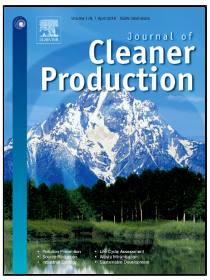
Accepted Manuscript



Modelling environmental value: an examination of sustainable business models within the fashion industry

Rudrajeet Pal, Jonathan Gander

PII:	S0959-6526(18)30305-6
DOI:	10.1016/j.jclepro.2018.02.001
Reference:	JCLP 11948
To appear in:	*Journal of Cleaner Production*
Received Date:	02 September 2017
Revised Date:	16 December 2017
Accepted Date:	01 February 2018

Please cite this article as: Rudrajeet Pal, Jonathan Gander, Modelling environmental value: an examination of sustainable business models within the fashion industry, *Journal of Cleaner Production* (2018), doi: 10.1016/j.jclepro.2018.02.001

Modelling environmental value: an examination of sustainable business models within the fashion industry

1. Introduction

Viewing sectors of the economy through the lens of business model literature enables managers and researchers to interpret and understand the value system of any given industry (Baden-Fuller and Morgan, 2010). Though business model literature is a diverse and contested domain (Markides, 2015), there is general acceptance that a business model is a system or sequence of production and consumption exchanges that can be used as a framework to trace and analyse the complex value system of benefits, costs, capabilities and relationships that comprise a firm (Demil and Lecocq; 2010; Teece, 2010). Business model frameworks capture decisions taken and identify the resources generated and organized to support this value system, enabling scholars and managers to understand how value is created for customers and captured for the firm (Zott et al., 2011; Baden-Fuller and Mangematin, 2015).

Despite the contribution to knowledge this view of a firm as a model of value creation and capture has made, most accounts of value in business models remain incomplete. This is because value creation and capture is largely viewed as an organizational dynamic, occurring within the firm or between the firm and its customers. Yet what of the value created or destroyed in the physical or natural environment (Brundtland Commission, 1987; Hart, 1995)? Business models have consequences on the physical environment in which they are practiced, both positive (sustainable production) and negative (pollution, non-renewable resource use). Developing an understanding of sustainable business models (SBMs) demands that one includes value relationships beyond those exchanged between customer and company (Abdelkafi and Tauscher, 2016; Evans, et al., 2017), and move towards including the impact of the business model on the natural environment. A number of key questions are generated by acknowledging this imperative. Namely, which business model configurations create environmental as well as firm and customer value? Or in other words; to what degree does the creation of value for a customer and company come at the expense of the natural environment?

The application of business model approaches to investigating the sustainability of business practices and consumer markets, initially in Stubbs and Cocklin's seminal work (2008), has seen a rich literature emerge (Boons and Lüdeke-Freund, 2013; Schaltegger et al., 2016). Studies have analysed SBMs in sectors such as energy production (Matos and Silvestre, 2014), airlines (Heinz and O'Connell, 2014), automotive (Wells, 2013), chemical industry (Illes and Martin, 2013) and furniture production (Hogevold, 2011). This paper seeks to contribute to this literature by exploring the development of sustainable business models within the global fashion industry; the manufacture, distribution, sale and use of fashion clothing. The specificities of this important sector of the economy, such as highly globalized mass production, fast fashion consumption and linear take-make-disposal model (The State of Fashion, 2017; Pulse of the Fashion Industry, 2017), raise challenging questions when set against the ambition to design SBMs capable of disrupting the currently dominant operating

logics of fashion businesses. The most critical perhaps being how such SBMs can achieve the competitive advantages of scale and provide products that are in keeping with changing trends.

The analysis that follows is restricted to the examination of environmentally sustainable business models and does not include consideration of the wider social impact of global fashion business models. Though of course of considerable importance in an industry strongly associated with child labour (Guardian, 2017) and unsafe working environments (CITI IO, 2017), the challenge of including this type of impact alongside that of environmental, is that as Joyce and Paquin (2016) point out, there is not yet a consensus on which social impacts are necessary to include and how they might be measured. There is therefore an advantage of achieving greater clarity and focus when restricting analysis to environmental issues. Something of particular benefit when the purpose of the paper is to generate testable propositions to guide the designers of sustainable business models in fashion.

The structure of the paper is as follows. Firstly, a brief section highlighting the environmental impact of the fashion industry establishes the serious and urgent nature of the current situation. Interested readers seeking more detail on the environmental impact of the fashion industry are encouraged to consult the reports referenced in this section particularly, Pulse of the fashion Industry (2017) and work of The European Environmental Agency (2014). Secondly, drawing on Bocken et al's work, the analytical concept of resource flow is introduced, and used to examine and categorize the different sustainability activities of firms in the fashion industry. The paper's argument is then developed by considering whether such sustainable models of production and or retail can be translated into a system of value creation (for the customer) and capture (by the organisation) that is capable of replacing the current, highly unsustainable business models in fashion. Based on this analysis a number of propositions are developed that can be used to test whether emerging ways of producing and distributing fashion garments have the potential to become the foundation of more sustainable business models.

2. The fashion industry's environmental impact

Fashion is undoubtedly one area of the economy that urgently requires the adoption of more SBMs. The European Environmental Agency, for example, has ranked clothing, textiles and footwear fourth in the list of industries by impact on the environment, after Housing, Transport, Travel and Food, (2014). This undesirable ranking is largely a result of the "rise of fast fashion" (The State of Fashion, 2017), which has led to strikingly high environmental costs stemming from high water usage required during textile production, pollution from chemical treatments used in dyeing and preparation, and the scale of landfill produced during disposal (Fletcher, 2016; Kant, 2012; Pulse of the Fashion Industry, 2017). In a world with growing water scarcity, the current usage level of fashion (79 billion cubic metres annually) is very concerning, particularly when textile production largely takes place in areas of fresh water stress (Pulse of Fashion Industry, 2017). In a fashion system where only around 20% of clothing is recycled or reused huge amounts of fashion product ends as waste in landfills or is incinerated (Global Footprint Network, 2017). For example, it has been estimated that in the UK alone around 350,000 tons of clothing ends up as landfill

each year (WRAP, 2016). Furthermore, the scale of the problem is increasing in-line with increasing demand for clothing with a study by McKinsey and Company estimating global production to have reached 1 billion items annually for the first time in 2014 (2016). This is a rising trend owing to the dominance of the fast fashion logic of competing. Overall apparel consumption is predicted to increase by 63% from 62 million tons today to 102 million by 2030 (Pulse of the Fashion Industry, 2017). This huge scale of clothing production mitigates against traditional recycling efforts such as those involving shipping unwanted clothing to Africa as part of social enterprise initiatives such as Oxfam's Senegal programme, 'Frip Ethique'. This is because the hundreds of thousands of tons of clothing donated to Africa can produce a glut in the market that suppresses the development of the local clothing economy, and in the case of Kenya has coincided with a drop in textile sector jobs from 500,000 in the 1980s to around 20,000 (Business Daily, 2010).

These negative externalities created during the highly globalized fashion production, consumption and disposal chain, have not been satisfactorily accounted for (GS1, 2013). The suggestion is that, perhaps in part because of this, the established and mainstream business models that operate in the fashion apparel production system have remained largely unchanged, operating highly wasteful and ultimately unsustainable business models. Omitting the true cost of these business models blunts the innovation incentive to discover and develop new more sustainable ways of creating and capturing value in fashion apparel production. Fashion apparel manufacturers and their customers are not, of course, unaware of the environmental consequences of its dominant business model and new, more enterprises are indeed emerging that attempt to operate according to sustainable principles (Stubbs and Cocklin; 2008). However, the question around these business models and the subject of this examination is, given the omission of the full environmental costs of production and disposal, can these new logics of business become sufficiently widely adopted by mainstream fashion labels so as to effectively challenge the dominant and highly unsustainable fashion industry paradigm of production and consumption?

The competitive dynamics of the global fashion apparel manufacturing industry also make for a very challenging context in which to birth new SBMs. For example, fast moving trends mean extremely short product life-cycles that create intense pressure on manufacturers to rapidly create and supply an ever changing array of new product lines. In such circumstances being able to respond to changing demand for products with different aesthetic attributes is critical. However, this can make the fashion customer a challenging one to service sustainably (Mont, et al., 2006). Activities such as the use of mono-material garments to increase their recyclability, or of creating modular clothing designs that can be updated or renewed, can place limitations on the responsiveness of the firm and the aesthetic aspect of customer value. In addition to customer value propositions being challenged by more sustainable methods of production, global value chains enable large firms to apply bargaining power against smaller textile producers and manufacturers, and generate scale economies that are used to reduce costs that in turn feed into almost constant price wars and promotional battles. Under such circumstances, the adoption of novel manufacturing methods and design principles can add extra costs to an industrial system that is extremely sensitive to cost increases.

3. Examining sustainable resource flows in the fashion industry

Given the structure and character of the fashion system, it is clear that any new SBM innovations cannot reduce environmental costs merely by transferring the cost to the company or requiring customers to sacrifice some of the value they seek in their fashionable products. Competitive dynamics and the nature of the customer value proposition mean that such a redistributive approach would not be sustainable economically. Companies practicing such SBMs risk their survival and limit their ability to grow and thus reduce their ability to challenge the dominant unsustainable business models of their competitors. What is required are innovative ways that resources can be used, production and distribution organized and value exchanged and perceived. Despite the size of this innovation challenge, business model thinking is precisely the approach that can help reveal fundamental systems of value creation and capture, and in so doing enable newer, perhaps nontraditional operating logics and value propositions to be considered and applied (Arend, 2013).

