



Emerging design strategies in sustainable production and consumption of textiles and clothing

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ABSTRACT

This study contributes to current knowledge of sustainability in textile and clothing production and consumption. When the textile and clothing industry aims to promote sustainability, the main change factors have been linked to eco-materials and ethical issues in production. At present, however, business models are mainly linked with a large volume of sales and production. Although industrial development has moved toward smaller environmental impact, production as well as consumption has increased to levels where the benefits of technological development are reduced. A change is thus needed to reach a systemic transformation, not only in production but also in consumption. The aim of this paper is to open up the discussion on opportunities for radical change in this industry. The paper presents ways to rethink and redesign business in the textile and clothing field by offering an overview on several design strategies that exist today in niche markets. Furthermore we evaluate how interested consumers are in these design strategies and discuss the opportunities these design approaches offer to sustainable development through new value creation.

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1. Introduction

Until recently, development in the textile and clothing industry has focused on technological and cost aspects. Emphasis has been placed on keeping the price of the final product low and increasing efficiency in production. Designers, manufacturers and retailers have paid less attention to other dimensions of the offering, e.g. ownership and related business models, as well as consumer wishes and values. Hence, the products are designed and produced according to regularly changing trends that enable quick profit, rather than radically rethinking the ways of designing and manufacturing the offering that is based on consumer needs and sustainability. Thus the question to be addressed is how textile and clothing offerings should be designed and manufactured to better suit consumer preference in a more sustainable way. At present, the business models are linked to the volume of sales and production alone. Therefore, more sustainable consumption is seen merely as leading to reduced volumes and decreasing profitability in production, not as an opportunity for a new kind of green business (Allwood et al., 2008). A radical new mindset among designers, manufacturers and consumers is needed in order to find more

sustainable ways to fulfill consumer needs and to attain sustainable improvements in the relationship between production and consumption. As Perrels (2008) points out, to a large extent the issue in sustainable development is change, not only in production systems but also in consumption patterns.

As Kemp (2008) reports, a fundamental change is needed to reach a systemic change, but transition faces resistance and it takes time to emerge. Strategic innovations are needed to create a fundamentally different way of doing business. Strategic innovation questions who the customer is, what products or services should be offered, and how to offer those products and services (Markides, 1997). In other words, it is not merely about rethinking the fundamentals on the supply side, but also about redesigning the business on the demand side, e.g. in the form of the user experience and rethinking value creation.

This paper opens up the discussion on the radical new mindset and change needed in textile and clothing design, manufacturing, business and consumption. The paper presents design strategies that can lead development to a more sustainable path. The paper combines empirical research data with a theoretical background discussion. The paper begins with an overview on the structural change inside this industry, provides a description of planned obsolescence in a throw-away society, and then further discusses the possibilities for radical change. Section 7 extends the discussion toward the need for a new mindset and change in the pattern of designing and manufacturing

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textiles and garments by presenting design strategies that question today's system of mass manufacturing. Sections 6 and 8 present the results from the questionnaires, and in the final part we evaluate the environmental impact of production and consumption in the various design strategies and discuss the opportunities to redesign the business through new value creation.

2. Research material and methods

This study concentrates on the consumer perspective and is constructed on the basis of two online questionnaires. The study employs qualitative research methods and can be classified as a collective and instrumental case study, which, as defined by Stake (2005), is a case study extended to several cases to provide insight into an issue and to offer possibilities to redraw a generalization. In this study the consumer questionnaires are used to gather insightful knowledge regarding consumers' environmental attitudes interest and worrisome issues in the field of textile and clothing manufacturing and further to map consumers' interest in various design strategies. This knowledge functions as the basis for constructing a theoretical discussion on opportunities to decrease consumption and the environmental impact of this industry through various design strategies. Furthermore this study maps out the area of new value creation opportunities through certain design strategies. As Anttila (2006) points out, empirical data in a qualitative research method can be used not only as a basis for description of reality but also as a catalyst in the process of constructing a theoretical discussion, as we have done in this study. When using data for this purpose it can be descriptive. We follow the principles of qualitative research where an abductive process of drawing conclusions uses both empirical as well as theoretical viewpoints to result in deductions. The limitation in a qualitative case study is that the results may not be repeatable as such in other cultural contexts. However, textile and clothing consumption patterns as well as the development inside this industry in Finland can be roughly comparable with the situation in other Western countries. Hence we propose that the results and conclusions can tell us something about the general attitudes toward sustainable textiles also in other Western countries.

