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**Special Edition:** Sustainability &
Innovation in the Fashion Field

# the nordic textile journal

The Nordic Textile Journal is a peer reviewed international journal publishing high-quality articles dedicated to research and artistic development related to textiles and fashion.

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1. Research articles: A research article is a regular article which aims to present new findings in textile and fashion research.

2. Articles on artistic development: An article on artistic development aims to present artistic progress and may relate to practice-based design research, design methodology or novel achievements in textile art and craft.

3. Notes: A note is a short article, which aims to report new findings.

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Areas covered by the Nordic Textile Journal include several aspects related to textiles and fashion, such as design and arts, engineering and technology, business, management and socio-economic issues, as well as cross-disciplinary and transdisciplinary issues.

# Fashion Function Future (F:3)
# – a research programme

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We are all affected by fashion: as individuals when we use clothes and other products to create an identity and an image and as consumers participating in the wheel of consumption and economy. As researchers, we try to understand fashion and its actors and how research can contribute to a better society and prosperous industries. This issue of the Nordic Textile Journal presents both articles based on research conducted at the University of Borås and articles from other researchers who share our interest in sustainable fashion and the textile industry.

Once upon a time, Borås was well-known as a cluster for the Swedish textile industry. Although many textile and fashion businesses closed down as a result of the decline of the industry in the 1970's, the Borås region still hosts many fashion and textile businesses and is the home of the only fashion incubator in Sweden (Modeinkubatorn). Together with the Swedish School of Textiles, the University of Borås and other educational organisations focusing on fashion and textiles this region has once again become a hotbed for a dynamic fashion and the textile sector. Thus, it is no coincidence that a research programme called *Fashion Function Future (F:3)* was initiated at the University of Borås in 2010.

*Fashion Function Future (F:3)* – is a programme for research and artistic development, addressing issues and topics ranging from artistic design to distribution logistics, as well as the marketing and management of fashion and textile companies, where sustainability is a shared concern. The programme is based on an interdisciplinary environment that supports the development and balancing of artistic expressions, design methodology, technology and management, all related to the field of fashion and textiles. Several departments at the University of Borås collaborate to achieve this interdisciplinary approach and contribute with the knowledge required to shape F:3.

Although we are based in Borås, where tradition associates fashion with clothing and textiles, we realise the term fashion is more complicated than that and that it needs to be further investigated for our readers to fully understand the intention behind our programme. Our research is *Future* oriented, but the in-between term Function also needs some explanation, which we will come back to below.

To explain why fashion is not only the study of dress and clothing, Kawamura (2005, p. 1) coined the term "Fashion-ology", which she defines as "a sociological investigation of fashion, and it treats fashion as a system of institutions, that produces the concept as well as the phenomenon/practices of fashion". Fashion is an immaterial concept and clothes are the materialized objects of this concept. In this sense, Kawamura refers to the actors who are part of a specific system that defines what is defined as fashion and what is not. For clothing to become fashion, it is not enough that a collection

of clothes has been shown on the catwalk. The participation of multiple actors is required for something to be defined as fashion. Hence, fashion is a sociological phenomenon, a socially constructed process, because a social context is required. It is also one reason why research in fashion primarily takes place within the field of sociology and considers fashion a cultural phenomenon.

Although the fashion industry is an old industry, research focusing on fashion businesses from a management perspective is rather young. Parallel to the emergence of brand management in the 1980's, an interest emerged in the marketing of fashion (c.f Rogers and Gamans, 1983; Hines & Bruce, 2001). This happened in a time when fast-fashion took off and companies such as H&M and Zara conquered fashion markets globally. This triggered Teri Agins to write her book *The End of Fashion: the Mass Marketing of Clothing* in 1999. However, fashion marketing continued to grow as a subject; especially, luxury brands raised an interest among brand researchers in the late 1990's and have continued to do so after 2000 (Kapferer, 1997; Moore & Birtwistle, 2004; Okonkwo, 2009; Radon, 2010). Business schools such as Bocconi in Milan, Essec outside Paris and the London Business School even initiated special Master's programmes addressing luxury branding.

In 2009, the Swedish School of Textiles started a new Master's programme in Fashion Management and Marketing in collaboration with the London College of Fashion, where the Master's programme in Fashion Management at the LCF was a source of inspiration. This caused a need to strengthen research in fashion from a management and marketing perspective and also a need to reinforce the research profile in textile and fashion already established across several departments at the University of Borås. This collaboration came to form the foundation for the research programme *Fashion Function Future*.

Fashion is, as stated by Kawamura (2005), a system driven by certain fashion companies, designers, trend institutes, media, modelling agencies, PR agencies, and consumers – intertwined and interdependent. The system allows some clothes to be embraced and to become "fashion" and while others fail and are, probably, forgotten. In this sense, Kawamura distinguishes between fashion production and fashion consumption on the one hand and production and consumption of clothing on the other. A fashion company creates garments of a specific design, which will be produced at a certain quality level, at a certain price, and will reach the market and the customers as efficiently as possible. Hence, it is a quite traditional enterprise focused on technology, materials, distribution, finances and, of course,

design and creativity. Therefore, at the different departments of the University of Borås, we stand to benefit from research from a broad perspective in the fields of management, leadership, marketing and technology and are also able to apply it to the fashion and textile sector. However, in order to understand how different management models are to be interpreted in connection with the fashion industry, we need to recognize the fashion market as an aesthetic market and one which comes with certain particularities (Entwistle, 2009).

The importance of being part of a specific culture and of participating in specific events is not unique to the file of fashion. Principally, similar institutional systems for e.g. producers, designers, media, PR-agents and consumers are also valid for other product categories that are part of what we described above as an institutionalized system and what could be referred to, in a wider sense, as aesthetic cultures. The products in question are usually ones we do not consume solely for their function, as we do e.g. with a chair to sit on or a table to eat at, but also for the value of a certain aesthetic, which in many cases is endorsed by a famous designer brand and legitimized by defined trends. Researchers need to have an understanding for how an aesthetic culture affects the companies and people who are part of it, while these companies also experience the same management issues as any other company – in principle. Through participation and interaction in research projects and at seminars organized within F3, researchers from the fields of fashion and textile design, technology, materials, management and marketing are given opportunities to share knowledge and experience with practitioners from the field.

All clothes are not fashion: not only because they are not part of the fashion system, but also because they are worn primarily for their function. This is not to say that aesthetics is not relevant for functional products; on the contrary, they are significant to the wearers and users both as identity markers and because of different signal features provided by the appearance of the products. This applies to everything from workwear and sportswear to uniforms, traditional folk costumes and other textile products. But what is considered *function* and what is considered *fashion* change over time. Sportswear used to be worn primarily for its functionality, whereas today a lot of sportswear is affected by the fashion concept and sportswear companies compete directly with fashion companies. Manufacturers of products focusing on functionality have collaborated with the University of Borås for a long time regarding materials, design and supply chain issues. This research also provides a foundation for developing research in F:3 related to fashion products.

Fashion is one of the largest industries worldwide, prospering at the very heart of consumer society, and provides great opportunities for newly industrialized countries, while it also challenges our capability to solve many of the environmental issues related to it that cause severe problems. Fashion is responsible for some of the obstacles to achieving a sustainable society and environment. There are problems along the entire chain of production of garments and other products essential to the world of fashion, from issues related to the cultivation of fibres, pollution of soil and water, and exploitation of the work force and animals, all the way to issues related to consumption of fashion and clothing. The task of solving all these problems is overwhelming. Hence, the Future for the fashion and textile companies, as well as for the consumers, holds many great challenges.

In the creation of the new research programme in 2010, the challenges and opportunities facing the fashion industry guided our ideas for different projects. When defining sustainability, three areas were considered: environment, ethics, and economy. Although it seems the industry focuses mainly on the creation of a luxurious and glamorous world, there is an interest, forced or not, among fashion companies for improving matters and solving problems. Some leading companies of the industry have joined forces and have started to measure improvements in different ways, e.g. through the Higg-index. This is of course a necessity if they want to survive in the long run.

Fashion is a global industry to a great extent and one where even very small companies from e.g. Sweden have to deal with production both in other European countries and the Far East. Digital development is changing the ways in which companies reach their consumers and this is an opportunity for small companies, although it is not quite as easy as it is sometimes seems. There has been some discussion on the existence of "the Swedish Fashion Miracle" based on the success of several Swedish fashion brands (Falk, 2011). Rather than being a miracle, this is the result of creativity and hard work. Growing to become an international company is a great challenge to a small enterprise. Thus, economic sustainability is a subheading in our definition of sustainability and also the topic of some of the research projects within the *Fashion Function Future* programme.