One way of doing this is to look at the flow of materials in the fashion system and shift the sector's attitude from the largely linear model of production, sale, use and disposal to a more circular model of reuse and reintegration. To apply this notion of flow and insights gained from a more circular or 'looped' approach to the study of fashion value chains, the paper draws on Bocken et al.'s (2014; 2016) influential research. This body of work conceptualizes three methods to reduce natural resource usage and lesson environmental damage; narrowing, slowing and closing the resource flow. 'Narrowing' the resource loop means increasing the efficiency of the production and manufacture process so that fewer natural resources are used. The objective here is to reduce the amount of resources (material and energy) used during the design, manufacture, distribution, use and disposal of products (Bocken et al., 2016). 'Slowing' the resource flow uses the reuse and extension/repair of products to lessen overall environmental damage. Strategies for slowing down the resource flow and thus reducing overall natural resource usage and environmental damage, involve creating longer-life clothing thus extending the period the product is used and thereby reducing overall demand for the product. Strategies for attempting to 'close' resource flows include a range of social and technological resource recovery activities. The creation of a closed cycle of resources comes in different forms, from the chemical or mechanical processes that recover part or the entire material used in the clothing and reintroduce it into the manufacturing loop (Stahel, 1994; McDonough and Braungart, 2002), through simply reclaiming the garments and reselling them as they are, to remanufacturing by upcycling or reworking the products. Though distinguishable as different approaches, they are not mutually exclusive. These different logics can be applied together in combined ways that reinforce the effort towards establishing a more sustainable value creation model. For instance, 'closing' the loop activities can in fact narrow resource flow through the principle of substitution, while 'slowing' can be achieved in conjunction to 'closing' the loop.

In the following section the conceptual value of categorizing sustainable logics, via this resource loop perspective is demonstrated by applying them to the analysis of a number of fashion initiatives and enterprises. Starting with a clear methodology to select representative cases of fashion SBMs from practice, the examples help elaborate each type

of resource flow and set up the next stage of the paper – the analysis of their prospects for creating SBMs within the fashion industry.

3.1. Methodology for selecting representative cases used in the study

This section discusses how the the three logics (narrowing, slowing and closing) for designing resource flows to attain SBMs in fashion industry were identified from academic literature and used as a framework to select representative cases from fashion sector practice. To guide the selection process the following steps were used: (1) relevant keywords were combined to create search terms within academic databases to identify the narrow set of literature on SBMs addressing the fashion industry (section 3.1.1), (2) the categorization of the identified literature was carried out by matching their topical areas to the three logics (section 3.1.2), and (3) both the scientific literature and additionally identified practice-oriented sources were screened to select representative cases from the fashion industry (section 3.1.3). The representative cases for each logic are discussed in detail in sections 3.2-3.4.

3.1.1. Criteria for selection of search terms

The three logics of narrowing, slowing and closing are not mutually exclusive, and often scientific documents do not specify how each logic contributes to the research. To counter this searches on Scopus and Web of Science databases in the subject area of Business and Management were carried out, using keywords: (i) “sustainable business model”, and (ii) “business model” and “sustainability”, instead of specifically looking for closing, slowing or narrowing. In combination, keywords “fashion” or “textile” or “apparel” or ”cloth*” were used to set the industrial context. Infact this is in line with the purpose of choosing representative cases, which is not to compare or contrast different SBM methods following these logics, but to use them as an argument for defining how value is created by them.

In addition, as per the seven key archetypes of SBMs presented in Bocken et al. (2014), additional keywords were used to devise search criteria. Different keyword combinations were generated by connecting these concepts with “fashion”, ”textile”, ”cloth*” to identify the methods for designing sustainable resource flows in fashion industry and retrieve the related literature. As an example, “sufficiency” (archetype 6) and “business model” were combined with fashion industry related keywords yielded paper: Bocken and Short (2016); keyword based on archetype 4 “Deliver functionality rather than ownership” yielded papers: Pedersen and Netter (2015), Weber et al. (2017) and Hvass (2014).

3.1.2. Categorization of scientific documents into topical areas

In order to choose the right set of literature and summarize the SBM methods, both authors classified the work retrieved through the keyword searches and compared their categorization. A tabular data sheet was used to create a grid of the results, where each row represented the keyword search combinations while the columns represented the three logics. Appendix 1 presents the results of the categorization of the selected articles. Further, based upon the reading, the topical areas of the articles were summarized and matched with the logics, to identify the SBM method used. For example, product-service systems were identified as an SBM method that delivers functionality instead of product ownership (e.g. Corvellec and Stål, 2017; Armstrong et al., 2016; Armstrong et al., 2015).

3.1.3. Selecting representative cases

In some cases, industrial practice appears to be ahead of academia in exploring and developing novel business models (Bocken et al. 2014). Hence, examples from practice became a crucial addition. Using the search terms honed during the literature research to reveal the SBM methods (please see Table 1), Google searches were carried out and industry reports, websites and trade magazines were identified and searched. Additional SBM methods were revealed through the screening of these documents. For example, under the narrowing logic, demand-driven production approaches as followed by some fast fashion companies like Zara was considered significantly sustainable considering their targeted manufacturing system unlike forecast-driven mass production (e.g. The State of Fashion, 2017). The most helpful and frequently referenced sources of information were:

- Sustainability and other sector-specific reports related to the fashion industry, e.g. Nordic Council of Ministers reports (e.g. Watson et al., 2014, 2016), McKinsey Quarterly reports, WRAP reports,
- Website of organizations involved with/reporting fashion industry sustainability (e.g. Ellen MacArthur Foundation, Mistra Future Fashion, European Commission website etc.), and
- News magazines, like The Economist, Guardian, Business of Fashion.

This purposive sampling technique, as employed in other sustainable business research (e.g. Teh and Corbitt, 2015) was, as described above, used to select representative cases based upon: (i) richness of data presented on the chosen cases, and (ii) triangulation of information on the cases from multiple sources including scientific documents. However, the main limitation of this technique is that radically new but small SBM cases, those not yet reported or documented in written format, may not have been visible during the sampling of academic and trade literature and thus not included in the investigation.

Table 1 summarizes the main methods underpinning the three logics for designing resource flows to attain SBMs and provides key resources explaining them.

Table 1. Categories for sampling representative cases from the fashion industry

Logics	**Categories based on methods used in fashion industry to attain SBMs**	**Key references to the methods from practice and grey literature**	**Representative cases chosen for this study**

Narrowing	• Energy and material efficiencies through:
	  • Lean manufacturing and waste reduction
	  • Clean technology for low-carbon, low effluents
	  • Integrated pollution prevention and control
		DEFRA (2009); Euratex (2013); Klepp et al. (2015); Textileexchange.org (2017)	Continental Clothing

	• Demand-driven product development and production (digital 3D visualization and prototyping, fast fashion, made-to-measure)	Circle Economy (2016); SourcingJournal.com (2017); The State of Fashion (2017)	Zara, Hugo Boss, NikeID

Slowing	• Slow fashion - Timelessness through use of durable quality of materials and processes Product-service system based dematerialization	Fletcher, (2010); Klepp et al. (2015); ECAP (2017)	Timeless: Eileen Fisher Dematerialization: Swishing.co.uk Nudie Jeans,
	• Design for longevity - Design simplicity, creativity modularity, incremental improvements	WRAP (2013), Designforlongevity.com; MFF (2016)	Fast Refashion, Kättermusen
	• Sufficiency - Establishing intimacy with garments through premium service, quality - Social branding	Circle Economy (2016);	Sufficiency: Patagonia (Don't buy this jacket), Nudie Jeans Social Branding: Peoples Tree
	• Responsible promotion - Employ anti-consumerist marketing messages	Chouinard (2006)	Patagonia
Closing	• Collaborative Consumption (product-service systems: use-oriented, renting, online sharing platforms)	Guardian (2014); CBS News (2016); BoF (2016); Ellen MacArthur Foundation (2013); Kiørboe et al. (2015)	Uniforms for the Dedicated's "The Collection Library", Fillipa K's "Make it Last", Rent the Runway, Le Tote
	• Multiple product lifecycles, closed loop - Recycle, recovery - Remanufacture, upcycle, refashion - Reuse/sell	Schmidt et al. (2016); Palm et al. (2014); ; Elander and Ljungkvist (2016); Watson et al. (2014, 2016); Circle Economy (2016); Ellen MacArthur Foundation (2013)	Recycling: FIBERSORT, Relooping Fashion, Worn Again, Pure Waste Redenim by Lindex (Remanufacturing) 2nd hand retail (Resell)

3.2. Narrowing

Studies suggest that nearly seven out of every ten fashion companies do not focus on managing environment and resources such as water and cotton along the supply chain (Deloitte, 2013). Given the huge impact of the material stage in the supply chain in terms of energy and resource consumption and emissions (e.g. 1 pair of jeans utilizes nearly 3,625 litres of water, 3 kilograms of chemicals, 400 megajoules of energy) (Allwood et al., 2006; Deloitte, 2013), such an 'un-narrowed' linear flow of resource poses huge problems for a sustainable future. In contrast, Continental clothing, a UK-based fashion brand, has developed an EarthPositive collection that is 100% organic and reduces CO_2 emission by 90% during manufacturing. The reduced impact on the environment is achieved through a combination of low-impact organic farming, efficiency in manufacturing and transportation,

and the use of renewable energy instead of fossil fuel, thus saving around 7 kilograms of CO_2 per T-shirt.

Though not usually described as an SBM, Zara's version of the fast fashion approach is also an example of narrowing the resource flow. This is because their demand-driven, in-season purchasing model, replaces the more wasteful conventional supply model characterized by long-lead times and forecasted demand. In comparison to the mass production strategy followed by many fashion labels, Zara's more accurate sales-led approach using flexible and modular production techniques, results in more efficient production, higher proportion of goods sold and therefore less waste resulting from unsold stock. In addition, some fashion companies have started integrating digital technology solutions for product development and prototyping which can also reduce the environmental footprint of their processes (Papahristou and Bilalais, 2017), e.g. Hugo Boss. This is in contrast to conventional fashion supply chains which can end up with nearly one-third of the produced goods as unsold (Mustonen et al., 2013). Such an excess in production produces wasteful resource consumption upstream along the supply chain (Pal, 2014). Many high-street fashion businesses including those often tagged (often erroneously) with the fast fashion business model, e.g. Primark, illustrate and epitomize this systemic challenge. So, viewed in this light, the increased accuracy of Zara's version of the fast fashion business model represents the promise of a more sustainable approach.