Two online questionnaires were conducted in Finland in spring 2010. The content of both questionnaires was the same, and they included structured as well as open questions about environmental issues in the textile and clothing industry. In addition they mapped consumers' interest and worries in this field. Moreover the questionnaires included questions about consumers' textile and clothing purchasing, interest in different design strategies, and product use duration. Questionnaire A was a random sample sent to 500 respondents selected to equally represent female and male respondents and different age groups between 18 and 64 years. For this questionnaire we received 137 answers, a reply rate of 27%. Despite the low reply rate for questionnaire A, the respondents represented rather equally male (42.9%) and female (57.1%). Furthermore the respondents well represented different age categories: 17.8% were 18–25 years old, 21.5% 26–35 years old, 20.7% 36–45 years old, 25.2% 46–55 years old, and 14.8% 56–64 years old.

Questionnaire B was based on a "snowball sampling" method, i.e. a type of convenience sampling method where the respondents recommend new respondents to the researcher. Altogether 204 respondents participated. The link to the questionnaire was randomly sent to about 30 people, who were then asked to further disseminate the link to their acquaintances. In questionnaire B most of the respondents belong to the age group under 35 (77.9% were 18–35 years old), and 70.4% of the respondents were women; hence the result is dominated by a young, female standpoint.

3. Structural change

In order to study any new design approaches and new ways to create value, we must begin by giving an overview on the structural change inside this industry. The volume of the industrial production of textiles and clothing has changed dramatically in the last ten years in Finland. The production of garments has dropped by 60% during 1998–2008. At the same time, the import of garments has increased by 57%. This is a noticeable change, because in the previous ten-year period, 1988–1998, the volume of garments imported into Finland rose by 44%. During 1998–2008 the number of personnel working in the textile and clothing industry dropped from 13 870 to 7556. However, in the early 1980's nearly 70 000 people were working in the textile and clothing industry in Finland. Obviously the tendency to move industrial production to lower-cost countries began already during the 1980's. (Federation of Finnish Textile and Clothing Industry, 1999; 2009)

Table 1 presents the main countries from where textiles and clothing were imported during the years 1998 and 2008. Looking at these statistics, we can clearly see where the textile industry has moved: the winner in this game has been China. The growth in garment import from China in 2007–2008 alone was 21% (Federation of Finnish Textile and Clothing Industry, 2009).

This structural change inside the textile industry can be seen globally. In Britain it is estimated that currently 90% of clothing is imported (Defra, 2008). Textile and clothing production has increased significantly and at the same time moved from the Western world to mainly Asian countries in the pursuit of lower production costs. The global growth in textile production between the years 1979–1990 was 143%, and the Far East had the highest export growth of 430% during 1979–1990 (Lim, 2003). It is estimated that China will take over half of all the textile and clothing manufacturing of the world in the coming years (Ulkoasianministeriö, 2005).

As textile manufacturing has moved to lower-cost countries, so have the environmental impacts. According to Chen and Burns (2006) global textile consumption is estimated to amount to more than 30 million tons a year, which causes heavy environmental impact during production.

4. Planned obsolescence in a throwaway society

During the last 25 years industrial development has achieved environmental improvements and has moved toward a smaller environmental impact. However, at the same time production as well as consumption has increased by the same levels, which erodes the environmental benefits of the technological advances: i.e. the rebound effect (Throne-Holst et al., 2007). Efficient production brings down prices and increases consumption. As

Table 1
Imports of Textiles and Clothing to Finland in the years 1998 and 2008. The amounts concerning the year 1998 are given in parentheses (Federation of Finnish Textile and Clothing Industry, 1999, 2009).

Imports of Textiles and Clothing to Finland		
	Textiles %	Garments %
EU	(78.2) 71.1	(43.8) 38.0
Other Europe	(8.9) 5.4	(23.5) 7.4
China	(1.9) 6.7	(17.7) 35.8
India	(3.2) 4.3	(3.3) 4.1
Bangladesh	(–) 0.8	(2.5) 4.0
Pakistan	(2) 1.7	(–) 1.6
Hong Kong	(–) –	(5) 1.4
USA	(2.3) 1.8	(–) –
Thailand	(–) 0.5	(–) 1.0
Vietnam	(–) –	(–) 1.5

textile manufacturing has moved to lower-cost countries, the quality of garments has also declined; hence, the lifetime of garments has shortened. It is not only important how much consumers buy, but also what kinds of products they buy and how they use and dispose of them. Garments are affordable and easy to buy, up to a point where repairing the garments is no longer worthwhile. Consumers possess increasing amounts of short-lifetime garments, which have been bought without deep consideration and used only a few times before being disposed of.