Although we cannot present all topics, we have initiated research projects addressing development of fibres that are harmless to the environment, aesthetics of new materials, organization of local production, new business models based on re-design of old garments, the creation of more efficient supply chains without returns, the international growth of Swedish

fashion design companies, leadership in fashion design companies and for fashion etailers, innovation in the field of fashion, as well as studies of consumer behaviour from a sustainability perspective. In the textile and fashion value chain, from ideas to customers and beyond, the decisive stage is in the design process, which combines artistic skills and functional considerations in order to make fashion products logistically manageable, attractive to customers, and resourceful from an environmental and sustainability point of view. For more information about on-going projects, please visit our homepage: http://www.hb.se/f3

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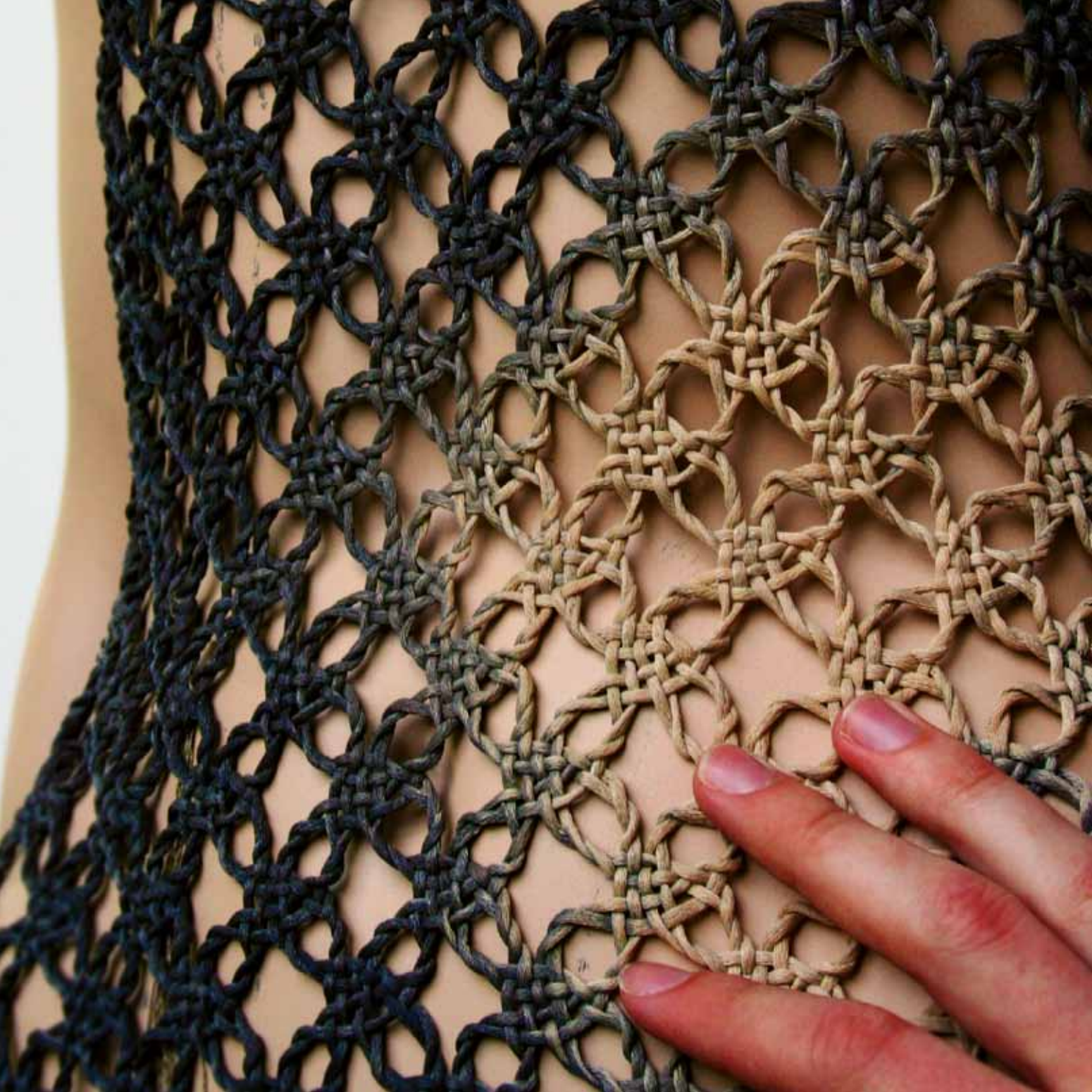
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# Crafting Smart Textiles – a meaningful way towards societal sustainability in the fashion field?

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**Abstract**
Smart textiles with its vast range of possibilities provide a considerable opportunity for societal sustainability for the waste-oriented fashion industry. May the new textiles react to the environment, wearer, have a mind of its own or simply provoke and inspire people – it is a great tool for the transition from the product-oriented industry to the service-minded economy. Fashion field needs to mature and adapt to the new rules set by the user within today's environment. While developing the new field of smart textiles, this paper stresses the importance of learning from traditional crafts and the value of craftsmanship.

We start by introducing the importance of crafting and connecting it to the industrialized way of producing. Then, we ask whether we could merge valuable insights from both in order to develop the smart textiles area. Later, you will find an example project merging Quick Response (QR) codes with traditional embroidery that inspired a set of TechCrafts explorations in a form of student projects. In case of the embroidered QR codes, the link to technology is an add-on feature to textiles. In the other examples, craftsmanship technologies are used to create the textile substrate itself. These explorations are the input for a discussion about the role of craftsmanship and skills in developing materials with interactive properties that is held with relation to the possibilities for societal sustainability.

**Keywords:** craft, crafting smart textiles, digital technology, societal sustainability, culture of connectedness

**Introduction**
Textiles and traditions, and rituals and crafts related to them have existed for millenniums. Natural fibers spun, weaved or knitted together have been close to the human body, environment and conscious for basic survival purposes, social distinctions, expressing different power relations and even interacting with the spiritual realms.

Crafts and everything related to them are much more than some old techniques. Sennett (2008, p. 9, 149) describes craftsmanship as "basic human impulse, the desire to do a job well for its own sake," and craft as a more advanced level of technique, such that the "technique will be intimately linked to expression".

Everything from the cultivation of the plant up to the finalization of a garment used to be done by a specialized hand, therefore each step, stitch and loop had their own personalized share of attention and time. Processes were slow and people involved could put their own personalities into it – "learning about themselves through the things they made" (Sennett, 2008, p. 8). With mechanical production textile and garment processes got standardized, automated and, due to the shift towards consumer culture mindsets, extremely wasteful.

Smart textiles are around for a while now with a great technology-driven emphasis on what is possible to develop. There are many inspirational examples around that express how technology and textiles could exist together creating effects or even feelings. For example, stage targeted products of CuteCircuit (2012), Hussein Chalayan (2012), XS Labs (2010) or Ying Gao (2012). What if now that new techniques emerge, in order to craft a more sustainable future, we would get inspired from ancient techniques and meanings as well? Many rules for life, ways of living and making things got changed during industrialization. Certain decisions and directions towards efficiency and standardizations killed older and long-lived principals of quality, individualized approach and value of handwork. Crafts were considered too time demanding for mainstream in that period, but now re-considering some decisions that led us to mass production, they sound inspiring and worth looking into. Could we learn values passed on for generations through making and transfer/translate them to the smart textiles applications? What would have a similar meaning to us today and what would get lost in translation?

Technology and material developments allow us to create smart objects, like apparel. Garments are able to sense, track and output movements, temperature, touch, sound, moisture, pressure, bend, orientation, light, etc. Textile objects react to whatever we wish for; data gets transferred between desired parties in no time. For example, the Hug Shirt (CuteCircuit, 2012) that as a very clever hoodie senses characteristics of a hug (strength of the touch, skin warmth, heartbeat rate) from one person and transfers those via Bluetooth and mobile network to the recipient. Now, all these possibilities may act rather as gadgets unless they find a meaning during the design process.