3.3. Slowing

Most commonly slowing refers to what has been termed 'slow fashion' (Fletcher, 2010). An approach which can be practiced in many ways, for example by designing systems of sharing fashion products, or explicitly designing apparel to increase its durability and ease of repair (Bocken, et al., 2016). The following examples illustrate how this approach is operationalized. Eileen Fisher is a UK-based brand that offers eco-fashion products and in parallel encourages customers to bring back their lightly worn Eileen Fisher apparel to be cleaned, refashioned, and sold again under its "Green Eileen" program. Swedish jeans brand Nudie encourages customers to perform this work by offering repair toolkits to its customers free of charge as a part of its Eco Cycle program aimed at prolonging the life of the garment. 'Swishing.co.uk', a UK clothing retail and exchange platform facilitates slow fashion by organizing the exchange and purchase of second-hand clothing and giving reductions based on value of donated clothing. On the production side of slow fashion, 'Fast ReFashion', part of the Mistra Future Fashion research consortium is an example of how a single-cycle garment designed with higher durability materials can be servitized and thus have extended use through upcycling – augmenting and redesigning the item (Earley and Goldsworthy, 2014; 2015).

Designing for longevity is also achieved by creating apparel that can be modified and introducing a more evolving and personal relationship between the owner and their fashion items (Laitala et al., 2015). Organisations exploring such design-led approaches to extending the longevity of garments, use a variety of modular, multifunctional or incremental garment construction and ornamentation (Gwilt, 2014; Seivewright, 2007). This is a different way of tackling longevity to that of extension of use through sharing, and repair. Instead these design-led approaches aim at exploring the notion that fashion garments as living products, designed to evolve and transform in order to have a longer period of use. Kättermusen, a

Swedish outdoor brand, is one such example of encouraging slow fashion through which has designed longevity of their products. Their trousers, called Mithril, are designed with functionality that they can be changed by attaching and detaching pockets and gear-loops of different kinds. In this way it also modular in design.

It is often the case that slowing and closing are used together. For example, fashion brands like Patagonia and Nudie Jeans, on one hand promote sufficiency in the consumption cycle through premium service and quality, while simultaneously engaging in activities intended to moderate sales by organizing consumer marketing campaigns, offering limited or no sales incentives, and choice editing to help customers curate and select garments for longer use (Bocken and Short, 2016). Patagonia, for instance, developed a campaign called "Don't buy this jacket", encouraging people to consider the effect of consumerism on the environment and purchase only what they need (Chouinard, 2006).

Promoting ethical sourcing and social value creation by creating ethical consumption campaigns, also help to reduce fashion's environmental footprint. This positioning attempts to counter the otherwise hectic speed of consumer behavior by giving structure and meaning to fashion product that can lead to a more deliberate, selective and slower style of purchasing and use. People tree who work closely with women artisan groups from Bangladesh help to meet these standards by producing handwoven and natural dyed products. In this way slowing down the resource flow takes on a brand building aspect through the formation of so-called 'brand communities' (McAlexander et al., 2002).

3.4. Closing

Closing is linked to the wider movement of circular economy and refers to the switch in logic from viewing production and consumption as separate ends of a pipe to attempting to connect them together to form a loop where resources cycle (Pearce and Turner, 1989; Linder and Williander, 2012). The more closed or circular the loop is, the more efficient the use of resources will be and consequently less damage to the environment occurs. A number of research and company-driven initiatives in fashion such as *FIBERSORT, Relooping Fashion, Worn Again, Pure Waste* aim to create such closed loops of production and consumption. For example, UK-based 'Worn Again' is developing a chemical 'textile to textile' recycling technology and have partnered with fashion companies such as H&M and Kering (Worn Again 2016). A Finnish brand, Pure Waste, has partnered in the Relooping Fashion initiative, and is involved in process in recycling material from industrial waste (using a cellulose dissolution technology), which is then sorted by color, 'refibered' and finally spun into yarn that is used to produce garments (Pure waste 2016). Even though recycling of textiles can be achieved at scale, the more complex the product is in terms of material content the harder it is to recycle due to a current lack of technology for the separation of the blended fibres. Fashion remanufacturing is however largely restricted by issues of scale and scope, due to challenges related to material and process repeatability and standardization on one hand and consumer acceptance on the other (Dissanayake and Sinha, 2015). As a consequence, as of today, only pilot initiatives have been launched by mainstream fashion companies, e.g. project Re:denim which is such collaboration between a Swedish fashion retailer Lindex and Re:textile, a university run initiative with the purpose to remanufacture dead-stock into commercial items (Lindex, 2017). Much shorter loops

involve 'post-retail' initiatives and take two forms, either second-hand retailing and/or take-back schemes (Hvass, 2014).

A 'socialized' approach to closing the loop, involves setting up and promoting shared or collaborative forms of consumption that aim to replace ownership with access (Pedersen and Netter, 2015). Organised via online platforms, these largely subscription based business models include the renting model used by a number of brands under different concepts, e.g. Uniforms for the Dedicated's "The Collection Library", and Fillipa K's "Make it Last". Several online retailers such as Rent the Runway, Le Tote, etc. have also ventured into such rental schemes, by renting out designer labels for a fee. Additional services are provided to create customer value such as free drop-off, style and mix-match suggestions.

All of these initiatives vary considerably in the type of technology employed, degree of resource intensity used/reduced, and amount of value regenerated along multiple loops of product recovery options. The underlying causes for this variability can be linked to differences in kinds of fiber being treated and, by extension, in intensity of activity required based upon the condition of the collected post-consumer textile waste. To illustrate, a sensitivity analysis conducted in Schmidt et al. (2016) suggested that the impact and benefits from different treatment routes for all major fibers (cotton, polyester and wool) in Nordic countries, measured in terms of primary energy usage (as person equivalents per ton), reuse is by far the best option.

While these logics and exemplary cases of narrowing, slowing and closing the loop of resources certainly provide a direction for the development of more SBMs for fashion industry, it is not clear whether they have the potential to be adopted as a dominant paradigm or at least a business model that is able to meaningfully reduce the overall damage done to the environment during the fashion apparel production and consumption cycle. The change in organization and attitude required is significant and there exist many obstacles that need to be overcome (Evans, et al., 2017).

4. Sustainable business model innovation

The literature on business models examines how managers and analysts use them to create a snapshot of how a firm creates value for its customers in the form of benefits and attributes and captures value for itself in the form of revenues (Teece, 2010). A variety of different approaches have conceptualised business models as a means for the commercialization of new technology (Chesbrough, 2010), a way of organising (Afuah and Tucci, 2001; Zott et al., 2011), or as cognitive models aimed at enabling the firm to be understood and managed (Baden-Fuller and Morgan, 2010; Arend, 2013). The emerging research area of innovation in sustainable business models applies these approaches to the investigation and design of business models that don't damage the environment and threaten the future viability of the planet (Boons and Lüdeke-Freund, 2013).

One of the benefits of business modelling is that it provides a way of capturing essential relationships and dynamics so that the value system of a firm can be visualized such as in Ostewalder and Pigneur's Business Model Canvas (2010). Capturing the value system in a representative, albeit simplified way, enables scholars and managers to identify typologies

to apply across different industries and thereby reveal opportunities for reworking current methods and types of value creation (Baden-Fuller and Morgan, 2010). Yang et al. (2017) for example proposed considering value that remained uncaptured during the operation of a business model, such as when products are disposed of at the end of their use. By reconfiguring business model frameworks to include value uncaptured, managers, they argue, may be better able to identify opportunities for more sustainable practices that can lead to increased revenue. Franca et al. (2017) combined the business model canvas with the Framework for Strategic Sustainability Design (Broman and Robert, 2016) to provide a detailed sustainable approach to the business model canvas. While Joyce and Pacquin (2016) similarly developed an alternative modelling of the standard dynamic of value exchange (benefit for revenue), by creating a triple layered version that incorporated environmental and social impacts and benefits, alongside those of the customer and the firm.

A linked body of work problematizes the design process behind the generation of such SBM conceptualizations. Baldasserre et al (2017) for example apply the principles of user driven innovation (von Hippel, 2005) to the creation and testing of sustainable business models. By focusing on user and stakeholder value propositions throughout the development of the SBM, managers are better informed on its eventual effectiveness and likely adoption. While Geissdoerfer et al (2016) apply a different management approach, that of Design Thinking (Brown, 2008) to the creation of SBMs and establish a process that could be followed by managers during the development of a more sustainable business model.

This paper compliments these valuable contributions to the widening of the scope of business model thinking and the depiction of the value relationships of more sustainable business models by focusing on some key trade-offs and performance features that need to be considered when making decisions over the precise use of such models. When one's attention shifts towards such implementation details an important distinction emerges. Between a sustainable business model and a 'more' sustainable business model. These have been termed the strong and weak form approaches to sustainability (Roome, 2012). A strong form sustainability approach involves placing environmental value at the heart of the operation, making it the driving logic and most important performance metric. Strong form sustainability often involves a radical transformation of how an enterprise does business (Upward and Jones, 2016). In contrast, weak form sustainability doesn't seek to challenge the profit motive and primary performance metric of the business. In the weak form of sustainability, activities that increase environmental value are present and encouraged and even measured as an output, but their role is secondary. Changes made to how the business operates are incremental and the overall effect of the introduction of sustainable practices is partial. Each approach has pros and cons, involves trade-offs being made between environmental and economic value and relies, to as differing degree, technological innovations, shifts in the concept of value and reworking of social and individual attitudes and behaviours.

The scale and complexity of the challenge is daunting. Yet one of the contributions of business model theory is the insight and evidence that for technological innovations to succeed and social changes in attitude and behavior to be embedded and become part of a new value proposition or exchange relationship, one needs an innovation in the business

model of the firms in question (Chesbrough, 2010). Technological innovations or social shifts cannot on their own deliver change, business models are needed to create the pivot (Amit and Zott, 2012). Unless the more sustainable logics of production and consumption that have been identified within the fashion system are accompanied by business model innovations, they risk becoming a distraction, a set of positive initiatives that give the appearance of a sustainable future, but are ill-equipped to replace dominant unsustainable business models in fashion and thus address the damage the fashion industry is doing to the planet.

