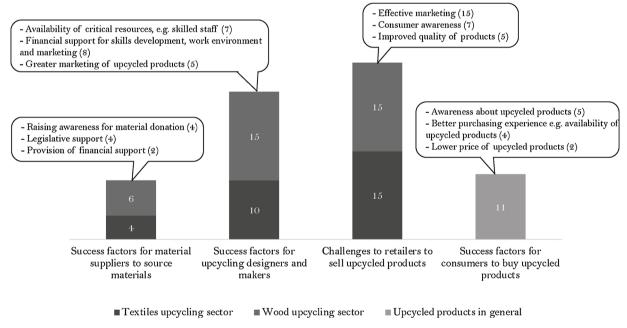

Fig. 5. Stakeholder perspectives on success factors for upcycling businesses in the textile and wood sectors in the UK.

4.4. Key system mechanisms and interventions for upscaling the upcycling businesses

The cause and effect interlinkages were discussed and validated during the workshop with experts. The workshop provided new insights on the interlinkages and suggestions for scaling up upcycling businesses. The validated CLD provided insights into some of the key system mechanisms essential to scaling up the upcycling businesses. These interdependent system mechanisms were: (a) increasing consumer demand for the upcycled products; (b) effective marketing of the upcycled products; (c) provision of critical resources to the makers/designers; and (d) improving the availability of materials for the suppliers.

Key interventions proposed by experts during the workshop for scaling up the upcycling businesses are shown in Table 6, divided into

infrastructure-oriented, regulatory/institutional-oriented and economic incentive-oriented.

4.4.1. Consumer demand for upcycled products

A number of feedback structures underlying the system mechanisms were identified (for more details on key feedbacks structures see Appendix A). Four underlying feedback mechanisms affecting 'consumer demand for the upcycled products' are shown in Fig. 9. One of these feedback loops – Loop 1: Consumer Demand – Prices (Consumer demand for upcycled products – Price of upcycled

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[4] The number in brackets shows the frequency of occurrence of a particular issue among the interviewees.

(Availability of the upcycled products
with high quality and variety)

Marketing expenditure (retailers) ————

Marketing expenditure (upcyclers/designers)

Access to consumers

Availability of the upcycled products
with high quality and variety

Price of upcycled products ————

Consumers' positive perception of
upcycled products

Consumers' intentions
to buy the upcycled
products

Consumer demand for
upcycled products

(a)

Customer demand (retailers and/or upcyclers) ——— Demand for materials

Consumer demand for
upcycled products

Price of upcycled products ——— Consumers' intentions to buy the upcycled products
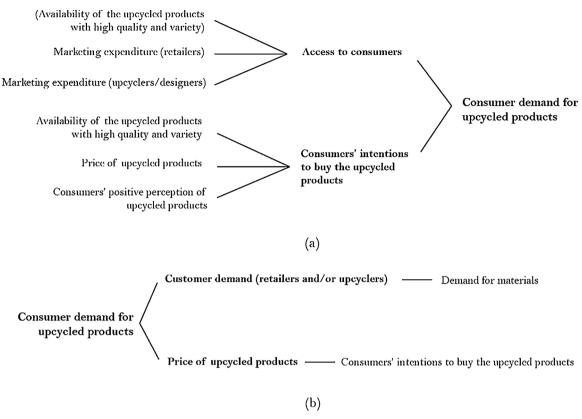
(b)

Fig. 6. Illustration of (a) causes tree diagram showing underlying causes for 'consumer demand for upcycled products' and (b) effect tree diagram showing effects of 'consumer demand for upcycled products'.
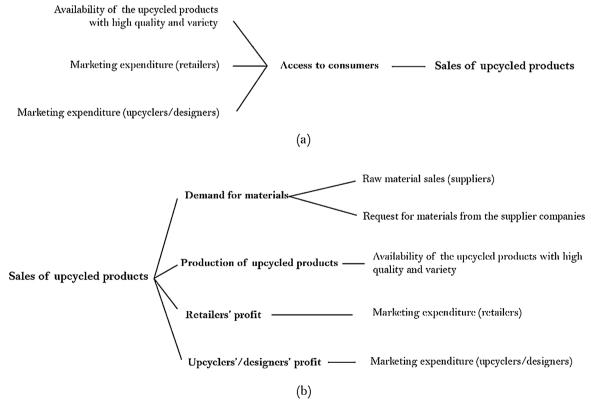
Availability of the upcycled products
with high quality and variety