Fashion industry, suffering in exhaustive sustainability issues, doesn't need a further drive by the "next cool" thing that is growing the pile of waste in few months. Next to all the efforts done in wiser material use, reuse and recycling, vintage promotion, new business models, it needs a way to close the loop from materials and energy use to the industry and user, and back to the industry and user. (Fletcher and Grose, 2012) This is not a material driven change: it must be a deeper behavioral turn. A change that makes garments more valuable to the users: through the combined influence of the process, materials, final outcome, care taking and disposal. Influential steps need to be taken by the designer, producer, supplier and with the greatest impact: the user. This change asks for a multi-stakeholder approach, currently researched in the "CRISP Smart Textile Services" project (Bhömer, 2012), with the goal to integrate the different design and production processes of textile, technology and services. However, considering the ungraspable complexity of the whole system, how to make sure the "smart" garments created are actually leading us to a desired direction?

**Behavioral Turn**

In the 18th century, when people used to craft textiles and garments for their personal and family use there was much more supporting it than just the act of knitting, weaving, sewing etc. Rituals of making together used to bring people into workshops to craft high quality items. Those activities tightened bonds between makers and made them share much more than a skill with each other. They shared life experiences.

Everything was made with a heart and soul in it, therefore with exceptional quality and purpose to last as long as possible. With industrial age "The machine introduced a new element concerning the relation of quantity and quality," (Sennett, 2008, p. 109) reversing the relation between the two got expressed through waste. Not only post-consumer waste, but also pre-consumer waste and production waste started to grow in uncontrollable amounts. Garments go through systems that are invisible to consumers and lack of value and appreciation due to it. Combined together with the mindset of nowadays where "the function of culture is not to satisfy existing needs but to create new ones - while simultaneously maintaining needs already entrenched or permanently unfulfilled" (Bauman, 2011, p. 17) we have achieved a fashion industry proud of low quality cheap disposable clothing. Everyone needs to change constantly. As Bauman (2011, p. 24) puts it "Time is indeed passing, and the trick is to keep pace with it. If you don't want to drown, you must keep on surfing: that is to say, keep changing, as often as you can, your wardrobe, furniture, appearance and habits, in short - yourself."

This opposes to the culture mentioned before, that used to build a person up stitch-by-stitch, day-by-day and year-by-year. Handicraft used to be an important part of it. "Just one hundred years ago a woman's worth in Setu was judged by her skills in handicraft. There couldn't be any small mistake for the girl to be seen as a good future mistress. It was thought to be her mother's fault when a girl could not manage handicraft" (Summatavet, 2005, p. 68). She says that before marriage a girl had to have woven all the material needed for her future husband's clothes. This was seen as a preparation to step into independent life. And the care for each detail in handicraft was seen as one's ability to craft the life in general.

According to Bauman (2011, p. 52) these traditional rules for life had become a hindrance rather than help in the new conditions. "It did not matter that under other conditions, now receding into the past, they had helped people to live in a spontaneously created, but change resistant, atrophied and corroded society: now these rules were turning into "superstitions" and "old wives tales" becoming a burden and the main impediment on the road to progress and the full realization of human potential". (Bauman, 2011, p. 52) Education and social reform took people further from the old beliefs and fashioned us according to the dictates of reason and rationally designed social conditions.

| Technique Traditions Rituals Local Values | Crafts & Modern knowledge and tools |
|---|---|
| Craftsmanship & Culture of sharing and connectedness | New technologies Smart materials Combined value Today's concepts Science |

Fig 1: Possible merging combinations for culture and technology

In times of blooming handicrafts sewing, knitting, weaving and crochet were part of the skill-set of each respectful girl/woman. Putting aside reasons for keeping woman's hands busy, like keeping them in houses or away from politics and general discussions, those meditational hand practices were part and also built further valuable traditions and rituals of making together, giving meaning to things done, ornaments on clothing and accessories. Those mindsets supported and developed very personalized local approach to living. Each piece had an author who's life story was also known to the rest of the community and therefore values such as unstoppable drive for quality and tight bonds within a family and community were honored.

Today we are overwhelmed by new emerging technologies and tools, such as laser cutting, 3D printing and smart materials, like conductive textiles, yarns, thermochromic dyes, Arduino etc that get more and more accessible and easy to handle for the end-user. We have different problems and priorities than there used to be in the 18th century. Technology developments have given us new ways of looking at things and tools to play with. We like to be connected and belong, similarly to what used to be, but in a new non-geographical way.

There seems to be a nice synergy between craftsmanship with its drive for detail and quality and values applied through tradition and rituals, and the modern culture of sharing and connectedness. Also combining craft techniques and the hands-on approach with knowledge and tools emerging and still to come, we have the potential to achieve a very sustainable combined value of old and new. Maybe some of the decisions and directions (not) taken while pursuing the efficiency in production and development lines that has shaped our "the way it's being done" could be questioned or changed. Fashion designers are inventing and proposing new ways for sustainability, but since this means asking questions about speed and "fast fashion" principles, also doubts economics as we know it, those alternative emerging directions take time to get adapted and appreciated.

Some examples as the impact-led fashion models replacing trend-led ones as defined by Fletcher and Grose (2011) would be adaptable garments, that can be adjusted and changed in order to fit or suit a certain situation, including trans- and multifunctional clothing that replace several other garments or are meant to be worn in various scenarios. Also clothes that can be worn through seasons, modular play of assembly or shape change.

Another example could be optimizing garment lifetimes or promoting their low-impact use, that can be achieved by enhancing emotional connection of the wearer with the garment, creating durable clothes that can actually be used more than few wash-

cycles or changing the way people take care of the garments. Textiles that require no washing and garments designed to accept stains, spills and wrinkles as well as low ironing heat play its role here.

An alternative way towards sustainable business-models are repair services that allow the industry to get other kind of income besides from selling more material and garments. Designing and working with local materials and artisans for local culture helps to develop smaller communities, which means improving from inside. Biomimicry - another exciting emerging field - ".. is not simply a tool for copying. Rather it is understanding and applying nature's principles - surprisingly simple at their core - that is more the point." (Fletcher and Grose, 2012, p. 115). That means changes starting from material level up to processes and proposals for seeing completely different, in harmony with nature, business models.

"Slow is not a simple description of speed. Rather it represents a different worldview that names a coherent set of fashion activity to promote the pleasure of variety, the multiplicity and the cultural significance of fashion within biophysical limits. Slow fashion requires a changed infrastructure and a reduced throughput of goods" (Fletcher and Grose, 2012, p. 128). Slow fashion means accepting diversity, producing in small scale, and trusting local partners, valuing making and maintaining and a true price of the product incorporating ecological and social costs.

Within smart textiles and garments development, the main issue today is yet to explore possibilities, push borders of what is possible and propose scenarios of potential use. It is very much material, technology driven - more as a hack to prove that something can work, rather than fulfilling a need and growing upon that. Crafting smart textiles makes it a slow process, hands-on experience; it allows craftsmen to grow together with their creation and the smart textiles to record a narrative, story — tradition.

Because we envision meaningful results from the tension between crafts/culture and modern technology, our approach is to explore the design options of where these two come together. In figure 1, we can see the existing axes from culture (upper-left) to technology (lower-right). We may expect inspiring design with respect to craftsmanship/connectedness (lower-left) and crafts/technology (upper-right). In the next sessions we explain our explorations.

## QR-coded Traditions

Looking into such developments Kristi Kuusk wanted to incorporate some of the forgotten old wisdom into the new possibilities of digital and otherwise new technologies. While approaching the integration of textiles and technology she aimed to show and, through that also, see how new ways of communicating can be a mean towards sustainability in the fashion field. After first steps of exploring different combinations of crafts and technology, and seeing what would be more valuable in terms of transferring meaning from one society to the other she ended up pursuing an exploration of embroidered Quick Response (QR) codes carrying cultural information in several layers (Fig. 2). This was a first tryout in this series of practicing a craft (in current case embroidering with a machine) and giving it a new modern use while keeping values that inspired the integration in first place within the final concept.