Business models can be seen as the agents of sustainable change in the fashion industry. In order to begin the task of building business models that are sustainable and can survive in the challenging field of fashion apparel production and consumption, it is necessary to explicitly build propositions that can test the dynamics and properties of the emerging business models in fashion that are attempting to operationalize environmental value. In this way observers of the fashion industry can distinguish between interesting, but ultimately marginal contributions to building sustainable fashion business models, and the qualities needed to construct SBMs that have the potential to replace the existing unsustainable ones.

4.1. Propositions

One can make the general proposition that the total value in a particular business model ($_{bm}$) can be defined in terms of a surplus or 'net gain', which can be written as V_{bm}, and is the sum of consumer surplus or value (C_v) and firm surplus or value (F_v) (Peteraf and Barney, 2003). Thus;

$$V_{bm} = C_v + F_v$$

By reducing the marginal economic cost and increasing the customer's willingness to pay, firms can increase the value captured in the form of revenue. This basically suggests that one can achieve higher value creation when the total benefits to user/customer and seller increases without proportionately increasing costs (Zhang et al. 2015). In this way, V_{bm} is dependent on scale (S), and therefore that $C_v + F_v$ too is.

The literature on SBMs ($_{sbm}$), has mostly theorized a SBM in terms what can be termed environmental surplus or value (E_v). In line with Bocken et al. (2016), E_v can be gained by the differential between environmental benefits and marginal environmental cost.

Combining these two perspectives on surplus value encourages a shift in thinking beyond the economic-centred notion of value, and and an integration of environmental value as a way of developing more SBMs (Joyce and Paquin, 2016). Thus;

$$V_{sbm} = E_v + C_v + F_v$$

> **Proposition 1:** Value in SBMs is equal to the sum of environmental value, customer value and firm value.

Applying this simple rubric to the three different sustainable logics (narrowing, slowing, closing) identified as emerging within the fashion industry, it is possible to reveal and track the obstacles and conditions required for their translation into SBMs.

4.2. Narrowing logic

Narrowing is achieved through modular production systems, demand-driven approaches to production, or low impact energy use during production.

Narrowing through low energy production processes involves investing in specialist machinery, computerized systems and new technology solutions. Such as Product Lifecycle Management (PLM), 3D visualisation or 3D prototyping all designed to reduce carbon footprint through more efficient operation (Papahristou and Bilalais, 2017) and use of recycled energy sources (Subic et al., 2013). Yet the current highly globalized fashion value chains are extremely long and include factories and production facilities located in low wage economies. Firms operating in these countries often have difficulty accessing the kind of funds needed to acquire the sophisticated machinery that can operate at low energy, or can cut patterns with optimal use of material and limited waste. Of course firms in such low-wage economies could, as they move up the value added industrialization ladder (Keane and de Velde, 2008) make such investments. However, because fashion supply chains need to be flexible in order to cope with rapid customer preference changes (requiring new material or skills) such investment carries extra risk. These flexible networks work against investment, as firms have no guarantee that current relationships with buyers will last long enough to reach payback point.

Another obstacle is the institutionalized nature of the practices of fashion apparel design and assembly. Embedded in traditional craft skills and cultural tacit knowledge, the practices of people involved in the design and creation of clothing can be resistant to change. This can make adoption of new manufacturing processes more difficult. The 'stickiness' of traditional techniques and practices of fashion design, cutting, assembly and finishing is perhaps also explained by the lack of standardization in the measurement and manufacture of clothing. Despite the availability of digital design software systems (e.g. Gerber) and emergence of latest 3D technologies for virtual prototyping (Papahristou and Bilalis, 2016), the complexity of different kinds of materials - how it moves, behaves with other materials, responds to finishes and cuts, allied to the extreme variety of the human body, has prevented the widespread adoption of standards and codes to organize and communicate over the measuring, cutting, and assembling apparel. The resulting lack of standardization means that skills and knowledge in fashion production are largely learnt and transferred through observation and practice. This apprentice mode of knowledge transfer necessarily reduces the rate at which new methods and technologies can be adopted.

SBMs based on the narrowing logic of reduced natural resource usage are thus unlikely to be widely adopted due to the globalized fashion value chains, institutionalized practices of garment design and assembly, competitive networks of flexibly organized firms and unpredictable customer preferences for material. Under these conditions, SBMs based on narrowing logic will be restricted in scale as suppliers employing these methods will not be widely available. Such SBMs can be characterized as lacking in 'scalability'. Scalability is defined as the ability to increase the number of units produced and sold without a proportional increase or disproportional increase in cost (environmental and/or economic) (Zhang et al., 2015). With fewer suppliers compliant with the narrowing logic of sustainable production, costs of transacting with those will increase damaging the ability of the

organisation using such suppliers to grow in production capability. Given these obstacles to scalability in narrowing logic SBMs, C_v and F_v are likely to be low due to the inherent lack of scale (S) for SBMs following the narrow-efficiency logic. Prices increase reducing customer value, firm costs increase reducing firm value. Both of which lead to low market share of production and sales which consequently limits overall E_v, as the impact on overall fashion market sales is limited. In this sense the E_v of such narrowing logic models is not fully realized. Thus in narrow efficiency loops, E_v can be modelled as monotonically increasing with C_v and F_v, however is stalled due to restricted C_v, F_v. This leads to the second proposition.

> **Proposition 2:** Environmental value in SBMs created through efficiency-based narrowing logic is not fully realized due to costs of coordination and the resistance to change within established design orthodoxy hindering the potential for scalability.

The accuracy model of Zara that can be seen as belonging to the narrowing logic of sustainability, does at first sight appear to have operationalized the three forms of value creation, C_v, F_v and E_v. An outcome achieved mainly through a greater effectiveness of matching production to demand. Yet while accuracy does narrow the loop competitively, importantly, it does not address the *speed* of the product flow in the system. In other words, while accuracy based narrowing certainly lessens resource usage per customer demand order, it does not necessarily reduce overall resource usage, as customers may simply increase the number of items they buy (and throwaway) (Allwood, 2014). Indeed, accuracy based business models (e.g. fast fashion) by following demand and taste rather than producing to seasonal cycles, arguably increase availability of potential purchases (McKinsey and Company, 2016). Narrowing ends up being an enabler of a speeding-up of the cycle and a shortening of fashion-product life cycles and can therefore facilitate rebound-effects where accuracy magnifies the scale of consumption (Bocken et al., 2014).

The above discussion suggests that, attaining scale (S) and V_{sbm} for narrow-accuracy logic increases, as C_v and F_v are high, due to the *few to one* correspondence between products produced and customer demand order. However, the logic does not really reduce the aggregated overall consumption (due to the inherent throwaway principle). This means that with the increase in scale (S) even though C_v, F_v increases, the rebound-effect results in constantly decreasing the marginal increment of E_v till there is a tipping point at which the positive effects of producing *fewer to one* products is overshadowed by the consumption increase. Thus one can argue that in narrow-accuracy loops, E_v can be modelled as decreasing with increasing C_v, F_v, hence with (S). This leads to our third proposition.

> **Proposition 3:** Environmental value in SBM created through accuracy-based narrowing, is counteracted by increases in scale and shorter life-cycle of products.

4.3. Slowing logic

The clear benefit of slowing down the flow is to reduce production, thereby creating less excess, and accordingly less waste. The slow fashion model comes in the form of highly

durable garments, and the introduction, or re-introduction, of tailoring services to refit and repair, adjust and perhaps augment treasured and long lasting pieces. Slowing down the loop clearly attempts to reduce consumption, but this has arguably very limited scope as it is largely confined to the haute couture, luxury or other niche segments of fashion, e.g. ethical fashion where the garments initial high price justifies the extra costs of time and 'true' labour. Such pieces are not generally owned by the majority of fashion users. The approach is akin to establishing a 'collection' which itself requires high amounts of cultural capital (Bourdieu, 1986), in order to have the knowledge required to be aware of the value of different fashion items and the means of caring/curating them.

The second obstacle to the widespread adoption of slow fashion logic based business models, is that its central premise is in direct opposition to the dynamic and meaning of fashion. Namely, that fashion involves styles that change according to social and political trends and broader cultural movements (Bikhchandani et al., 1992; Aspers and Godart, 2013). As an intensely social practice, these fashion choices form trends made of designated apparel attributes on material, cut, shape, finish and colour. While consumers and producers vary according to how rapidly they follow a trend, the overall effect of trends is to reduce the life-cycle of fashion product. The value sought by customers and captured by producers is tied to change and is therefore in direct conflict with the logic of slow fashion. It is possible to defend this challenge that slow fashion is in fact an oxymoron (e.g. Clark, 2008), and slowing the flow is in indeed in line with growing consumer awareness of the availability and benefits of sustainable products (GS1, 2013). However, the authors argue that a business model based on slowing the loop that does not also address the value proposition of the majority of fashion customers for rapid and frequent product changes, risks being of marginal contribution to the pursuit of a less environmentally destructive fashion system.

The result of these features of slow fashion is that business models based on its proposition will likely only attract a niche customer segment as customer value (C_v) is reduced (lower benefits and higher knowledge costs). Niche customer value propositions mean that the effect of a large number of such business models would be to increase competition within the segment and would not have a cumulative imapct that would sum to larger market share. Lack of scalability is another concern in slow loops, as the fundamental assumption of slowing the loop is restricted consumption. This leads to low firm surplus or value (F_v), as increasing the price of garments to balance out the reduced quantity of sales is difficult in a trend based market (with high degree of product standardization) with global competitors placing heavy downward pressure on price points. Even though by shifting from ownership to functionality models may provide opportunity to decouple the physical product life from its fashion cycles resulting in prolonging the active life of the product, often the durability or trendiness limits this achievement to marginal effect. So, due to the inherent lack of scale (S), resulting in restricted C_v and F_v, it can be argued that E_v in such slowing down models is not fully realized. In slow loops, E_v can be modelled as in narrow-efficiency loops, as monotonically increasing with C_v, F_v, however the value gained is stalled due to restricted C_v, F_v. This leads to our fourth proposition.