The clothing industry is based on extremely fast cycles of fashion and consumers' unsustainable desires; hence it is a good example of the planned obsolescence existing in the current industrial system. Accordingly, low quality, short-term use, frequent clothing replacement and increasing textile waste cause an environmental burden. In Britain clothing and textile waste is estimated to be the fastest growing waste stream between the years 2005–2010, currently amounting to 1.5–2 million tonnes annually (Defra, 2008). In landfills this waste causes methane emissions to air and pollution to groundwater through toxic chemicals (Fletcher, 2008). The increase in textile waste is a consequence of the increase in textile and clothing consumption, which saw a growth rate of thirty per cent in 1995–2005 in Britain (Defra, 2008). "Fast fashion" with low quality accounts for 20% of the market, and moreover it doubled its growth between the years 1999–2006 (ibid.). In Finland Nurmela (2009) estimated that the consumption of clothing and footwear will increase by 23% from 2006 to 2010.

An increasing amount of textile and clothing waste has led to the development of using the textile waste, i.e. reuse and recycling – which is sometimes called the eco-efficiency approach. These approaches have faced the critique that they do not face the real sustainability problems: the increasing consumption, the growing waste problem, the environmental impact of increased textile production and the social sustainability problems of the textile and clothing industry. Fletcher (2008) points out one reason why recycling is currently so popular: it demands only a small change from producers and consumers, and this approach allows consumers to continue with their unsustainable consumption patterns. The recycling approach fits in current routines and how things are done today.

5. Change is needed

The present system in the textile and clothing industry is based on fast cycles of fashion trends that aim to continuously produce new consumer needs and products. Product life cycles are shortening, and companies want to substitute their products at an increasing pace. A study by Procter and Gamble shows how the life cycle of consumer products dropped by 50% between 1992 and 2002 (cited by Vaitheeswaran, 2007). While the supply side of the textile and clothing industry focuses on achieving low prices and effective manufacturing, other opportunities for new value creation through sustainability have not been mapped.

Sustainable innovation has traditionally been driven by the supply side. Sustainable inventions often remain as inventions instead of becoming innovations, merely due to the lack of acceptance on the demand side which, in turn, results from the lack of demand side consideration in the innovation process. Berchicci and Bodewes (2005) have highlighted that successful green products must not only address the environmental attributes, but they must also fulfill market requirements accordingly with their non-green counterparts. They further suggest that consumers' environmental concerns should be translated more deeply into the product design.

Gardner and Prugh (2008, 15) believe that innovations "fueling sustainable economics are spawning the sixth major wave of

industrial innovation since the start of the Industrial Revolution". The sixth wave not only emphasizes technological innovation but takes advantage of social issues and offers a leadership role also for the consumers (ibid.). Several companies acknowledge that market competition is driven by products' meanings: "why" people need a product rather than "what" they need in a product. People use things for profound emotional, psychological, and socio-cultural reasons as well as utilitarian ones. (Verganti, 2009)

A rethinking of fundamentals has to take place within the company, and the focus should be on the *outcome* the user wants to accomplish with the offering. The key is then to design the most sustainable way of producing that outcome for the user. Outcome-driven thinking places the focus on the *job* the user wants to get done (Christensen et al., 2007) and not on the solutions of how to produce or deliver the offering. The "job" can be functional, social or emotional. When searching for opportunities that do not pertain to the existing ways of operating, an outcome-driven approach is a viable strategy.

Eco-materials, ethical production, and eco-efficiency have been popular themes in the textile industry in recent years. Moreover, at the beginning of the 21st century several designers have made use of the concept of reuse and *redesign* in designing trendy products. However, a new sustainable mindset is still waiting to emerge at large, as we continue to design and manufacture textiles and clothing mainly in traditional ways. As Fletcher (2008, 121) describes the current situation, "...it uses yesterday's thinking to cope with the conditions of tomorrow".