There is a clear parallel between information stored in folkloric garments, accessories expressed by colors, ornaments and placing, and data revealed by QR codes. Both require a key to get accessed. Folkloric embroidery, traditional patterns on mittens and socks, the variations of colors on skirt-stripes – they all meant something specific for the family or village producing and wearing those. The symbols used to be taught and developed traditionally within local communities. It used to be a personal story only understood through the knowledge of the local context and an outsider could only see or hear the meaning if she was given the key to it. (Summatavet, 2005, p. 95) Similarly, in order to understand what is hidden linked to a QR code, it has to be first recognized by software on a mobile device. Whereas now in the "connected world" we have symbols readable by machines universally. The mean of reading might be the same, even message composed with same data, but meaning still varies in different parts of the world for communities used to other kind of inputs.

Furthermore, to ask the question, how could traditional craft support or guide technology as a new craft, Kristi experimented quite a while with merging QR-codes with folkloric embroideries. She prepared some more concrete proposals of use of this nationalized QR code embroidery. One of them is a concept of bed-sheets that, while scanned, start telling a fairy-tale that originates from the region which patterns and colors are used in its design. For example, sheets with Danish colors would tell a bedtime story about The Little Mermaid or The Ugly Duckling while one imitating Muhu skirt in Estonia shows a cartoon about a princess or allows a parent to read out a story about The Gold Spinners.



Fig 2: QR-coded Fairy-tale pillows by Kristi Kuusk

The beauty of the approach lies not only in the integration of traditional local colors and patterns with new technologies but also in the values, which have been taught through family-line for centuries. Maybe the bed sheets could talk about the kid's own family and therefore enhance the interaction between generations daily basis. The information referred by the code can change in time, so it is another way a garment to become more valuable while being used. It carries tradition and history in many levels while encouraging new ways of interaction. For example bringing fairytales back into our daily knowledge, not forgetting old wisdom.

Such interactive ornaments on our textiles, on one side feel right - they look and feel familiar. It is just embroidery as it has been used on garments since ancient Egypt. On the other side, it is used in a new way taking into account possibilities of technology today and values important to the current society. It has potential to contribute for a more sustainable fashion and world with the combination of static ornament on a textile being linked to digital dynamic information changing in time. First examples that were made with the QR embroidery were embodying the garment's history into the code. The story of the item: where and by whom did it get grown as crops or melted from what kind of oil, where did it get woven, knitted, laminated into a textile, what kind of finishes were used, dyes, treatments. Where and by whom did the garments get designed, cut, sewn, finished, sold etc.? Maybe it had another user before - who was it, pictures of her using it? Maybe the garment got assembled into a second life already? Was the bag in its previous life a dress? It could be a way to make garments foot-print more visible and used or second-hand items more appreciated by their

rich visible history. This information could be shown intimately to the wearer or exposed to whoever cares to read it. It could be protected with a key that the owner can share or openly accessible by anyone. The data linked to the embroidery could tell a predefined story or be configured by users. For example, Tiina would get an item with the embroidered code on it. She would enter a website and define in what conditions the specific code would result in what outputs. It could tell a mutual joke on Monday, suggest a cake recipe on Tuesday, play a selected video on Wednesday or even change the output every hour, on special occasions etc. Then, Tiina gives the item to her friend Tom, who gets a new surprise every time he scans it. It is very personally customized gift from Tiina to Tom, therefore embodies potentially great emotional value. Or imagine every morning waking up with an inspirational quote suggested by your group of friends!

Now that the value of the item can grow in time, it does not just get old - it might hide new exiting message next day and the user plays a clear role in the lifecycle of the specific textile object, he must also pay more attention to the care process. If it gets treated in a wrong way the user loses more than merely a cover-cloth. He loses a certain connection to a friend or group, or to a certain database of information.

The QR coded traditions concept can be seen as a physical representation of a virtual value. May it be connected to a local wisdom, inspiring quote, personal message from a friend, fairy-tale, history of the item or something else, the digital data is ever changing and always growing. While the physical embroidery is static and always present. Maybe those could be the tools and artifacts Milli John Tharakan (2011) is asking for, that would help us to find a balance when the changes, caused by rapidly developing technology, are happening too fast.

## Towards Crafting Smart Textiles

Application used to be the force demanding material innovation. Now we are strongly driven by the new technologies - anything is possible and that might be the problem! Development in the smart textiles area is mainly driven by material sciences, new opportunities in fiber level. But not everything technologically possible is necessarily valuable. Creating something technologically very challenging and fancy has no value if nobody needs it. Tharakan (2011, p. 189) suggests creating narratives for smart textiles. Referring to the modern constant lack of satisfaction she argues, "The ability to transcend the physical through myths and the slowness in the making and use of craft artifacts could be some of the missing ingredients that our soul and senses are longing for."

Fig 3: Unlace by Eef Lubbers as part of the TechCrafts project

During a project TechCrafts Bachelor students started up each getting to know one craft rather deeply. They researched about weaving, silversmiths, crocheting, knitting, bobbin lace making etc. and found themselves a master of the specific craft to learn from. From practicing the skill, they took a step further and started to merge the old technique with new materials and electronics keeping in mind what the craft traditionally had served for. The intention was to learn the wisdom of the old craft and to bring it into today, not as a museum would do - preserving it, but hacking, cracking, re-thinking and inventing way.

Unlace (Fig. 3) is an interactive lace lingerie garment which allows two-way interaction for the piece to react on touch and heat up thermochromic yarns, while also the interactive change invites and guides the touch into desired places. Combining bobbin lace making together with its values of slowness and details with new smart materials, we have a very delicate piece of technology.
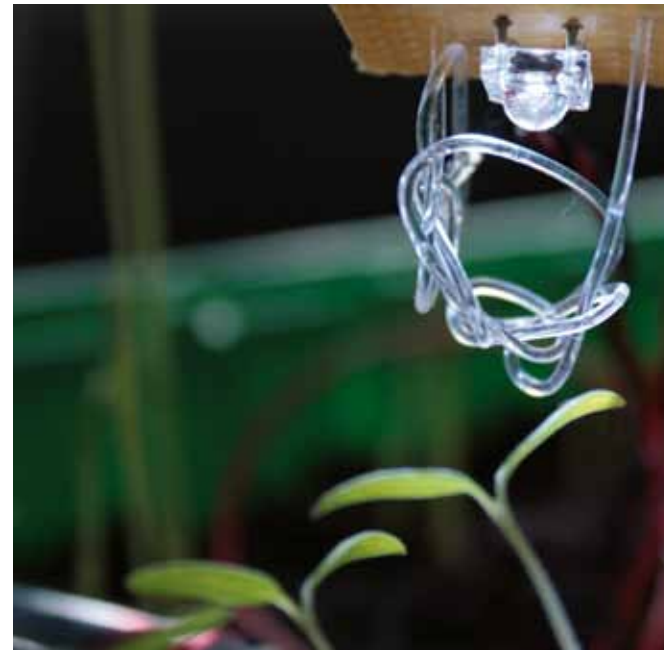


Fig 4: Morrow by Liza Blummel as part of the TechCrafts project.

New valuable concepts can be achieved mixing traditional and new in different levels. There are various approaches possible to take to integrate technology and crafts. We have done series of explorations in Eindhoven Technical University (TU/e), Industrial Design, Wearable Senses theme. And based on that we are making first attempts to create a mutual language to talk about crafts mixed with technology.