> **Proposition 4:** Environmental value in SBMs based on slow fashion practices is not fully realized due to the immiscibility of

restricted consumption and dynamic customer preferences in fashion hindering the potential for scalability.

4.4. Closing logic

Closed loops or circular systems are a highly attractive alternative to less sustainable linear systems of production, consumption and disposal (Geissdoerfer et al, 2017; Urbinati et al, 2017). In its ideal form, resources, or the majority of those used to create the garments, are 'rescued' from disposal and reintroduced into the production/consumption process. There is of course a declining return each loop made by the raw material.

There are, however, some major drawbacks when this concept is applied to fashion apparel manufacture. Technologically, closing, is an approach largely applicable to only mono-materials, such as natural fibres (e.g. cotton) or manmade fibres (e.g. polyester, nylon), and is limited for blends which increasingly dominate the contents of consumers' wardrobes. Closed loop production has limited application to such blends as the recycling and separation technology is less developed and costly to execute on a large scale (Palm et al., 2014, p. 66). The difficulty of recycling fibre blends have driven newer design approaches focusing on future recyclability (e.g. mono-material garments) but this, as mentioned previously, places significant restriction on the designer and their ability to respond to changing consumer tastes. To make matters worse, attempting to increase the durability of apparel (and thus decrease consumption) can actually work against recycling as the use of chemical treatments and blends that it can involves makes recovering the materials more difficult.

Remanufacturing processes are also challenged when applied to fashion raw materials, as the great variety of the collected items prevents the kind of standardization that supports larger scale manufacturing processes (Dissanyake and Sinha, 2015). Looping via reselling to developing countries of Asia and Africa is less effective due to the huge scale of unwanted/donated items and the debate over whether it damages local textile and fashion industries (Brooks and Simon, 2012). Platforms that create circularity through sharing economy principles are effective for special occasion wear, but have limited application for the daily and personal use and relationship users require and have with their clothing products.

Closed loop logic is thus a principle of sustainable production and consumption that is awaiting technological innovation, a shift in social attitudes and institutional change. Technological innovations in fibre-recycling are needed to make it applicable to the varied production materials and processes that make up current fashion product, a social revolution is required for fashion consumers to adopt a non-ownership style of relationship with their clothing (Armstrong et al., 2016), and institutional change is needed in the approach to design and the transfer of design production knowledge in firms and institutes.

Furthermore, E_v achieved through business models based on closing the loop, is also low as reuse and extended life-cycle are niche activities with small potential scale (S) and thus of limited capability to replace unsustainable produced fashion product. In terms of production related aspects, E_v is also reduced by either technological limitations or the necessary restrictions that come with designing for reassembly that are placed on designers focused

on the latest trends. Socialized closing of the loop through platforms that share garments have limited application for a product that is worn daily and therefore is largely restricted to occasion wear special use garments.

Due to this inherent lack of scalability, resulting in restricted C_v and F_v, it can be argued that E_v in such closed down models cannot be fully realized. Without widespread adoption, fashion consumers will continue to support unsustainable business models and the potential environmental value will be marginal. Thus, in closed loops, E_v can be modelled using the same reasoning as in narrow-efficiency and slow loops, as monotonically increasing with C_v, F_v, yet being stalled due to restricted C_v, F_v. This leads to our fifth proposition(s).

> **Proposition 5 (a)**: Environmental value in SBMs based on circular resource loop practices is not fully realized due to technological limitations hindering scalability potential.
>
> **Proposition 5 (b):** Environmental value in SBMs based on circular resource loop practices is not fully realized due to institutional inertia hindering scalability potential.

5. Conclusion

Growing awareness of the damaging environmental consequences of the fashion industry have encouraged the emergence of new more sustainable models of organizing production and consumption. In this paper the authors have examined the potential benefits of incorporating the sustainable logics of narrowing, slowing and closing resource loops into fashion industry business models. Though the emerging examples from companies applying sustainable logics and practices are attractive and welcome, when placed in the context of the current system of value creation and capture that operates in the global fashion industry they appear unlikely to replace the dominant and unsustainable business models of current fashion apparel producers. This is because the introduction of sustainable resource practices and technologies are arranged in business models that result in reducing either the value to or competitive ability of, the host firm, or the attractiveness of the customer value proposition. Or both. Given this, the potential environmental value of the sustainable logics is not realized as they unable to scale and replace existing unsustainable business models in fashion, as can be observed in Figure 1.

<<Insert **Figure 1.** Developed propositions, here>>

It is the lack of a scalable SBM rather than a lack of sustainable business initiatives themselves that is revealed to be the problem. Table 2. presents an integrative analytic rubric to support those seeking to understand existing sustainability-oriented business model in fashion industry and creatively explore their potential for environmental value creation.

Table 2. Analytical rubric

Sustainability logic	Source of environmental value creation	Forms of environmentalism	Current environmental value	Potential environmental value
Narrow-Efficiency	Through reduced environmental footprint	Strong	Low and stalled	Low: Coordination costs and resistance to change within established design orthodoxy reduce scalability (P2)
Narrow-Accuracy	Through reduced waste from more accurate production	Weak	High but declining with scale	Low: Highly scalable business model but increases in volume of consumption is self-defeating (P3)
Slow	Through restricted consumption	Strong	Low and stalled	Low: the mix of incompatible logics (restricted consumption and dynamic identity seeking customer preferences) makes it niche and unlikely to scale (P4)
Closed	Through reduced resource use via more circular resource use and consumption	Strong	Low and stalled	Low: Technological limitations, institutional inertia, and dynamic customer preferences restrict firm and customer value damaging scalability (P5)

Using relationships between customer value, firm value and environmental value this paper has identified and discussed the obstacles faced by firms attempting to create scalable as well as sustainable business models around these logics. While one might argue that innovations necessarily start off attracting only a niche market of consumers, examination of the competitive dynamics and sources of value has found that these innovations are likely to remain niche as they contain unscalable operational and customer value proposition features. Reproducing these relationships in the form of basic equations that result in propositions enable scholars to test the adoptive potential of new SBMs under review. In applying these propositions business model designers are more aware of the necessity to construct scalable systems of value creation and capture that may be able to replace the currently highly damaging business models in fashion.

Two conceptual steps need to be taken to shift the fashion system onto a more sustainable footing. One, SBMs in fashion need to be designed to be scalable, and offer customer value propositions that do not require foregoing the 'fashioness' of the resulting apparel. SBMs cannot be built by sacrificing or degrading firm value or the attractiveness of the customer value proposition. If they are, then the sustainable fashion innovations will remain marginal and the damage being done to our environment will continue. The strong form sustainability initiatives that this paper has analysed appear in their current modelling to only add to available business models in fashion manufacturing and distribution, not replace them.

Secondly, and similarly, the linear and unsustainable business models of the majority of fashion apparel manufacturers must incorporate the concept of environmental value in their balances of customer and firm value. This is because unless environmental value is captured in their business models then the impetus and incentive to change is weakened. If business model design decisions are taken with the inclusion of environmental value alongside deliberations on firm and customer value, firms can explore more sustainable methods of resource usage and value more highly the benefits of entering into relationships with related firms offering more sustainable approaches to design, production and consumption.

Further research is required to investigate this argument and test the propositions. Future work could include quantitative surveys or case studies of decision makers in established fashion companies who are operating business models that incorporate weak form sustainability initiatives to examine how they conceive value and whether and how they measure and include environmental value. For enterprises with business models built on strong form sustainability logic, research could be conducted into their attempts to build scalability and responsiveness to changing fashion styles into their firm and customer value propositions. Given the visual nature of business models, such research might usefully employ cognitive mapping methodology, involving the drawing or visual depiction of their business models and the value they aim to create and capture.

Acknowledgements
The authors would like to thank Florian Lüdeke-Freund for his thoughtful feedback on earlier versions of this work, and the participants of the 1st Business Model Conference (2017) held in Venice, Italy where an earlier version of this paper was presented. The research was part-funded via an extended regional research and innovation initiative taken by Region of West Sweden (Environmental Board) – “Re:textile” (2016-18).

References

Abdelkafi, N., Tauscher, K., 2016. Business Models for Sustainability from a Dynamic Systems Perspective. Organ. & Environ. 29 (1), 74-96.

Afuah, A., Tucci, C.L., 2001. Internet Business Models and Strategies. McGraw-Hill International Editions.

Alkaya, E., Demirer, G.N., 2014. Sustainable textile production: A case study from a woven fabric manufacturing mill in Turkey. J. Clean. Prod. 65, 595-603.

Allwood, J., Laursen, S.E., de Rodriguez, C.M., Bocken N.M.P., 2006. Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom. Cambridge: Institute for Manufacturing, University of Cambridge.

Allwood, J., 2014. Squaring the circular economy: the role of recycling within a hierarchy of material management strategies, in: Worrell, E., Reiter, M. (Eds.), Handbook of Recycling, State-of-the-Art for Practitioners Analysts, and Scientists. Elsevier, Amsterdam.

Amit, R., Zott, C., 2012. Creating value through business model innovation. MIT Sloan Manag. Rev. 53 (3), 41-49.

Arend, R.J., 2013. The business model: Present and future - beyond a skeumorph. Strateg. Organ. 11 (4), 390-402.

Armstrong, C.M., Niinimäki, K., Kujala, S., Karell, E., Lang, C., 2015. Sustainable product-service systems for clothing: Exploring consumer perceptions of consumption alternatives in Finland, J. Clean. Prod. 97, 30-39.

Armstrong, C.M., Niinimäki, K., Lang, C., Kujala, S., 2016. A Use-Oriented Clothing Economy? Preliminary Affirmation for Sustainable Clothing Consumption Alternatives. Sustain. Dev. 24, 18-31.