Marketing expenditure (retailers) ————

Marketing expenditure (upcyclers/designers)

Access to consumers ——— Sales of upcycled products

(a)

Raw material sales (suppliers)

Demand for materials

Request for materials from the supplier companies

Production of upcycled products ——— Availability of the upcycled products with high quality and variety

Sales of upcycled products

Retailers' profit ——————— Marketing expenditure (retailers)

Upcyclers'/designers' profit ——— Marketing expenditure (upcyclers/designers)

(b)

Fig. 7. Illustration of (a) causes tree diagram showing underlying causes for 'Sales of upcycled products' and (b) effect tree diagram showing effects of 'Sales of upcycled products'.

Table 5
Identifying cause and effect (or consequence) relationships between different variables relating to challenges and supporting factors identified during the stakeholder interviews.

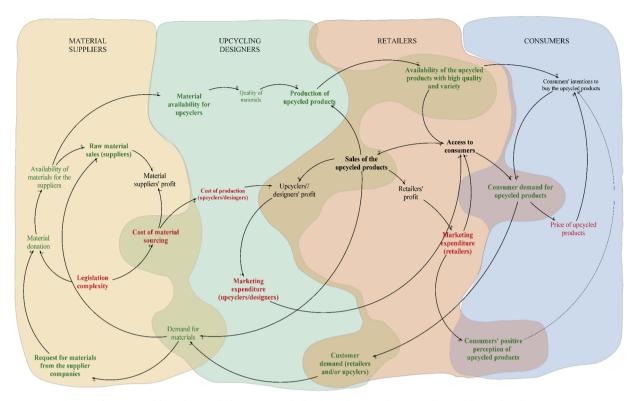| Key variables	Causes		Effects	
	Main causes	Further causes	Main effects	Further effects
Consumer demand for upcycled products	Access to consumers	- Availability of the upcycled products with high quality and variety - Marketing expenditure (retailers) - Marketing expenditure (upcyclers/designers)	Customer demand (retailers and/or upcyclers) Price of upcycled products	- Demand for materials - Consumers' intentions to buy the upcycled products
Sales of upcycled products	Consumers' intention to buy the upcycled products Access to consumers	- Availability of the upcycled products with high quality and variety - Availability of the upcycled products with high quality and variety - Marketing expenditure (retailers) - Marketing expenditure (upcyclers/designers)	Demand for materials Production of upcycled products Retailers' profit Upcyclers'/designers' profit	- Raw material sales (suppliers) - Request for materials from supplier companies - Availability of the upcycled products with high quality and variety - Marketing expenditure (retailers) - Marketing expenditure (upcyclers/designers)
Availability of the upcycled products with high quality and variety	Production of upcycled products	- Quality of materials - Sales of upcycled products - Variety of materials	Access to consumers Consumers' intentions to buy the upcycled products	- Consumer demand for upcycled products - Sales of upcycled products - (Consumer demand for upcycled products)
Availability of materials for the suppliers	Material donation	- Legislation complexity - Request for materials from the supplier companies	Material availability for upcyclers	- Quality of materials - Variety of materials - Material suppliers' profit
Material suppliers' profit	Cost of material sourcing Raw material sales (suppliers)	- Legislation complexity - Availability of materials for the suppliers - Demand for materials	Raw material sales (supplier)	
Upcyclers'/ designers' profit	Cost of production (upcyclers/designers) Sales of the upcycled products	- Cost of material sourcing - Access to consumers	Marketing expenditure (upcyclers/designers)	- Access to consumers
Retailers' profit	Sales of the upcycled products	- Access to consumers	Marketing expenditure (retailers)	- Access to consumers - Consumers' positive perception of upcycled products
Consumers' intentions to buy the upcycled products	Availability of the upcycled products with high quality and variety Consumers' positive perception for upcycled products Price of upcycled products	- Production of upcycled products - Marketing expenditure (retailers) - Consumer demand for upcycled products	Consumer demand for upcycled products	- Consumers' intentions to buy the upcycled products

Fig. 8. Causal loop diagram linking various challenges and success factors in the upcycling value chain.

products – Consumers' intentions to buy the upcycled products) – shows how the prices of the upcycled products affect consumer' demand for the upcycled products. Some of the key interventions proposed by the experts in the workshops concerning this loop include devising awareness campaigns to inform consumers about the true cost of products (including the environmental aspects, i.e. consumers' positive perception of upcycled products), teaching mending skills to people, and improving outreach through media coverage. According to the experts, such awareness campaigns could be organised by regulatory institutions and trade organisations, etc. The other three loops are part of the other system mechanisms.