Morrow (Fig. 4) is a fence made for climbing plants. The stimulating lights will turn on when a person interacts with the fence. In this way the plants will grow towards the light. It creates a moment for observation and realization between plant and the one taking care of it.
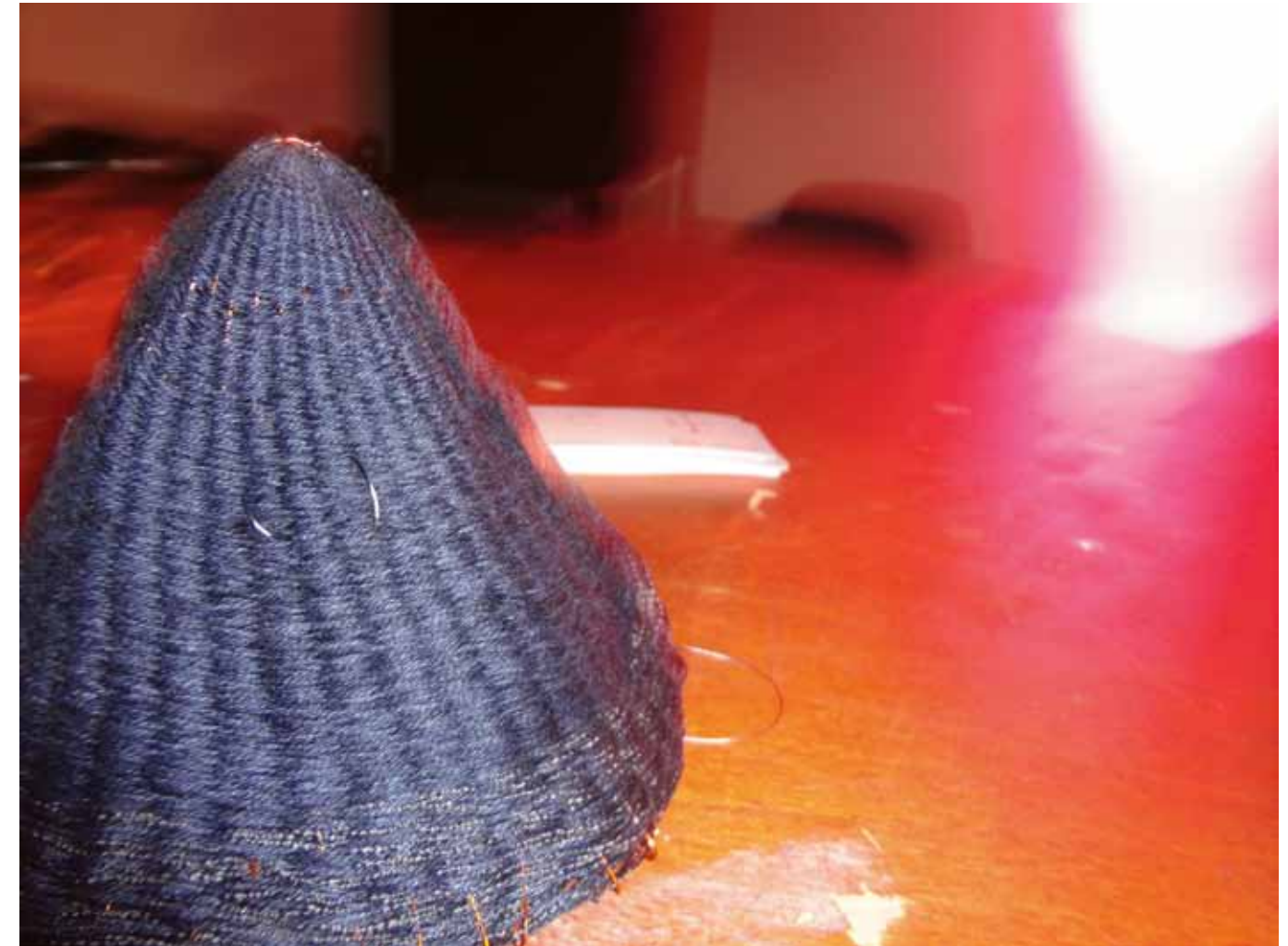


Fig 5: Intimacy tower by Orfeas Lyras as part of the TechCrafts project.

Intimacy tower (Fig. 5) is a circular woven tower that uses the textile to represent the complexity of one's inner self and the growth of it with his experience. It plays with the privacy and the allowance to reach it.  The goal of the tower is to create empathy between people that have the same experience at the same time.

### Discussion
"Technology can be part of the actual textile (e.g. smart textiles), a tool for their creation (e.g. the software CAD), or used to manipulate the input (e.g. using wearable technologies)." (Seymour, 2008 p. 173). From the described and other realized projects conducted in TU/e we can see that the concepts developed through making with one's hands and learning straight from a master even after  combining with high technologies still carry the core values of the craft started with. And even if the prototypes are not technically perfect, they incorporate a strong value for relationships between people or environment and people. "Skills are also a certain way against superficiality. Skills lead to quality, to refinement, to depth." (Trotto, 2011, p. 42).

Strong Do-it-yourself (DIY) communities and Fablabs around the world are supporting open-source digital fabrication, which unites global design, and local assemble, production. Making things helps us to learn about ourselves (Sennett, 2008, p. 8) and give values to the objects around. With those developments part of the making process becomes visible again. "Work created with the hands gives birth to new ideas." (Trotto, et al., 2009, p.13)

When talking about crafting smart textile we don't necessarily mean applying the skill of handicrafts, but moreover the attitude to make things ourselves, give personalities to them and to appreciate the value created by combining time and attention – our most valuable resources. The rapid prototyping tools and digital technology can be seen as a key element here.

"In response to the excess of globalization and over the top industrialization, there's a renewed interest in local traditions and crafts. Since the eighties Van Slobbe holds a passionate plea for the value of crafts and says it is the "new luxury" the world is in need of." (Hirvonen, 2009) Joining the new luxury of slowness, time and attention provided by craft together with possibilities provided by the advancements in technology and ways of communication and living there might be an idea towards more sustainable (fashion) world.

Crafts incorporate a lot of layers of value in them; it has to be made explicit. Textile realm that has naturally step by step developed from handicrafts into industrialized factories has a new challenge as smart textiles, to tackle. It missed the slow need-driven beginning, as textiles had, and has to start already from industrialized point of view. The field is too immature and deserves a childhood of playing hands-on trying to figure out how and why everything could function. We could let smart textiles find its own way of seeing the world, without the dominating industrialized-consumer glasses.

Similarly to the development of digital applications, websites users need to have access to the tools, skills and inspiring materials to craft the smart textiles in order to the revolutionary valuable things to happen and be noticed. For this platforms, such as Kobakant, introducing techniques and do-it-yourself projects, by Mika Satomi and Hannah Perner-Wilson (2012) are essential as much as availability of small amounts of new functional materials.

"Ornaments used to protect, cleanse, heal and also communicate and serve as a ritual sign. People used to leave part of themselves together with the ornament" (Summatavet, 2005). Having

similar ambitions for smart textiles we must gather patience to let time craft the path for it.

"Our economy is stressed because our material world opeartes on the basis of physical resources that we do not have, and waste we have nowhere to hide. Perhaps the first change we should make is to stop producing and consuming things we do not really need that make the waste that no one wants, especially waste that is toxic to ourselves and our fellow beings on this planet." (Pauli, 2010, p. 7) Toxic waste is a gentle topic around smart garments. Let's make really sure to learn from what fashion industry is already able to teach us today, to treasure quality over quantity, trusting relationships over dependency and meaningful applications guiding people to that direction.

## Conclusion
Clothes and objects provide a crucial "carrier" service, helping to bond the relationships between others and us and with the society as a whole. The continued relevance of things to people through change or novelty is essential in this context, for all of these relationships are in constant flux as our own perspectives and the values of society co-evolve (Fletcher and Grose, 2012, p. 138).

Textile industry is heading towards smart and interactive garments valuing our need for connectedness and sharing. With lost craftsmanship approach of drive for detail and quality and values applied through tradition and rituals, craft techniques and the hands-on approach this next stage could be ecologically more responsible stepping stone for the next eras approaching.

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# The Worn, The Torn, The Wearable: textile recycling in Union Square

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**Abstract**

This narrative focuses on one aspect of the growing phenomenon of textile recycling: the act of "getting rid of" one's no longer wanted clothing. The story here derives from many visits to Wearable Collections, a business that collects apparel (as well as towels, sheets, shoes, and other textiles) with an "inlet" at the popular Union Square Greenmarket in Manhattan. Over several months, I watched hundreds of individuals drop off thousands of kilos of materials for recycling and talked with many of them about what they were doing and why they were doing it. This investigation was undertaken for two purposes. On one hand, it was a device for practicing a variety of ethnographic field methods to support my current Ph.D. action research with enterprises aiming to build more sustainable fashion systems. On the other hand, it was a means to gain knowledge of what is happening with textile recycling in New York City. The pages that follow have been excerpted from a longer and broader account.

The term *textile recycling* is used here broadly. It encompasses upcycling (for example, making a dress from old dresses, or producing yarn from trimmings from garment manufacturing); downcycling (such as shredding worn out textiles for insulation); practices such as selling, swapping, or giving away; and any other ways of reusing or repurposing that saves — or at least delays — textiles from being buried in landfills or otherwise wasted.

**Keywords:** textile recycling, second-hand clothing, textile waste management, sustainable fashion, Union Square Greenmarket

**Introduction**

*Give me your tired [trousers], your poor [pajamas]*
*Your huddled masses [of clothing] yearning to breathe free,*
*The wretched [but recyclable] refuse of your teeming shore.*
*Send these, the homeless, tempest-tost [textiles] to me, …*

with apologies to Emma Lazarus, poet of "The New Colossus" that is associated with the Statue of Liberty.