Aspers, P., Godart, F., 2013. Sociology of Fashion: Order and Change. Annu. Rev. Sociol. 39, 171-192.

Baden-Fuller, C., Morgan, M.S., 2010. Business models as models. Long Range Plan. 43 (2–3), 156-171.

Baden-Fuller, C., Mangematin, V., 2015. Introduction: Business Models and Modelling Business Models, in: Baden-Fuller, C., Mangematin, V. (Eds.), Business Models and Modelling. Adv. Strateg. Manag. 33, 11-22.

Baldasserre, B., Calabretta, G., Bocken, N.M.P., Jaskiewicz, T., 2017. Bridging sustainable business model innovation and user driven innovation: A process for sustainable value proposition design. J. Clean. Prod. 147, 175-186.

Beh, L.-S., Ghobadian, A., He, Q., Gallear, D., O'Regan, N., 2016. Second -life retailing: a reverse supply chain perspective. Supply Chain Manag. 21 (2), 259-272.

Bikhchandani, S., Hirshleifer, D., Welch, I., 1992. A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades. J. Polit. Econ. 100 (5), 992-1026.

Bocken, N.M.P., Short, S.W., Rana, P., Evans, S., 2014. A literature and practice review to develop sustainable business model archetypes. J. Clean. Prod. 65, 42-56.

Bocken, N.M.P., de Pauw, I., Bakker, C., van der Grinten, B., 2016. Product design and business model strategies for a circular economy. J. Ind. Prod. Eng. 33 (5), 308-320.

Bocken, N.M.P., Short, S.W., 2016. Towards a sufficiency-driven business model: Experiences and opportunities. Env. Innov. Soc. Transit. 18, 41-61.

Boons, F., Lüdeke-Freund, F., 2013. Business models for sustainable innovation: State-of-the-art and steps towards a research agenda. J. Clean. Prod. 45, 9-19.

Bourdieu, P., 1986. The Forms of Capital, in: Richardson, J. (Ed.), Handbook of Theory and Research for the Sociology of Education 241-258. New York: Greenwood Press.

Brooks, A., Simon, D., 2012. Unravelling the relationships between used clothing imports and the decline of African clothing industries. Dev. Chang. 43 (6), 1265-1290.

Broman, G.I., Robèrt, K.H., 2016. A framework for strategic sustainable development. J. Clean. Prod. 140, 17-31.

Brown, T., 2008. Design Thinking. Harvard Bus. Rev. Available at: https://hbr.org/2008/06/design-thinking (accessed: 12.11.17)

Brundtland Commission. 1987. Our Common Future. OUP: Oxford.

Business Daily (2010). Textile industry faces imminent death, Available at: http://www.businessdailyafrica.com/Opinion-and-Analysis/Textile-industry-faces-imminent-death/-/539548/924916/-/sdk5w7z/-/index.html (accessed 13.05.17)

BoF (Business of Fashion), 2016. Will the 'Sharing Economy' Work For Fashion?, Available at: https://www.businessoffashion.com/articles/fashion-tech/will-the-sharing-economy-work-for-fashion-rent-the-runway-rental (accessed: 12.01.17).

CBS News, 2016. The sharing economy's new frontier: Everyday clothing rental, Available https://www.cbsnews.com/news/sharing-economy-gwynnie-bee-everyday-plus-size-clothing-rental/ (accessed: 15.06.17).

Chesbrough, H., 2010. Business Model Innovation:opportunities and barriers. Long Range Plan. 43 (2-3), 354-363.

Chouinard, Y., 2006. Let My People Go Surfing: The Education of a Reluctant Businessman. Penguin Books, New York.

Circle Economy, 2016. Service-based business models and circular strategies for textiles. Available at: https://www.circle-economy.com/service-based-business-models-and-circular-strategies-for-textiles-a-report-for-sitra-finland/#.WjFPb1WnGpp (accessed: 13.08.16)

CITI IO, (2017). 10 truly oppressive working conditions of the clothing industry, Available at: https://www.citi.io/2017/03/23/10-truly-oppressive-working-conditions-of-the-clothing-industry/ (accessed: 25.11.17).

Clark, H., 2008. Slow + Fashion – an oxymoron – or a promise for the future?. Fash Theory. 12 (4), 427-446.

Corvellec, H., Stål, H.I., 2017. Evidencing the waste effect of Product-Service Systems (PSSs). J. Clean. Prod. 145, 14-24.

DEFRA, 2009. Reducing the environmental impact of clothes cleaning, EV0419, Department for Environment, Food and Rural Affairs report, BIO Intelligence Service, Giraffe and Intertek.

Deloitte, 2013. Fashioning Sustainability 2013: Redesigning the fashion business. Christiansen, A.M., Hvidsteen, K., Haghshenas, B. (Eds.), Deloitte.

Demil, B., Lecocq, X., 2010. Business model evolution: In search of dynamic consistency. Long Range Plan. 43 (2–3), 227-246.

Designforlongevity.com, 2017. Full Speed Ahead for Circular Fashion, Available at: https://designforlongevity.com/articles/full-speed-ahead-for-circular-fashion-2 (accessed: 09.08.17).

Dissanayake, G., Sinha, P., 2013. Sustainable waste management strategies in the fashion industry sector. Int. J. Environ. Sustain. 8 (1), 77-90.

Dissanayake, G., Sinha, P., 2015. An examination of the product development process for fashion remanufacturing. Resour. Conserv. Recycl. 104, 94-102.

Earley, R., Goldsworthy, K., 2014. Textile Toolbox. www.textiletoolbox.com (accessed 27.04.15).

Earley, R., Goldsworthy, K., 2015. Designing for fast and slow circular fashion systems: exploring strategies for multiple and extended product cycles. In PLATE conference, Nottingham Trent University (17-19 June).

Elander, M., Ljungkvist, H., 2016. Critical aspects in design for fiber-to-fiber recycling of textiles, Mistra Future Fashion report 2016:1, IVL Swedish Environmental Research Institute Ltd., Available at: http://mistrafuturefashion.com/wp-content/uploads/2016/06/MFF-report-2016-1-Critical-aspects.pdf (accessed: 19.12.16).

Ellen MacArthur Foundation, 2013. Towards the circular economy: Opportunities for the consumer goods sector, Available at: https://www.ellenmacarthurfoundation.org/publications/towards-the-circular-economy-vol-2-opportunities-for-the-consumer-goods-sector (accessed: 17.06.15).

Euratex, 2013. Benchmarking energy efficiency in apparel production, Sustainable Energy Saving for the European Clothing Industry (SESEC), Available at:

http://euratex.eu/fileadmin/user_upload/images/ongoing_projects/Benchmarking_energy_efficiency_in_apparel_production_.pdf (accessed: 13.10.16).

ECAP (European Clothing Action Plan), 2017. European textiles and workwear market: The role of public procurement in making textiles circular, Ministry of Infrastructure and the Environment, Available at: http://www.ecap.eu.com/wp-content/uploads/2016/09/ECAP-Workwear-Report-Pt-1-def-final.pdf (accessed: 12.08.17).

European Environmental Agency. 2014. Environmental Indicator Report: Environmental impacts of production and consumption systems in Europe. Publications of the European Union: Luxembourg.

Evans, S., Vladimirova, D., Holgado, M., Fossen, K.V., Yang, M., Silva, E.A., Barlow, C.Y., 2017. Business Model Innovation for Sustainability: Towards a Unified Perspective for creation of Sustainable Business Models. Bus. Strategy Environ. 26 (5), 597-608.

Ferdows, K., Lewis, M.A., Machuca, J.A.D., 2004. Rapid-fire fulfillment. Harvard Bus. Rev. 82 (11), 104-110+150.

Fletcher, K., 2010. Slow Fashion: An Invitation for Systems Change. Fash. Pract. 2 (2), 259-265.

Fletcher, K., 2016. Craft of Use: Post Growth fashion. Routledge: Oxon.

França, C.L., Broman, G., Robèrt, K.-H., Basile, G., Trygg, L., 2017. An approach to business model innovation and design for strategic sustainable development. J. Clean. Prod. 140, 155-166.

Gaiardelli, P., Resta, B., Martinex, V., Pinto, R., Albores, P., 2014. A classification model for product-service offerings. J. Clean. Prod. 66 (1), pp. 507-519.

Geissdoerfer, M., Bocken, N.M.P., Hultink, E.J., 2016. Design thinking to enhance the sustainable business modelling process – A workshop based on a value mapping process. J. Clean. Prod. 135, 1218-1232.

Geissdoerfer, M., Savaget, P., Bocken, N.M.P., Hultink, E.J., 2017. The Circular Economy – A new sustainability paradigm?. J. Clean. Prod. 143, 757-768.

Global Footprint Network. 2017. http://www.footprintnetwork.org/our-work/ecological-footprint/ (accessed 12.06.17).

Guardian, 2014. From Parisian catwalks to your home, 3D printing is democratising fashion, Available at: https://www.theguardian.com/sustainable-business/sustainable-fashion-blog/paris-catwalk-3d-printing-democratise-fashion (accessed: 05.10.16).

Guardian, 2017. How high street clothes were made by children in Myanmar for 13p an hour Available at: https://www.theguardian.com/world/2017/feb/05/child-labour-myanmar-high-street-brands (accessed: 25.11.17).

Gwilt, A., 2014. A Practical Guide to Sustainable Fashion. London: Fairchild.

GS1, 2013. Research support for an informal expert group on product traceability. Final Report. Prepared for the European Commission Directorate General. Health and Consumers (DG SANCO) (accessed 12.06.17).

Hart, S.L., 1995. A Natural Resource Based View of the Firm. Acad. Manag. Rev. 20 (4), 986-1014.

Heinz, S., O'Connell, J.F., 2013. Air transport in Africa: toward sustainable business models for African airlines. J. Transp. Geogr. 31, 72-83.

Ho, H.P.-Y., Choi, T.-M., 2012. A Five-R analysis for sustainable fashion supply chain management in Hong Kong: A case analysis. J. Fash. Mark. Manag. 16 (2), 161-175.