4.4.2. Effective retail marketing

Two feedback mechanisms driving marketing by retailers are illustrated in Fig. 10. Loop 1: Marketing expenditure – Retailers' profit shows how market expenditures could result in access to more consumers, generating more sales of the upcycled products, leading to

more profit for the retailers. The experts suggest promoting upcycled products through venues, funding etc. by the upcyclers, and financial support for upcycling businesses from the government. Loop 2 in Fig. 10 is also a part of the other system mechanisms.

4.4.3. Provision of critical resources to the makers/designers i.e. raw material, skills and expertise

The feedback loop represented in Fig. 11 is a fundamental system structure of the upcycling value chain. The experts in the workshop identified as main challenges the lack of access to materials and expertise to deliver high-quality upcycled products. These experts proposed improving educational capacities and technical expertise at the educational institutions to improve the quality and address the compliance-related issues associated with the upcycled products. Another suggestion was provision of a platform by government or local councils for knowledge exchange among the actors across the upcycling value chain to initiate and support upcycling projects. Such a joint platform

Table 6
Key interventions suggested by the experts during the workshop.

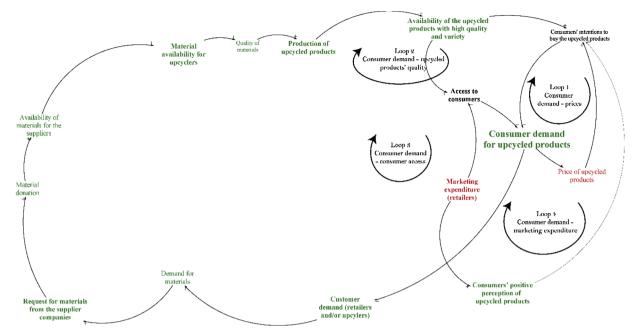|	Responses on key interventions:	Responses on who should act:
Infrastructure-oriented	1. Creating infrastructure for material database material provision and testing, e.g. through a joint platform or crowdsourcing	A non-governmental organisation or a consortium of actors across the upcycling value chain
	2. Providing a platform for knowledge exchange among the actors across upcycling value chains to initiate and support upcycling projects	Government and local councils
	3. Sorting materials at disposal centres and directing them to the material suppliers	Councils, charities
Regulatory/ institutional-oriented	1. Promoting upcycled products through venues, funding etc.	Upcyclers
	2. Devising awareness campaigns to: - spread awareness about the true cost of products (including the environmental aspects) - teach mending skills to people - improve outreach through press coverage	Regulatory institutions, trade organisations
	3. Improving educational capacities and technical expertise to improve the quality and address compliance-related issues associated with the upcycled products	Educational institutions
Economic incentive-oriented	1. Tax incentives to the supply chain actors across upcycling value chains, such as material supplying industries that make material donations	Government
	2. Financial support for upcycling businesses	Government

Fig. 9. Four underlying feedback mechanisms (Loops 1–4) affecting 'the consumer demand for the upcycled products'.

could establish infrastructure for a material database, material provisioning and testing, e.g. through crowdsourcing. The experts proposed that local councils and/or charity organisations could assist in sorting materials at the disposal centres and directing them to the material suppliers. In addition, a government could provide tax incentives to the supply chain actors across upcycling value chains, such as material supplying industries, to encourage them to donate materials.

4.5. Need for collaboration across the upcycling value chain

Planning and implementing interventions for scaling up upcycling businesses may require collaboration among multiple actors in society. Our workshop with experts led to some suggestions about how these actors could work together toward a common goal:

1 Establish an organisation that could provide the technical knowledge needed to improve quality and address the compliance aspects of the upcycled products, such as Guild (https://en.wikipedia.org/wiki/Guild). Such an organisation could be a UK-wide consortium (similar to the Seoul Design Foundation in South Korea). This would be supported by the government to enable and support communication among upcyclers, to provide a platform to raise awareness about upcycling, and to provide a common space to develop upcycling activities (such as the play and recycling centre in Derby, UK).