Increasing the amount of textiles that are recycled — whether as clothes to be worn again, repurposed into rags or bespoke suits, or in other ways made useful, such as for cleaning rags or fuel — is often thought of as one of the ways human beings might mitigate the damages caused by the intense appetite of the fashion beast (Council for Textiles Recycling 2012; Fisher et al. 2008). By weight, New York City's residential (non-industrial) textile refuse is about seven percent of the total amount of trash that

ends up in landfill (DSNY 2011), or about 181 million kilos. This translates into about twenty-two kilos per each of the 8.18 million (US Census Bureau 2011) city residents. This compares with Sweden's rate of nearly nineteen kilos of clothing and textiles discarded per person annually (PRODCOM in Cato 2010: 9).

This paper does not assess the potential environmental, economic, social or cultural benefits that the widespread recycling of textiles might yield, but it should be noted that in terms of life cycle assessment, the reprocessing of materials such as wool, cotton, and polyester into new yarns and fabrics, or repurposing of garments through reconstruction or other secondary uses does save energy, water, and carbon emissions as compared to fabric and garment production from "virgin" materials (Wang 2006; Farrant et al. 2010; SMART 2011; Textile Exchange 2012). Yet, those facts alone do not necessarily mean that textile recycling is increasing chances for global well-being. As far back as 2003, 6 million metric tons of used clothing were being exported annually from the USA, mostly to Africa and other developing areas of the world (Claudio 2007). The long term impact of this flood of second-hand clothing from high-consuming countries to developing countries is unknown. Even if it provides a number of economic benefits for local entrepreneurs and tailoring businesses, it may undermine others, such as local agriculture, manufacturing, and cultural diversity (Maynard 2004; Baden and Barber 2005; Mitumba 2005; Mhango and Niehm 2005; Palmer and Clark 2005; Allwood et al. 2006; Hawley recycling, by placing so-called "green halos" above consumers' heads, might in fact encourage fashion consumption. Such a phenomenon has been shown to occur in other areas of consumption (Polimeni et al. 2009, Catlin and Wang forthcoming), but appears to not yet have been studied in the realm of textile recycling. However, if consumption of clothing made with new materials can be offset with clothing made with recycled materials, the need for which has been argued repeatedly in the Defra's Sustainable Clothing Action Plan (2010), it would be a positive change. Meanwhile, the action of recycling textiles at least shows a willingness on the part of consumers to "do the right thing".

Wearable Collections is a New York City based business that collects textiles at various sites around the city, including apartment houses, schools, places of worship, and, in the case looked at here, the Union Square Greenmarket (farmers market), which has about 60,000 visitors per day (GrownNYC 2011b). Wearable Collections (which will sometimes here be referred to as WC, even with its unfortunate connotation) began in 2000, and started collecting textiles at the farmers market in January 2009 by agreement with GrowNYC, the not-for-profit agency that

runs the city's greenmarkets. Many New Yorkers have come to love and depend upon the fifty-four farmers markets featuring local fruits, vegetables, meats, artisanal breads, cheeses, wines, and other products that, together with urban agriculture, bike sharing, and the transformation of the city's waterfront into parks, are part of the greening of the city. WC is present at Union Square on Mondays and Saturdays throughout the year from about eight in the morning to four in the afternoon. As of mid-2012, WC was collecting "tens of thousands of pounds" of used textiles per week (Baruchowitz 2012), some of that from special events such as the November 2010 New York City Marathon, from which they picked up about roughly 15,000 kilos of garments from the starting point and along the route (CBS 2010). WC does not itself physically alter any material; they only collect it. In fact, Adam Baruchowitz, one of the founders and energetic president of the company, sometimes refers to himself as a garbage man. With its presence in New York City, WC could be said to be filling a public need through private enterprise, although Baruchowitz declines to call his enterprise a social-business (Baruchowitz 2012). Since 2007, when GrowNYC began collecting textiles for recycling, and in collaboration with WC since 2009, about half a million kilos of apparel and other textile waste have been diverted from landfill (GrowNYC 2011a). Baruchowitz estimates their eighteen greenmarket locations take in about a third of the total tonnage they receive annually, all of it without monetary compensation for the "donors".

**Recycling in the City**
Recycling of many materials was common in the city before World War II, but it fell out of practice soon after and was not restarted until modern day curbside collecting of used paper began in 1986. In 1989, recycling became mandatory where services were provided, and by 1997, all of the five boroughs, Manhattan, The Bronx, Staten Island, Queens, and Brooklyn were included. Recycling services were temporarily cut back after September 11, 2001 and again due to budget cuts between 2002 and 2004 (DSNY 2012a). Today recycling of most paper, many sorts of plastics, glass, and metal is a part of life for New Yorkers, but to greater and lesser degrees in the various geographic areas. In 2011 capture rates (the percentages of refuse of the type that the city requires its citizens to place in recycling bags and garbage receptacles marked for recycling) ranged from a high of nearly sixty percent to a low of just over fifteen percent. The highest rate was achieved in the wealthy southern tip of Manhattan; the worst rate was recorded in the impoverished South Bronx. Statistics indicate about fifteen percent of total refuse is diverted from landfill to recycling. The total average recovery rate for the city is less than half the national average (EPA

2011; DSNY 2007). This is anecdotally attributed to small living spaces. Many New Yorkers say they just have no place to store recyclables, which are picked up by the New York Department of Sanitation (DSNY) once a week as opposed to three times weekly for non-recyclables. Another much discussed hindrance is poor communication from the DSNY. Information provided to the public is famously hard to decipher, and multiple exceptions and inconsistencies about what can and cannot be put into the recycling stream exist: plastic bottles are allowed in some cases, but not in others; plastic bags and yoghurt cups are not; cardboard pizza boxes are, the paper plates on which the pizza is eaten are not. The Department claims economic justifications for determining what is accepted and what is not (DSNY 2012b) but the rules do little to encourage greater participation. Textiles are not permitted to join the other recyclable materials that can be placed at the curb for weekly pick up.

**Textile Recycling and Textile Recycling in the City**
Common sense and historical evidence inform us that textile recycling is as old as textiles. The time and effort needed for the production, collecting, and processing of raw materials throughout most of human history meant that textiles remained valuable even after extended wear and tear. This partially explains why few extant examples of commonly used pre-industrial fabrics exist today; they were so valuable that they were used until they literally disappeared. In Nordic regions, for example, old fabrics were stuffed into walls to help guard against the cold. Even after the industrial revolution was well-established, the shoddy and mungo (reclaimed wool) industry of nineteenth century England made fortunes (Jubb 1860), but as more efficient production took hold, textiles began to lose their high value. Today, in high consumption cultures such as the U.S. and Western Europe, putting a torn t-shirt in the garbage is now normal. In the United States about eighty-five percent of textiles end up in landfill (EPA 2011).

A large portion of the fifteen percent of textiles in the US that are not put into landfill are given to non-profit organizations such as Goodwill and the Salvation Army, which in turn sell the goods in their shops and to used-clothing sorters and exporters. As a result, only a small percentage of textiles are currently reused for any purpose within the United States, and the same presumably is true for New York City, where it is estimated that every year almost 180,000 metric tons of textiles from households, the majority of which is clothing, are thrown into garbage headed for the landfill (GrowNYC 2011a) accounting for seven percent of the waste that enters landfill (DSNY 2011).

Textile recycling is more common among the wealthy New Yorkers

than poor ones: "There is a clear inverse relationship between income and textile waste generation. Lower income residents throw out more [roughly three times as much] in the way of used clothing, linens, shoes … than do higher income residents" (DSNY 2007: 54), but the reasons for that are unknown. Could it be that rich people have better quality clothes that say "don't throw me out"? Do poorer and less educated people have worries other than finding a place for their used garments?