Hogevold, N.M., 2011. A corporate effort towards a sustainable business model: a case study from the Norwegian furniture industry. Eur. Bus. Rev. 23 (4) 392-400.

Hvass, K.K., 2014. Post-retail responsibility of garments – a fashion industry perspective. Fash. Mark. Manag. 18 (4), 413-430.

Iles, A., Martin, A.N., 2013. Expanding bioplastics production: sustainable business innovation in the chemical industry. J. Clean. Prod. 45, 38-49.

Joyce, A., Paquin, R.L., 2016. The triple layered business model canvas: A tool to design more sustainable business models. J. Clean. Prod. 135, 1474-1486.

Jung, S., Jin, B., 2016. Sustainable development of slow fashion businesses: Customer value approach. Sustain. 8 (6), art. no. 540.

Kant, R., 2012. Textile Dyeing Industry an Environmental Hazard. Nat. Sci. 4 (1), 22-26.

Keane, J., te Velde, D.K., 2008. The role of textile and clothing industries in growth and development strategies. Investment and Growth Programme. Overseas Development Institute.

Kiørboe, N., Sramkova, H., Krarup, M., 2015. Moving towards a circular economy – successful Nordic business models: Policy brief. Nordic Council of Ministers, Copenhagen.

Klepp, I., Laitala, K., Schragger, M., Follér, A., Paulander, E., Tobiasson, T., Eder-Hansen, J., Palm, D., Elander, M., Rydberg, T., Watson, D., Kiørboe, N., 2015. Mapping sustainable textile initiatives: And a potential roadmap for a Nordic action plan. Nordic Council of Ministers, Copenhagen, Available at: http://dx.doi.org/10.6027/TN2015-545 (accessed: 10.12.16).

Laitala, K., Boks, C., Klepp, I.G., 2015. Making clothing last: A design approach for reducing the environmental impacts. Int. J. Des. 9 (2), 93-107.

Linder, M., Williander, M., 2015. Circular Business Model Innovation: Inherent Uncertainties. Bus. Strategy Environ. 26 (2), 182-196.

Lindex, 2017. Available at: http://about.lindex.com/en/redesign2/ (accessed 14.04.17).

Markides, C., 2015. Research on business models: Challenges and opportunities. Adv. Strateg. Manag. 33, 133-147.

Matos, S., Silvestre, B.S., 2013. Managing stakeholder relations when developing sustainable business models: the case of the Brazilian energy sector. J. Clean. Prod. 45, 61-73.

McAlexander, J.H., Schouten, J.W., Koenig, H.F., 2002. Building Brand Community. J. Mark. 66 (1), 38-54.

McDonough, W., Braungart, M., 2002. Cradle to Cradle: Remaking the Way We Make Things. New York: North Point Press.

McKinsey & Company, 2016. Style that's fashionable: A new fast-fashion formula. Sustainability & Resource Productivity available at: http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/style-thats-sustainable-a-new-fast-fashion-formula (accessed 15.05.17).

MFF (Mistra Future Fashion), 2016. Digitise – Virtuality and Conscious Consumer Connectivity, Available at: http://mistrafuturefashion.com/design-longevity-workshop-digitise-virtuality-conscious-consumer-connectivity/ (accessed: 30.11.17).

Mont, O., 2008. Innovative approaches to optimising design and use of durable consumer goods. Int. J. Prod. Dev. 6 (3/4), 227-250.

Mustonen, M., Pal, R., Mattila, H., Mashkoor, Y., 2013. Success indicators in various fashion business models. J. Glob. Fash. Mark. 74-92. Available at: http://dx.doi.org/10.1080/20932685.2013.763476

Ostewalder, A., Pigneur, E., 2010. Business Model Generation. Wiley: New Jersey.

Papahristou, E., Bilalis, N., 2016. Can Virtual Prototype Conquer the apparel Industry?. J. Fash. Tech. Text. Eng. 4 (1), 1-6.

Papahristou, E., Bilalis, N., 2017. Should the fashion industry confront the sustainability challenge with 3D protoyping technology. Int. J. Sustain. Eng. 10 (4/5), 207-214.

Pal, R., 2014. Sustainable Business Development Through Designing Approaches For Fashion Value Chains, in Muthu, S.S. (Ed.) Roadmap to Sustainable Textiles and Clothing, Singapore: Springer Science+Business Media.

Palm, D., Elander, M., Watson, D., Kiørboe, N., Salmenperä, H., Dahlbo, H., Moliis, K., Lyng, K.A., Valente, C., Gíslason, S., Tekie, H., Rydberg, T., 2014. Towards a Nordic textile strategy: Collection, sorting, reuse and recycling of textiles. TemaNord 2014:538, Copenhagen.

Pearce, D., Turner, R.K., 1989. Economics of Natural Resources and the Environment. Johns Hopkins University Press.

Pedersen, E.R., Netter, S., 2015. Collaborative consumption: business model opportunities and barriers for fashion libraries. J. Fash. Mark. Manag. 19 (3), 258-273.

Peteraf, M., Barney, J., 2003. Unravelling the resource-based triangle. Manag. Decis. Econ. 24 (4), 309-323.

Pulse of the Fashion Industry, 2017. Global Fashion Agenda & Boston Consulting Group Available at: https://www.copenhagenfashionsummit.com/wp-content/uploads/2017/05/Pulse-of-the-Fashion-Industry_2017.pdf (accessed 20.06.17).

Pure Waste, 2016. Available at: http://www.purewaste.org/company/about-us.html (accessed 10.04.16).

Quinn, B., 2002. Techno Fashion. Oxford: Berg.

Rakib, M.I., Saidur, R., Mohamad, E.N. Afifi, A.M., 2017. Waste-heat utilization – The sustainable technologies to minimize energy consumption in Bangladesh textile sector. J. Clean. Prod. 142, 1867-1876.

Roome, N.J., 2012. Looking back, thinking forward: Distinguishing between weak and strong sustainability, in Bansal, P., Hoffman, A.J. (Eds). The Oxford Handbook of Business and the Natural Environment. Oxford: OUP, pp. 620-630.

Ruppert-Stroescu, M., LeHew, M.L.A., Connell, K.Y., Armstrong, C.M., 2015. Creativity and sustainable fashion apparel consumption: The fashion detox. Cloth. Text. Res. J. 33 (3), 167-182.

Sarwar, N., Mohsin, M., Bhatti, A.A., Ahmmad, S.W., Husaain, A., 2017. Development of water and energy efficient environment friendly easy care finishing by foam coating on stretch denim fabric. J. Clean. Prod. 154, 159-166.

Seivewright, S. 2007. Basics Fashion Design: Research And Design. Lausanne: AVA Publishing SA.

Schaltegger, S., Hansen, E.G., Ludeke-Freund, F., 2016. Business Models for Sustainability: Origins, Present Research, and Future Avenues. Organ. Environ. 29 (1), 3-10.

Schmidt, A., Poulsen, P.B., Watson, D., Roos, S., Askham, C., 2016. Gaining benefits from discarded textiles: LCA of different treatment pathways. Denmark.

Shen, B., Ding, X., Chen, L., Chan, H.L., 2017. Low carbon supply chain with energy consumption constraints: case studies from China's textile industry and simple analytical model. Supply Chain Manag. 22 (3), 258-269.

SourcingJournal.com, 2017. Can 3-D Virtual Sampling Save the Apparel Industry?, Available at: https://sourcingjournalonline.com/3d-virtual-samples-apparel-speed-to-market/ (accessed: 10.11.17).

Stahel, W., 1994. The Utilization-focused service economy: Resource Efficiency and Product-life extension, in Allenby, B., Richard, D. (Eds.), The greening of Industrial Ecosystems. Washington, DC: National Academy Press, pp. 178-190.

Stubbs, W., Cocklin, C., 2008. Conceptualizing a "sustainability business model". Organ. Environ. 21 (2), 103-127.

Subic, A., Shabani, B., Hedayati, M., Crossin, E., 2013. Performance Analysis of the Capability Assessment Tool for Sustainable Manufacturing. Sustain. 5, 3543-3561.

Teece, D., 2010. Business models, Business Strategy and Innovation. Long Range Plan. 43, 172-194.

Teh, D., Corbitt, B., 2015. Building sustainability strategy in business. J. Bus. Strat. 36 (6), 39-46.

Textileexchange.org, 2017. Organic Cotton market report 2016, Available at: http://textileexchange.org/wp-content/uploads/2017/02/TE-Organic-Cotton-Market-Report-Oct2016.pdf (accessed: 03.07.17).

The State of Fashion, 2017. Business of Fashion and McKinsey & Company Available at: https://images.businessoffashion.com/site/uploads/2016/11/The_State_of_Fashion_2017.pdf (accessed 10.05.17).

Todeschini, B.V., Cortimiglia, M.N., Callegaro-de-Menezes, D., Ghezzi, A., 2017. Innovative and sustainable business models in the fashion industry: Entrepreneurial drivers, opportunities, and challenges. Bus. Horiz. 60 (6), 759-770.

Upward, A., Jones, P., 2016. An Ontology for Strongly Sustainable Business Models: Defining an Enterprise Framework Compatible With Natural and Social Science. Organ & Environ. 29 (1), 97-123.

Urbinati, A., Chiaroni, D., Chiesa, V., 2017. Towards a new taxonomy of circular economy business models. J. Clean. Prod. 168, 487-498.

von Hippel, E., 2005. Democratising Innovation. MIT Press: Cambridge, MA.

Watson, D., Kiørboe, N., Palm, D., Tekie, H., Harris, S., Ekvall, T., Lindhqvist, T., Lyng, K.-A., 2014. EPR systems and new business models: Reuse and recycling of textiles in the Nordic region. Nordic Council of Ministers. Copenhagen.

Watson, D., Palm, d., Brix, L., Amstrup, M., Syversen, F., Nielsen, R., 2016. Exports of Nordic Used Textiles: Fate, benefits and impacts. Nordic Council of Ministers. Copenhagen.