Tischner and Charter (2001) identify four approaches to the development of sustainable design: repair, refine, redesign and rethink. They see the current emphasis being on "...repair modifications to existing products, with some movement towards increasing the eco-efficiency of existing products – the refine approach" (127). Currently changes to existing products are mainly made at the operational level, but new solutions should also offer value through sustainability and reduce the environmental impact of products and consumption in total. Hence, Tischner and Charter propose (2001) that the next shift will be towards the redesign approach, especially in the use of new technologies and materials to reduce the environmental impact of products. The next stage, *rethink*, requires a radical change in mindset, and it can offer breakthroughs for new lifestyles, the ways of living and doing things, as well as approaches to fulfill consumer needs in a more sustainable manner (ibid.). This approach needs strategic innovations that lead to new business models. As Tukker et al. (2008) argue these new practices often stay in niches for a long period until a window of opportunity opens and their breakthrough is possible.

In Section 7 we present several design and manufacturing strategies that offer a new approach to sustainability but which today still operate as niche practices. First, however, we present consumers' environmental worries in the context of textiles and clothing.

6. Consumers' environmental worries

In this section the results from the questionnaires are presented. The focus is on environmental concerns of consumers in the textile and clothing field. When asked if environmental impact as well as ethical manufacturing and safety issues affect their purchasing decisions, in Questionnaire A 21% of men and 40% of women said that these aspects often affected their textile and clothing purchasing decisions. However 74% of men and 87% of women said they were interested in ethical consumption as well as the environmental impact of products in general (Questionnaire A). Table 2 presents the results from questionnaire A regarding what consumers considered important aspects in textile and clothing. From these responses we can conclude that younger respondents

Table 2

Environmental worries of consumers according to age and gender. The numbers refer to the percentage value of the statement “totally or somewhat agreed”.

Questionnaire A	Age <35 [%]	Age >46 [%]	Women [%]	Men [%]
The ‘Made in Finland’ aspect in textiles and garments is important to me	39	60	60	48
It is important to me that textile production has a small environmental impact	71	65	70	68
I want to know about the production and environmental impact of the garments I am purchasing	61	44	57	38
I am worried about the ethicality of textile and clothing production	64	45	64	40
I am worried about the environmental impact of textile and clothing production	71	55	77	50

were more worried about the environmental and ethical aspects in textiles and clothing. In addition, women worried about these aspects more than men. Furthermore there was an obvious interest in acquiring more information about the environmental impacts as well as ethical issues inside this industry.

Local and domestic production seemed to be more important for older respondents and women than for young consumers and men. In questionnaire A, the Made in Finland aspect when purchasing garments was important to 39% of the respondents under the age of 35, while 60% of the respondents over the age of 46 considered this aspect important. However, when asked what aspects most affected their latest clothing purchases, the Made in Finland aspect was not particularly strong: in questionnaire A 16% and in questionnaire B 7% agreed with this. It is interesting to note that local production was an important value to consumers, especially considering that most garments are currently manufactured outside Finland, mainly in Asian countries. The option to choose a domestically manufactured garment is less available to consumers today. The same tendency can be seen in other European countries, as mentioned in Section 3.

In the questionnaires we asked the consumers to point out the phases of the product life cycle they were concerned about when thinking about the environmental impact of textiles. Table 3 presents the answers of the respondents. The lifetime of the product and the cultivation of fibers especially worried respondents in questionnaire B (younger female standpoint), and the location of manufacturing and product processing worried respondents of questionnaire A. Low quality and the short life span of the clothes are familiar issues to all consumers. When asked about the shortest time respondents had used some garment, they reported use of no more than a couple of times. In questionnaire A 30% of respondents answered this, and if we examine these answers more closely, 36% of women and 21% of men replied that they have used some garments only a couple of times. Regarding the reason for the short-term use, the main reason was low quality.

7. Design strategies

In this section we present design strategies that focus on extending the product life span. The short life span of textiles and

especially clothing is one of the main problems in the current industrial system based on planned obsolescence. According to our study, as presented in the previous section, the same issue is also a worry for consumers.

7.1. Long life guarantee and product satisfaction

As Mont argues (2002), manufacturers could shift the focus of their operations from exchange value to use value, which offers new opportunities to increase the intrinsic product quality and durability. Hence manufacturers can offer a longer product life span and deeper enjoyable use experiences to consumers. Earlier studies have shown (Niinimäki, 2011) that consumers’ biggest dissatisfaction in the area of clothing is with the low quality, especially experienced quality during use and maintenance stages. As the life span of the product as well as the quality of textiles and garments are difficult to evaluate at the point of purchasing, producers could offer consumers information about the intended lifetime of the product. While maintenance quality is critical to longevity in clothing, manufacturers could also provide information on how many washes the garment will take and still look good. This information could help consumers to evaluate connections between price, quality and utility; the product’s life span as well as its potential esthetic longevity; and moreover the environmental benefits of the product (Niinimäki, 2010).