In May 2011 DSNY, in partnership with the well-established non-profit organization Housing Works, began "one of the first large-scale consumer textile recycling programs in the country" (Navarro 2011). Called re-FashionNYC, it copies one aspect of the WC model by providing receptacles for textiles in or near apartment buildings. As this program has only recently been launched, the city has not yet provided data on its success or failure, but DSNY (2012c) notes that

*"[u]nlike existing thrift shops and charitable operations that receive donations in their shops or pick up door to door, re-fashioNYC allows you to make donations from the convenience of your own building whenever you want. In contrast to for-profit used clothing companies [such as Wearable Collections] that supply similar collection bins, re-fashioNYC is 100% nonprofit and charitable (emphasis added)."*

Without examining the DSNY's accounting alongside Wearable Collections, which donates part of its income to charity, it is impossible to know which entity is the more efficient benefactor. Curious is DSNY's implication that recycling textiles ought not to be monetized. Such a position would be contrary to the ideas promoted by environmental and economic policy gurus such as Paul Hawken (2010), and John Ehrenfeld (2008) who advocate for increasing the monetary value of resources.

**In the Field in the City**
Union Square is a compact-size city park and gathering spot at the crossroads of downtown and uptown Manhattan. On the days when the market is not too uncomfortably packed with jostling shoppers and passersby, the abundance and variety of fresh, often organic, fruits, vegetables, bakery goods, raw milk cheeses, New York City honey, and Long Island wines is an uplifting visual and gastronomical feast. In the autumn, the time of year this experiment was conducted, there are dozens of types of red, green, and yellow apples and pears, huge turquoise squash, pumpkins, herbs, purple and white cabbage, sprouts, turnips, fall flowers, pies, cakes and more, all ready for the coming of Thanksgiving.

I have been through this area thousands of times since the early 1980's when I moved to a nearby neighborhood. At that time Union Square Park was a bleak, litter-strewn zone where you needed to go to get the subway to get someplace else. For me it was also a place to see people sell, buy and use drugs openly, or where I occasionally got up the nerve to sit for a few minutes on the broken remains of a bench to ponder life in financially bankrupt but creative New York City. Surrounding the park were a few retail landmarks like S.Klein's decrepit department store which offered an "on the square" deal for its customers, and Paterson Silks, a late-lingering remnant of the days when buying fabrics for sewing clothes was common, as well as many 99-cent sorts stores selling low quality textiles such as sheer cotton-polyester sheets, similarly sleazy printed vinyl "damask" curtains, snagged terry cloth towels, kitschy embroidered dishcloths, and flatly utilitarian floral-patterned house smocks.

In 2012, due to the decades long resurgence of New York's economy, the rehabilitation of the park and the subway station beneath it, an influx of students and young employed people seeking once-affordable housing, and the popularity of the farmers market itself, the area is now charged with trendy and trend-setting restaurants, fashion and home furnishings retailers, modeling agencies, graphic and design companies, arts organizations, theatres and high-technology businesses that are part of the so-called creative class (Florida 2003). The streets bounding the north and east of the park have been traffic-calmed by paving them with cobblestones, and installing planters and café tables and chairs on the widened sidewalks. Visitors now enjoy new lawns, benches, and recreation areas, and even a clean public restroom, one of very few in the entire city.

Following the notions of prominent ethnographers (Geertz 1973; Humphrey 1989; Sanjek 1990), during my visits to Union Square for this research I tried to imagine myself to be a curious newcomer, and to firstly study the physical setting, including the various styles of buildings — from historical ornate terra cotta constructions to slick glass contemporary edifices — that hem the park. An anonymous-looking white apartment tower has replaced the mid-century red painted steel and glass building once housing Paterson Silks. Who buys fabric when clothes are so cheap? On the streets around the park are local, national and international chain stores: Staples, Barnes and Noble, Best Buy, and fashion outlets such as Forever 21, Diesel, American Eagle, and Shoemania. Whole Foods and Trader Joe's, two very popular grocery stores help make this area a foodie's paradise. A late nineteenth century stone-faced building held Andy Warhol's factory in the late 1960s and early 1970s. Nearby on an asphalt

island surrounded by car traffic is a larger than life-size chrome sculpture of a suited Warhol holding a gigantic shopping bag. Twenty meters away, in the park itself, amid small trees is a bronze sculpture of Gandhi walking in his famous dhoti. It is very frequently garlanded with marigold necklaces. The contrasting symbolism of these two sculptures is almost comical. The north side of the park is smooth with New York's signature hexagonal asphalt paving blocks, and serves as the location for the green-market, which first opened in 1976 with just a few farmers, but now hosts 140 vendors (GrowNYC 2011b).

Underneath the park is Union Square subway station, the fourth largest in the transit system, serving 35 million riders annually (MTA 2011). Everyday, in addition to the crush of inhabitants and commuters going to and from work, it seems that American tourists from every state of the country and guests from every country of the world are part of the famously vibrant New York mosaic of humanity. In this setting, I observed the goings on at Wearable Collections on most Saturdays in October, November, and December, 2011. Three of those visits are described in the next sections.

*Saturday November 5, 2011*

The morning air was chilly and the sky clear blue like early November should be. The sun was bright on a group of six or seven large grey polyethylene garbage cans being filled with rotting fruit and vegetable scraps carried here by those New Yorkers dedicated enough to divert their kitchen compostables from the mainstream waste stream. Ten meters away, on the western edge of the park in a cold shadow cast by the park's trees, is another waste repository: Wearable Collections. Under Wearable Collections' black canvas tent were three open nylon laundry bags, hanging upright with the help of metal frames, into which people come to dump all sorts of textiles products. Evan (a pseudonym), to whom I had introduced myself some weeks before, was there behind the folding table behind the bags. A young thin black man, he was huddled on a folding chair and waiting to help people with their incoming "donations". He was wearing a hoodie, and jacket trimmed with fake fur, surrounded by maybe twenty-five or thirty already-filled and tied-closed nylon laundry bags. No one else was with him at the time, but judging from the waist-high, five by three meter pile of stuffed sacks, a lot of "reverse-customers" had already been "de-shopping". The sacks were neatly stacked, and, because of the heavy shadow, their colors appeared dark: charcoal, maroon, black and indigo rather than the lurid synthetic colors that they would be if, like the rotting food nearby, they had been in the strong sunlight. I was concerned to be imposing on Evan's

time, especially since I had not received permission, from either GrowNYC, the city agency that runs the market or Wearable Collections, to observe and talk to people about why they were bringing in their used textiles. I reintroduced myself to Evan, and he said that it was fine for me to hang with him.

Evan is in his mid-twenties, grew up in Harlem and studied sociology at a prestigious all male, virtually all black college in the southern United States. He is analytic and curious about the phenomenon of recycling and consumer culture, and made it known that even before taking this part time job, he was thinking about recycling. He said that he has come to understand that textile recycling is a "greatly overlooked area". After we got more comfortable with each other, and when he had time between helping people stash their castaways, answering questions, and organizing the bags, Evan commented on some things he has noticed during his several months of working there. Particularly interesting insofar as my desire to look for ethnographic patterns, was that he has, after months on the job, observed some archetypes of people who bring in textiles. For example, husbands and boyfriends whom he suspects have been told by wives and girlfriends to get rid of old or worn out clothes. Another group he called "regulars", which meant those he recognized as dropping off things nearly every week. Soon after he mentioned "regulars", a regular showed up to drop off a few small articles. This older, modestly dressed but carefully coiffed women who (guessing from the nearly empty shopping cart she was pulling) came to the market to buy food more than to drop off textiles, said hello, and dropped into an open laundry bag a small cotton t-shirt and a pair of well-used, neatly folded graying athletic socks. I imagined that without the convenience of Wearable Collections, she might have otherwise tossed these things into the trash, and I wanted to ask her about that, but she too quickly went on her way.

Another category that Evan spoke about was people who ask for more than one receipt per donation. Although Wearable Collections is a for-profit business, through their partnership with the non-profit GrowNYC, and because WC donates about five cents per pound (roughly eight Euro cents a kilo) of textiles received to GrowNYC, receipts for tax-deductible donations are made available. That figure makes a typical sack's donation value about one dollar. It is hard to believe that anyone would actually claim such a low value (the receipts are filled in by the so-called donors themselves), but it points to the discrepancy between the actual worth (almost nothing) and the pretend worth (some increment toward the original purchase price?). Oddly, a moment after Evan mentioned this multiple receipts



Fig 1: New and worn clothing deposited for recycling.

category, a couple, a man and woman, dropped off several ripped paper bags of clothing and children's (so-called stuffed animal) playthings. They had driven in an expensive car up to the curb beside the site, and the woman, who happened to be quite loud, dressed in beige corduroy pants, black boots, and a bulky metallic knit sweater, demanded, "Give me six more receipts!" Evan gave her more receipts, saying to me afterwards that he guesses she was lying, but that it is not his job to inform the IRS of potential tax-cheats. Two other categories Evan mentioned were young women who bring in large shopping bags filled only with shoes and school teachers who bring their young students by to show that textile recycling is possible.