Weber, S., Lynes, J., Young, S.B., 2107, Fashion interest as a driver for consumer textile waste management: reuse, recycle or disposal, Int. J. Consum. Stud. 41 (2), 207-215.

Wells, P., 2013. Sustainable business models and the automotive industry: A commentary. IIMB Manag. Rev. 25 (4), 228-239.

Weissbrod, I., Bocken, N.M.P., 2017. Developing sustainable business model experimentation capability – A case study. J. Clean. Prod. 142, 2663-2676.

WRAP, 2016. Valuing our clothes: The true cost of how we design, use and dispose of our clothing in the UK, Available at: http://www.wrap.org.uk/sustainable-textiles/valuing-our-clothes (accessed 15.05.17).

Worn Again, 2016. Available at: http://wornagain.info/about/press-coverage/ (accessed: 12.04.16).

WRAP, 2013. Design for Longevity: Guidance on increasing the active life of clothing. Available at: http://www.wrap.org.uk/sites/files/wrap/Design%20for%20Longevity%20Report_0.pdf (accessed: 09.09.14).

Yang, M., Evans, S., Vladimirova, D., Rana, P., 2017. Value uncaptured perspective for sustainable business model innovation. J. Clean. Prod. 140, 1794-1804.

Zhang, J., Lichtenstein, Y., Gander, J., 2015. Designing scalable digital business models, in: Baden-Fuller, C., Mangematin, V. (Eds.), Business Models and Modelling. Adv. Strateg. Manag. 33, 241-277.

Zott, C., Amit, R., Massa, L., 2011. The Business Model: Recent Developments and Future Research. J. Manag. 37 (4), 1019-1042.

Appendix 1. Scientific literature retrieval and categorization along the topical areas

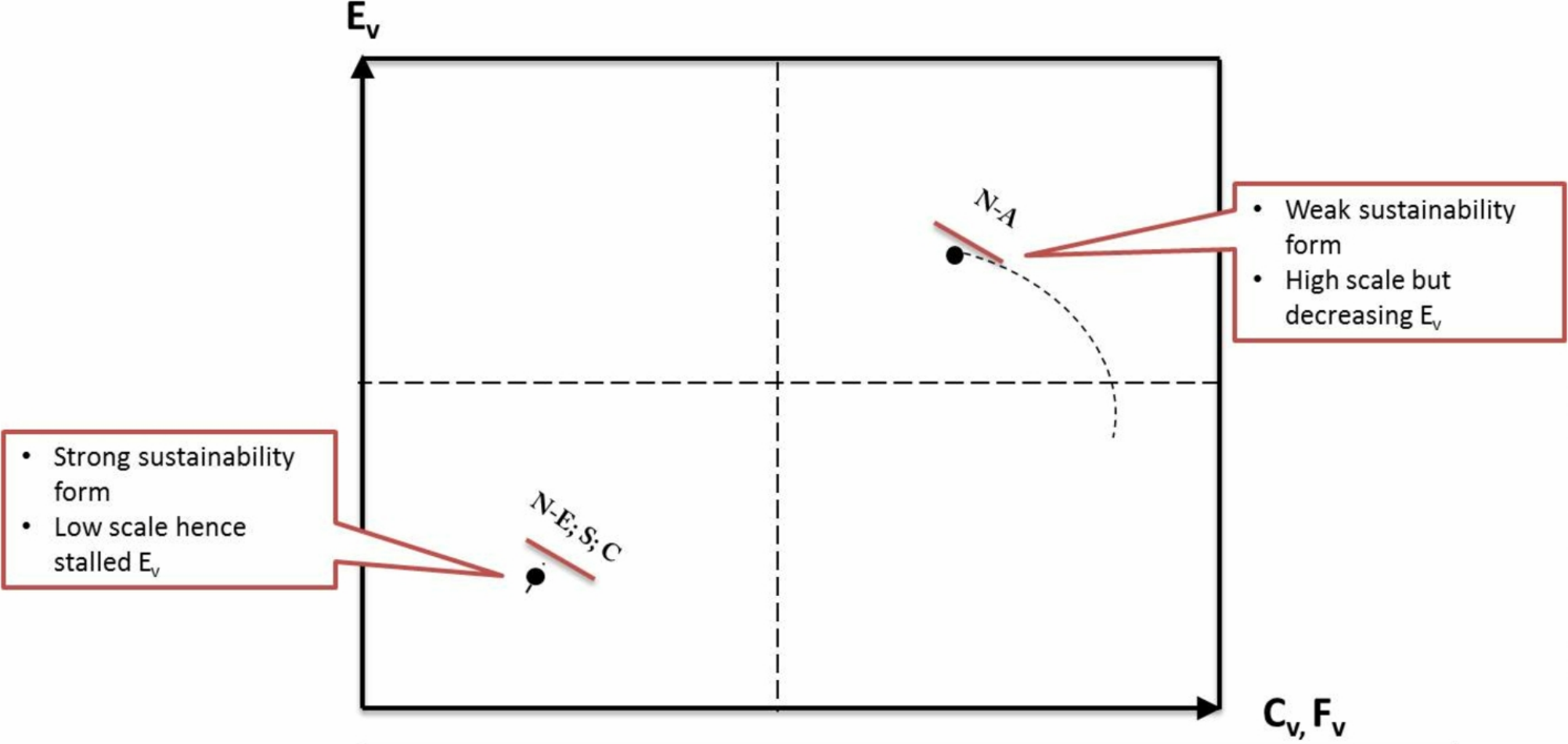
Keyword combinations for search	Narrowing	Slowing	Closing
“Sustainable business model(s)” + “fashion” or ”textile” or ”cloth*” or "apparel"	• Papahristrou and Bilalis (2017): reducing process footprint thru' digitalization and prototyping	• Todeschini et al. (2017), Jung and Jin (2016): Slow fashion • Papahristrou and Bilalis (2017) - extending use life;	• Todeschini et al. (2017): Upcycling • Dissanayake and Sinha (2013) - recycling, reusing, refashioning
“Business model” + ”sustainable*” + “fashion” or ”textile” or ”cloth*” or "apparel"	• Papahristrou and Bilalis (2017): reducing process footprint thru' digitalization and prototyping	• Todeschini et al. (2017): Slow fashion • Papahristrou and Bilalis (2017): extending use life • Corvellec and Stål (2017): PSS based dematerialization • Bocken and Short (2016): Sufficiency; • Ruppert-Stroescu et al. (2015): Creative fashion • Urbinati et al. (2017): leasing • Armstrong et al. (2016), Armstrong et al. (2015): Use-oriented: clothing consultancy, renting, swapping • Earley and Goldsworthy (2014; 2015); Laitala et al. (2015); Gwilt (2014); Seivewright (2007): Design for Longevity	• Todeschini et al. (2017), Han et al. (2017): Upcycling • Weissbrod and Bocken (2017): Recovery • Beh et al. (2016): 2nd life retailing • Dissanayake and Sinha (2015): remanufacturing • Dissanayake and Sinha (2013): Reuse, Recycle, Refashion • Armstrong et al. (2016), Armstrong et al. (2015): Use-oriented: clothing consultancy, renting, swapping • Pedersen and Netter (2015): Collaborative consumption • Gaiardelli et al. (2014) – PSS • Urbinati et al. (2017): closed loop
Archetype 1: Maximize material and energy efficiency + “Business model” + “fashion” or ”textile” or ”cloth*” or "apparel"	• Subic et al. (2013); Shen et al. (2017); Sarwar et al. (2017); Rakib et al. (2017): Clean techs for low-carbon, low effluents • Alkaya and Demirer (2014): Integrated Pollution Prevention and Control	-*	-

Archetype 2: Create value from waste + “Business model” + “fashion” or ”textile” or ”cloth*” or "apparel"	-		• Pedersen and Netter (2015): Collaborative consumption • Weber et al. (2017); Hvass (2014): reuse, recycle or disposal
Archetype 3: Substitute with renewable process + “Business model” + “fashion” or ”textile” or ”cloth*” or "apparel"	-		
Archetype 4: Deliver functionality rather than ownership + “Business model” + “fashion” or ”textile” or ”cloth*” or "apparel"	-	• Corvellec and Stål (2017): PSS based dematerialization • Armstrong et al. (2016); Armstrong et al. (2015): Use-oriented: clothing consultancy, renting, swapping	
Archetype 5: Adopt stewardship role + “Business model” + “fashion” or ”textile” or ”cloth*” or "apparel"	-	• Ho and Choi (2012): multiple life-cycles of products	
Archetype 6: Encourage sufficiency + “Business model” + “fashion” or ”textile” or ”cloth*” or "apparel"	-	• Bocken and Short (2016): Sufficiency	-
Archetype 7: Repurpose for society/environment + “Business model” + “fashion” or ”textile” or ”cloth*” or "apparel"	*Mainly directed towards social value creation*		
Archetype 8: Develop scale up solution + “Business model” + “fashion” or ”textile” or ”cloth*” or "apparel"	• Ferdows et al. (2004): Fast order fulfilment in fast fashion	-	• Pedersen and Netter (2015): Collaborative consumption

***NOTE:** Blank boxes suggest that no relevant articles or books were either found or could be categorized after screening the abstracts/summaries

Highlights:

- Technology innovations in fashion require business model innovation to be successful
- Sustainable business models in fashion need to be more scalable than currently
- Environmental value cannot substitute customer value in sustainable business models



- Weak sustainability form
- High scale but decreasing E_v

- Strong sustainability form
- Low scale hence stalled E_v

KEY:
N-E – Narrow-Efficiency loop; N-A - Narrow-Accuracy loop; S - Slow loop; C - Closed loop

Vsbm = $\overline{Ev+Cv+Fv}$ (Proposition 1)

OBSTACLES (—)
N-E – Costs of coordination & resistance to change (Proposition 2); N-A – Increased scale & shorter product life-cycle (Proposition 3); S - Immiscibility of restricted consumption & dynamic customer preferences (Proposition 4); C - Technologies limitations & Institutional inertia (Proposition 5)