2 Educational institutions could provide a basis for greater collaboration between the actors, for instance by creating collaboration opportunities among academic institutions, which could be set up through joint-funding schemes.

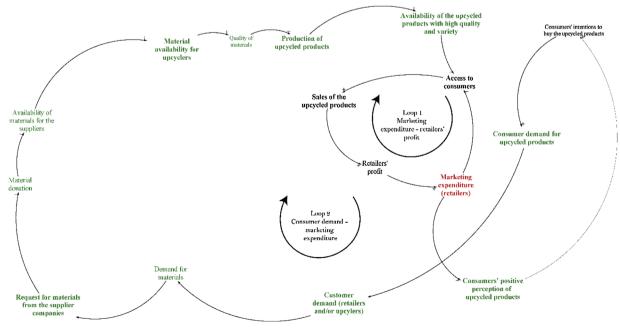Scaling up of upcycling businesses could help to reduce waste,

Fig. 10. Two underlying feedback mechanisms (Loops 1–2) affecting effective marketing by retailers.
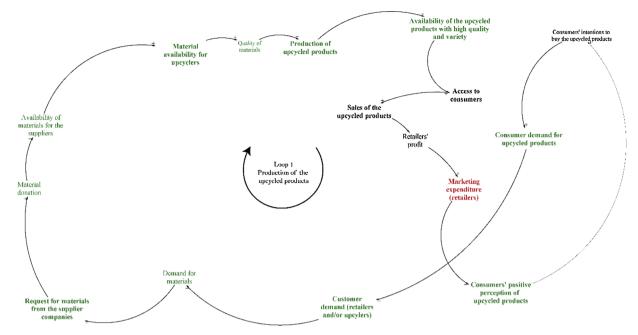
Fig. 11. Underlying feedback mechanism behind production of the upcycled products.

improve circularity of resources, and reduce dependency on imports. This could also increase material and energy efficiency, create jobs in the upcycling sectors (local manufacturing practices) and could encourage design for disassembly and remanufacturing. Increased demand for upcycling products could lead to environmental and social benefits. However, impacts across the upcycling value chain may significantly increase due to current business models. This may have positive impacts in terms of improving transparency and accountability of social and environmental impacts emanating from the upcycling value chains.

Success of upcycling could lead to the setting up of an organisation compiling and maintaining a database for product benchmarking. Targets could be set for hot-spot material resources that could be upcycled (like a Wikipedia of materials), which could lead to positive changes in product design (such as design for upcycling) and consumer behaviours (in terms of end-of-life product disposal). A platform could be set up to develop skills and knowledge about upcycling, share knowledge about successful business models, and support upcycling businesses when preparing pitches and bids for larger organisations.

5. Conclusions

One important gap in the current state of knowledge on upcycling is the lack of systemic understanding about challenges and success factors. This paper aimed to address this gap by examining different sets of challenges for upscaling and success factors as perceived by various stakeholders in the value chain of upcycling businesses. The study employed a broad range of methods for reaching its goal, including literature review, stakeholder analysis, semi-structured interviews, group model building, development of causal loop diagrams, and a workshop with stakeholders and experts to validate causal loop diagrams and to discuss promising interventions and how to proceed.

The analysis of stakeholder interviews revealed potential actors that could help upcycling businesses succeed, such as central government, local councils, businesses, consumers, media, activists and volunteers. Key challenges identified were lack of availability of materials for material suppliers, lack of affordable resources (space, time, equipment, skills and materials) and expensive marketing for upcycling designers and makers, as well as lack of resources for retailers to market upcycled products. Challenges experienced by consumers were equally

important, and included lack of good-quality products and high price, limited access, and negative perception about upcycled goods. Key success factors identified were raising awareness about upcycling, changes in legislation to redefine waste and thereby encourage donations of material to material suppliers, availability of critical resources, i.e. skilled staff for upcyclers, effective marketing for retailers, and improving the purchasing experience for consumers.