A “slow design” approach aims to prolong a product’s lifetime and to deepen product satisfaction. Slow fashion is designed to be used over a long time period, and it is made with high quality and high ethical values; it is durable and made of sustainable materials. The design lasts over time as styles and colors are classical, and the materials age well. This affects esthetic longevity. (Fletcher, 2008)

7.2. Product attachment and emotionally satisfying design

A deep product attachment has the potential of extending the life span of the product. The objectives of “empathic design” and emotionally durable design are to build on a deeper understanding of the individual consumer’s needs and values (e.g. Chapman, 2009). The aim is to design products that are meaningful to the user over a long period of time and thus they are not easily

Table 3

Phases of the product life cycle that worry consumers. The numbers refer to the percentage value of the statement “totally or somewhat agreed”.

Questionnaire A		Questionnaire B	
	[%]		[%]
1. Location of manufacturing	53	1. Lifetime of the product	76
2. Product processing	45	2. Cultivation of fiber	50
3. Lifetime of the product	33	3. Product processing	47
4. Transportation	32	4. Location of manufacturing	46
5. Cultivation of fiber	24	5. Fiber processing	35
6. Disposal of the product	22	6. Transportation	34
7. Fiber processing	20	7. Disposal of the product	32
8. Use phase (the use of water and energy)	11	8. Use phase (the use of water and energy)	11

disposable. This often means a unique design process or co-creation with the user. These fundamentally new ways of designing and co-creating require not only a new mindset but also new business models and manufacturing systems. Accordingly new product strategies, which include all aspects, designing, manufacturing, sales, marketing, service support, and reverse logistics, have to be constructed (Fuad-Luke, 2009).

7.2.1. Customization, halfway products and modular structures

As Chapman (2009) points out, products that are easily personalized or customizable offer an opportunity to create a deeper emotional bonding between the user and the product. Through customization, the user can create personal meanings and form attachments to products. Mass customization uses fast, flexible digital manufacturing technologies and computer-aided design. The idea is to satisfy both the manufacturers' and the individual user's needs in global, fragmented markets (Pine, 1993; Lee and Chen, 2000). Traditionally, the mass-customization concept offers the user a platform including a range of choices in styles and colors to create a personal look.

The design concept of halfway products (e.g. Fuad-Luke, 2009, 95; Papanek, 1995, 244) offers the user a more active role in the product design process and a larger opportunity for creativity than the mass-customization concept. The consumer can translate his/her own creativity and preferences and even individual memories into the product. Products that are available as kits and designed for disassembly are one opportunity to offer the consumer a creative experience. Kit-based products enable the user to build the products, thereby acquiring a deeper knowledge of the product and becoming able to repair the product if needed (Papanek, 1995).

A modular structure allows quick disassembly and reassembly of modules. In terms of clothing, this would mean detachable parts. This design concept offers the possibility to upgrade the product or to personalize the product through modifications; e.g. some pieces of the clothing can be changed or the consumer can select the details according to his/her favorite colors or materials. Garments with a modular structure may also need less laundering, if the garments are designed with this aim. The parts of the garment that become soiled more easily can be detachable and thus easy to remove and wash separately. (Fletcher, 2008)

7.2.2. Co-creation and open source design

Co-design approaches encourage participation of the end users in the design process. A co-design process offers multiple stakeholders the opportunity to collectively learn, solve problems and develop a design outcome with deeper consumer satisfaction. In a co-creation process the designer interprets users' responses and through this the company can create value together with the users (Fuad-Luke, 2009). This results in a sense of fulfillment on the part of the users, and they form an attachment to the product more easily.

However, even more radical thinking is now emerging. Open source fashion is a recent phenomenon, and the internet makes it possible to reach fashion consumers all over the world. Fashion designers can still sell their design skills through patterns and construction information, but the end-users implement the final design outcome. Open source fashion is not led by large companies or retailers. Hence the individual consumer has a leading role in decision-making, turning the consumer from a passive consumer into an active maker, and this deepens the feeling of achievement and in turn increases product satisfaction.

7.3. Services

Product-service systems (PSS) emphasize systems thinking and drive companies to focus on consumer needs (Charter and Clark,

2007). Mont (2002) describes how a product-service system focuses on competitive ways to satisfy customer needs; while doing so it also has a lower environmental impact than traditional business models. As Robert et al. (2002) point out, in a "Zero Emission Society" consumers should invest in services and purchase functions instead of products. In this type of society all materials should be automatically returned to the producer after the use phase, and this creates environmental value for the whole system.

Stahel (2001) states that consumer satisfaction in a service economy is at the center of focus, and it can be implemented by offering good product performance through services which do not increase waste streams. Guaranteed satisfaction at a guaranteed service per unit thinking offers the consumer a sustainable way to fulfill needs. Service thinking also offers flexibility in product utilization which ownership does not offer.

7.3.1. Design services

Traditionally design services for textiles and clothing have been employed in tailor-made suits or in customer-centered unique design processes. The tailor-made suit is a good example of the quality–durability–price connection. A tailor-made suit is more expensive than a ready-made garment, but on the other hand, it is made according to the user's preferences, needs and measurements, offering a perfect fit physically but also emotionally.

Today, designers are able to create individual and unique looks by using digital technologies that enable placing the consumer's attachments, emotions, and wishes at the center of the design process, securing a deep product relationship and increasing the likelihood of a long life span of the product (Niimäki, 2009). The development of small-sized and easy-to-use digital technologies in the area of textiles has created new design service possibilities. Digital textile techniques have expanded the possibilities to design and produce unique products. Digital textile printers, embroidery and laser cutting machines, and digital weaving machines offer wide opportunities to realize consumers' individual preferences and needs. These techniques enable savings in the use of materials compared to the industrial scale for manufacturing textiles; production is based on existing orders in lieu of surplus production. (Niimäki, 2009)

7.3.2. Services for intensive and longer utilization

Services for intensive utilization question the need for ownership of a product. Through shared use of goods, it is possible to reduce the material and resource flows and achieve a more intensive utilization of a product. This can mean renting or leasing, the replacement of goods with services, and non-profit networks for lending and sharing, as well as garment exchange stocks operating through the internet. As Stahel (2001) argues these concepts require a fundamental change from global manufacturing systems to local renting systems, which benefit the locality.

Products aimed for long-term use have to be made with high quality. The quality of products is directly linked with their durability. Classic and timeless design, good fit and high quality offer opportunities for longer utilization. Longer product life spans can also be achieved through services such as upgrading or updating, repairing or product modification systems or services. These services extend the enjoyable use time of the product as well as postpone the psychological obsolescence that consumers themselves feel about the product (Niimäki, 2011).

8. Consumers' interest in the design strategies

The design strategies presented above can potentially lower the environmental impact of clothing and textiles. Table 4 presents the results from questionnaire B, where respondents were asked about their interest in these various design strategies.

Table 4

Consumers' interest in design strategies. The numbers refer to the percentage value of the statement "totally or somewhat agreed".

Consumers' interest in design strategies	[%]
I could use repair and modification services.	86
Garments have to be suitable for recycling (multiple life cycles).	83
Garments could be upgradable.	72
I am interested in the customization possibilities of garments.	68
Manufacturers could offer exchange and return services for garments.	68
I can rent garments for short-term use.	62
I am interested in taking part in the design process e.g. through the internet.	61
I am interested in clothing with a modular structure, because I could repair or even make the garments myself.	60
I am interested in affecting the manufacturing process e.g. through the internet.	52
Garments have to be designed for an optimal use period, and the optimal use period has to be communicated.	50
I can rent garments for long-term use (e.g. one year).	22
I could buy a short-lifetime garment, which does not need any washing during its short life span.	11

It is often the case that innovations with a more radical approach do not generally come from user-centered approaches, meaning that users are tied to existing solutions and socio-cultural regimes (e.g. Verganti, 2009). The most popular design concepts in the questionnaire were ones that were already familiar to the consumers. The more radical long-term renting and the optimization of the garment use time did not appeal to the respondents. Exceptions are, however, the upgradeability, modularity and co-creation concepts. New service systems such as exchange or return organized by the manufacturer also interested consumers.

Does the concept of slow fashion interest consumers? When we asked, "Are you ready to buy a long-lifetime, repairable and more expensive garment and use it for a long time to minimize your own environmental impact?", in questionnaire B 83% and questionnaire A 78% of respondents totally or somewhat agreed with this statement.