The process and outcomes of creating and validating the causal loop diagrams based on the stakeholder interviews uncovered the key mechanisms: improved availability of materials for material suppliers, provision of critical resources to upcyclers, effective marketing for retailers, and increase in consumer demand. These key mechanisms implied that some of the suggestions from the experts participating in the workshop were more relevant than others for upscaling. For example, in order to provide critical resources (e.g. skills, materials) to upcyclers, schools and universities could improve educational capacities and technical expertise, governments could provide a platform for knowledge exchange, and local councils or charity organisations could assist in sorting materials and directing them to material suppliers. Effective and efficient planning and implementation of such multiple interventions for scaling up upcycling businesses would require collaboration between various stakeholders. A special organisation, such as a consortium of upcycling businesses and other relevant actors, could help facilitate such a collaboration. As a starting point, researchers and academics could create initial collaboration opportunities involving businesses through joint-funding schemes.

This paper presents a systemic approach to understanding stakeholder perspectives on challenges and success factors for scaling-up upcycling businesses, and describes key mechanisms through which relevant interventions and potential actions were identified. However, the study is intended for the upcycling businesses primarily utilising waste clothing and textiles, and furniture and wood, in the UK. A statistically representative sampling of consumers was not obtained and that future studies can be conducted such that relevant questions and challenges could be fully investigated.

The paper extends our understanding about how upcycling businesses work, challenges they face, support they need, how different factors influence each other in the value chain, and potential actions for upscaling. The paper thereby contributes to both conceptual understanding and practices of upcycling. It is our hope that our findings will

not only inspire and inform academic researchers but also instigate an action by direct stakeholders (material suppliers, upcyclers, retailers and consumers) and indirect stakeholders (central government, local councils, schools, etc.) for scaling up upcycling businesses in the UK and beyond.

Declarations of interest

The authors declare that there is no conflict of interests.

Acknowledgements

Appendix A. Key system mechanisms

1. Consumer demand for upcycled products (4 feedback loops)
Loop Number 1 of length 2
   Consumer demand for upcycled products
Price of upcycled products
Consumers' intentions to buy the upcycled products
   Loop Number 2 of length 10
Consumer demand for upcycled products
Customer demand (retailers and/or upcyclers)
Demand for materials
Request for materials from the supplier companies
Material donation
Availability of materials for the suppliers
Material availability for upcyclers
Quality of materials
Production of upcycled products
Availability of the upcycled products with high quality and variety
Consumers' intentions to buy the upcycled products
   Loop Number 3 of length 10
Consumer demand for upcycled products
Customer demand (retailers and/or upcyclers)
Demand for materials
Request for materials from the supplier companies
Material donation
Availability of materials for the suppliers
Material availability for upcyclers
Quality of materials
Production of upcycled products
Availability of the upcycled products with high quality and variety
Access to consumers
   Loop Number 4 of length 15
Consumer demand for upcycled products
Customer demand (retailers and/or upcyclers)
Demand for materials
Request for materials from the supplier companies
Material donation
Availability of materials for the suppliers
Material availability for upcyclers

Quality of materials
Production of upcycled products
Availability of the upcycled products with high quality and variety
Access to consumers
Sales of the upcycled products
Retailers' profit
Marketing expenditure (retailers)
Consumers' positive perception for upcycled products
Consumers' intensions to buy the upcycled products
2. Marketing of upcycled products
   Loop Number 1 of length 3
Marketing expenditure (retailers)
Access to consumers
Sales of the upcycled products
Retailers' profit
   Loop Number 2 of length 15
Marketing expenditure (retailers)
Consumers' positive perception for upcycled products
Consumers' intentions to buy the upcycled products
Consumer demand for upcycled products
Customer demand (retailers and/or upcyclers)
Demand for materials
Request for materials from the supplier companies
Material donation
Availability of materials for the suppliers
Material availability for upcyclers
Quality of materials
Production of upcycled products
Availability of the upcycled products with high quality and variety
Access to consumers
Sales of the upcycled products
Retailers' profit
3. Increased production of upcycled products through provision of critical resource to the makers/designers i.e. raw material, skills and expertise
   Loop Number 1 of length 15
Production of upcycled products
Availability of the upcycled products with high quality and variety
Access to consumers
Sales of the upcycled products
Retailers' profit
Marketing expenditure (retailers)
Consumers' positive perception for upcycled products
Consumers' intentions to buy the upcycled products
Consumer demand for upcycled products
Customer demand (retailers and/or upcyclers)
Demand for materials
Request for materials from the supplier companies
Material donation
Availability of materials for the suppliers
Material availability for upcyclers
Quality of materials

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