9. Considerations on design strategies

As aforementioned in this paper consumers are worried about the environmental impacts of current industrial manufacturing systems. Moreover, as shown in the previous section, consumers' interest in new design approaches is high. Table 5 provides a summary of the potential effects the various design strategies may have on the environmental impact of production and consumption. Furthermore we have evaluated consumer interest in the different strategies. Consumer behavior is not easy to predict; if these strategies, however, create deeper product satisfaction and product attachment, there is a greater possibility that consumers will postpone replacement of products and through this decrease their own consumption. On the other hand, it is not yet verified whether this happens in reality. Consumers may still increase total consumption. Furthermore, all these strategies do not necessarily decrease the environmental impact of the production if they, for example, do not lower the amount of production in total.

It may be wise to combine different strategies to promote sustainable consumption (Mugge et al., 2005). In clothing this may mean e.g. combining slow fashion with local production and perhaps even with customization to achieve high quality and sustainable value. On the other hand garment design must be combined with

Table 5

Evaluation of the design strategies.

Design strategy	Decreasing environmental impact of production	Decreasing consumption	Consumer interest
Multiple life cycles	+	–	+
Slow fashion	+	+	+
Customization	+/-	+/-	+
Halfway products	+	+	+
Modular structure	+	+	+
Co-creation	+	+	+
Local production	+	+/-	+/-
Design services, unique design	+	+	+
Services for longer or intensive utilization	+	+	–

multiple life cycle strategies that benefit the consumers, e.g. including reverse logistics. Adding services to the aforementioned, e.g. a garment exchange system, may lower the environmental burden of this industry.

When consumers are active partners in the design or manufacturing process itself, it is possible to increase the uniqueness and personalization of the product. Several studies have shown (e.g. Mugge et al., 2005) that these aspects symbolize an accomplishment to the consumer and therefore deepen the product attachment, and this emotional bonding may postpone product replacement. Strategies that offer opportunities to better meet an individual customer's needs, create deep product satisfaction and thereby offer the opportunity to decrease consumption in the textile and clothing industry include halfway products, modular structures, customization, co-creation and design services.

10. New value creation and radical change

When mapping the opportunities to redesign a business, the issue of a new kind of value creation is essential. Möller (2006) identifies three value creation systems: firstly core value, which is useful in stable exchange markets; secondly value-added value creation, which works through incremental innovations; and finally future-oriented value. In relation to the design field, traditional product design and manufacturing is based on core value creation while product-service systems are based on value-added value creation systems which benefit not only consumers but also the environment and society. Möller (ibid.) proposes that visioning and sense-making can reveal how new, radical future-oriented value can be created in radically new business offerings. He also points out that future-oriented value creation needs multi-party collaboration within complex networks, and it will offer radical changes in old value systems. Since, according to Möller (ibid., 917), future-oriented value creation includes opportunities to create "new value activities" and moreover offer "radical system-wide change" it fits well as a base for new strategic thinking. Accordingly, if this new future-oriented value thinking aims to decrease the environmental impacts of production and consumption as a whole, it could offer benefits for sustainable development.

According to Schlegelmilch et al. (2003) strategic innovation has three key elements. The first element is a fundamental reconceptualization of the business model: what business we are in, who our customers are, and how we achieve value. The second is the reshaping of existing markets that purposefully challenge the existing rules of the industry. For example, in modular products the lifetime of the product is viewed as a dynamic process, including modifications, additions, and updates to the initial product. In this

approach the product lifetime is a process in which the user has an ongoing active role in designing the product. Thirdly, strategic innovation creates dramatic value improvements for customers; strategic innovation places strong emphasis on value and has the customer, not the competition, at the center of strategic thinking (ibid.). The strategies presented in this paper have the user at a central position in the value creation activity; the user is either an active participant in the design process or the strategy takes the user needs and satisfaction as the starting point.

As Mont (2002) highlights, focusing more on use value than exchange value offers manufacturers new possibilities to include higher intrinsic quality in the product and hence offer a longer satisfying use experience and further extended utilization of the product. Park and Tahara (2008) point out that product value has to be defined in the actual use context, and accordingly the life span of product has to be connected more profoundly to products value. Moreover Mont (2002) emphasizes that recognizing the value of use and offering value-adding services means that manufacturers could create a new service-oriented economy, a functional economy, instead of the current industrial economy. In a functional economy, utilization, function and services are at the center, not industrial manufacturing. Hence Mont (2002) defines product-service systems as a model that satisfies consumers' needs in a more sustainable way than traditional business models. Accordingly this thinking offers emotional value for the consumer through deeper use satisfaction.

Mont (2002) further argues that this change from an industrial system to a functional system creates opportunities to develop systems that provide a certain quality of life for consumers through a new kind of value creation. Na et al. (2009) define this to mean lifestyle value, where at the center lies the consumer's satisfaction on the level of both psychological wants and emotional desires, not only on the functional level. In other words, this new value creation focuses not only on utilization and the consumer's use experience with the product but also environmental values which can be communicated to the consumer. By focusing on both production and consumption, this approach actually decreases the environmental impact of the whole system, thus creating environmental value and moreover sustainable development value.

A number of design strategies presented in this paper question the role of the consumer and turn him/her into an active value creator, instead of mere value consumer. All design approaches that demand more commitment and effort from the consumer's side change the consumer's role towards co-creator in value creation. A co-creation approach also offers social value for the participants. Moreover open source design questions the entire current industrial system and offers the consumer a leading role. It questions the global industrial manufacturing systems in garment manufacturing, if not in textile manufacturing, as it still needs the fabric with which to realize the garment. This approach offers deep emotional value where the consumer himself/herself can be part of the realization process, and through the resulting sense of achievement, he/she can then feel deep product satisfaction and product attachment. The result is an increase in the emotional value of the product and its use.

Moreover slow fashion, which includes local production, increases the cultural value and offers benefits for sustainable development, by, for example, decreasing the negative impacts of logistics. In addition, services that emphasize renting shift the focus from global to local actions, and hence they benefit the environment as well as local actors.

We can conclude that establishing a new value creation system is a prerequisite when redesigning more sustainable business in global textile and clothing markets. The types of values that can be promoted through these new design strategies are the following: use value, emotional value, added value through services, cultural

Table 6

Main value creation through particular design strategies.

	Use Value	Emotional Value	Cultural Value	Social Value	Added Value through Services
Slow fashion	x		x		
Long life guarantee	x	x			
Customization		x			
Halfway products		x			
Modular structure	x	x			
Co-creation		x		x	
Local production			x	x	
Open-source design		x			x
Design services, unique design		x			x
Services for longer or intensive utilization	x			x	x

value, social value, environmental value, sustainable development value and future-oriented value (see Table 6). A fundamental discussion on value creation can point the path to a radical new mindset and open the window for radical change, which can steer the redesign of the business. We argue that future-oriented value thinking combined with an environmentalist approach is the foundation that can initiate discussion on new value creation in the context of sustainable development. More research is still needed to make this value approach calculable and possible to communicate to consumers.

11. Conclusions

This paper presented a set of design and manufacturing strategies for the textile and clothing industry that could reduce the environmental impact of textile and clothing production and consumption. These strategies question the current industrial system and open views to new value creation opportunities inside this industry.

These presented strategies will not directly lead to sustainable practices, as the system is not yet ready for radical change. However, by focusing more on consumers' values and needs or providing better consumer satisfaction, these strategies may initiate discussion on how to start a systemic change in this industry. While the short life span of textiles and especially clothing is one of the main problems in the current industrial system, and it is also a worry for consumers, this paper presented design strategies that focus on extending product life spans through better intrinsic quality and lifetime guarantee, product satisfaction and product attachment. Moreover we explained how services might extend the product life span.

Secondly by suggesting a new kind of value creation the paper discusses how to develop new value in the product or its use through service thinking. It points out that the product value defined during the use context is most important and should be profoundly connected to consumer satisfaction as well as product life span. Other important values for the consumer are emotional value and environmental value. Moreover we defined cultural and social value, sustainable development value and future-oriented value to be most important when redesigning a business. Rethinking fundamentals in value creation offer opportunities to develop sustainable value both in production as well as in consumption, and through this knowledge it is possible to redesign the business.

Strategies presented in this paper have the potential to break the rules of the industry and change the nature of competition, but it is the realization of these strategies that will determine whether or not it will produce a strategic innovation, one that goes beyond

incremental improvements. These presented strategies exist still in the niche market, but as we have shown in this paper, consumers are most interested to change the patterns in current industrial manufacturing as well as in consumption.

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