After some hours of getting comfortable with each other, Evan and I speculated about other possible categories. We thought that perhaps some of the hundreds of apparently well-paid people dressed in clean casual clothes from retailers like the Gap, L.L Bean, and Club Monaco who stream through the market might be called Good Consumers. Evan said they would have to display a bit of righteousness when dropping off used clothes in order to qualify. Guilt Mediating Fashionistas was the name I proposed for the young women, maybe real life cousins of the Sex in the City television and film character Carrie Bradshaw, who shop frequently, buy large volumes of clothing, and have trouble storing it all. Could the young woman with noticeably well-applied makeup carrying a yoga mat in an eco-friendly labeled yoga mat carrier who dropped off kilos of clothing in undamaged, hardly-used faux-leather shoulder bags that were part of the donation be in such a category? There is a growing body of research about young consumers' clothing disposal habits in high-consumption societies, (Domina and Koch 1999; Bianchi and Birtwistle 2001; Domina and Koch 2007; Morgan and Birtwistle 2009; Joung and Park-Poaps 2011). I have not found research directly linking high volume clothing shopping with a propensity to recycle textiles, but it would not be a huge surprise to find such a correlation.

One person after another came to the site, almost everyone in a hurry. It was difficult to catch people for the semi-structured interviews I had prepared, which included these components: an explanation of the purpose of the interview; a disclosure about how it would be used, a consent form stating that it was voluntary; demographic questions; and a series of questions about an item being dropped off, such as: What is it? How many times did you wear it? How did you feel when you wore it? Why did you stop wearing it? Why did you decide to bring it here?" The same interview was available on paper for anyone willing to take the time to respond in written form, either on

the spot or at their leisure, but as soon became apparent, this method would fail. In retrospect, I should have guessed as much, as the interview took fifteen to twenty minutes – a lot of time for people who just want to stuff their stuff in bags, smile, maybe say thank you, and scurry away. When I managed to catch the attention of the slow ones, almost no one was willing to talk, even if, following Seidman's (2005) interviewing guidelines I tried my best to intuitively approach each individual in a way that I hoped respected his or her uniqueness. One of the several people whom I did get responses from that day, a woman with a Portuguese accent, wrote that she was sad that her beloved pants had fallen apart, and was happy they could be put to some use. An amiable man who dropped off some old t-shirts and running shoes, asked to take the survey by email. He answered promptly. It turns out he was twenty-four, a trader on Wall Street with an income of over $100,000. He happens to live in Manhattan District 1, the municipal area with the highest textile recycling rate in the city, but several miles from Union Square. He said his reason for bringing the clothes all the way up to Union Square was because he was already planning to go to the farmers market.

*Saturday November 12, 2011*

The market was very busy; people seemed energized by the crisp, almost cold air. In the vendor's spot north of WC were the farmers from New Jersey who bring in truckloads of grey-green and clean-smelling eucalyptus branches that shoppers, including me, buy by the armful to freshen up apartments for the holiday season. I felt more confident than the first week of interviewing, and was ready with an abbreviated version of the interview on clip-boards for people to fill in, and a sign up sheet for anyone who might agree to do it electronically. Evan was consolidating drop offs. He told me that as usual, there were some bags of clothing left in the lot before he and other workers from WC arrived at eight. After bringing my informant, Evan, a coffee, I started to approach people. "Hi, I'm doing academic research about textile recycling. Would you answer a couple of questions about what your brining in and why you're dropping it off?" I imagined that the words "academic research" might sound pretentious or off-putting, but it was important to convey that I was not selling something. A middle-aged woman, warmly dressed against the weather, was interested in talking. She was working full-time to shut down Indian Point nuclear power plant in Westchester County, about a thirty-minute train ride away. She didn't have anything to drop off, but asked me many questions about textile recycling. Besides loving the greenmarket and shopping there regularly, she described herself as a clothes hoarder. We talked in general about consumption habits, emotional attachments to

objects and clothing, and she was fascinated to watch with me so many people so freely disposing of their textile possessions.

Despite the auspicious beginning, my efforts that day produced fewer results than the previous occasion. It was still difficult to get people to engage. Dozens of negative responses were given. "No thanks", "Sorry, I don't have time", "Not interesting to me." The most common response, just as I have given countless times when someone in a public space approaches me with a request, was a quick shake of the head signifying "No." Although it had not been possible for this exploratory project, I was sorry not to have a dedicated area in which to sit down and talk with people. I imagined that comfortable chairs, literature on the topic, and an incentive — apple cider and donuts — would have made created the right setting. Nonetheless, it was clear just by observing and listening to the questions people asked and the very brief comments they made that many people were curious about textile recycling. I counted two people who only asked questions for every one person who dropped off items. That meant that approximately 150 people asked questions that day, with another seventy-five or so donating (and also sometimes asking questions). Most questions were about other days, locations, or times. About one in three people who came to the booth wanted to know what happens to the textiles. Evan stated again and again in very general terms throughout the day that it is sold to a sorting facility; that useable clothing is then sold by the sorter to second-hand vendors; and that non-useable clothing and other textiles are repurposed for insulation or stuffing. Specific statistics for the materials from WC were not known by Evan, but nationwide about forty-five percent is exported to developing and poor countries. Thirty percent is used for wiping and polishing rags; twenty percent for stuffing, insulation, sound-proofing, and "pet padding"; and five percent is "not fit" for recycling (SMART 2011). Interestingly although many were surprised, no one seemed to object to the profit making nature of the business, even if they were giving the resources for free. (This important tangent is discussed in the full version of this paper.)

Very often people expressed relief that they found a convenient place to dispose of old clothes. Others offered comments such as, "it's about time we had something like this", "finally", "see you next week", or the romantic "where have you been all my life?" Virtually everyone thanked Evan, either with words, a smile, or a thumbs up sign.

Toward the end of the afternoon, a human — submerged under a cloak of hundreds of interlinked aluminum beer and soda cans

— rattled into the market. The half-living half-dead sculpture, a mobile mini-mountain three meters high and nine wide, parked itself midway between Wearable Collections and the plastic composting cans food scraps. It seemed to me to being saying, "Remember metal is recyclable too!" "We're swimming in discards." "Who are we really?"

*Saturday November 19, 2011*

To prepare for the next visit, I sought advice from two experts. I discussed my methods with ethnographic Professor Terry Williams, in whose Field Methods class I was participating and sustainable fashion and textile researcher Kate Fletcher, whose ethnographic research includes the project Local Wisdom that investigates individuals' long-term attachments to particular garments. Having recognized that most potential respondents would share, if I were lucky, less than a minute of their time, I decided to abandon the structured interview entirely in favor of attempting many very brief interactions or "flash interviews" (Williams 2011). Fletcher shared with me a compilation of categories of clothing that she keeps in mind while doing unstructured interviews that seek insights into why people cherish and keep certain items of apparel (Fletcher 2011). To make the categories relevant for my project, I simply considered their opposites, which are listed below within the brackets following Fletcher's originals.

o *Garments that are shared between people* [those that are worn only by one person];

o *Garments that are regularly worn and have never been washed (and aren't leather!)* [those that are washed frequently];

o *Garments that show or tell the story of how they have been used* [those that are silent about their history];

o *Garments that are made up of interchangeable pieces that can be worn in different ways* [those that are static];

o *Garments that are worn the same in different situations* [those that feel appropriate only to specific situations];

o *Garments or elements of garments that make for easy repair* [those that are difficult to fix];

o *Garments enjoying a third, fourth or fifth life* [those that last only one life time];

o *Garments that catch your attention each time you wear them* [those that are boring];

o *Garments worn in ways that reinforce or defy the producer's* [or wearer's] *values* [those that are silent about values];

o *Garments that connect us to others and/or remind us of our potential* [those that have forgotten to remind us of our potential];

o *Garments worn in response to changing economic and environmental* [social, or cultural] *concerns* [those that are irrelevant to economic, environmental, social, or cultural issues];

o *Garments that are adapted over and again to meet changing needs* [those that fossilize];

o *Garments that are perfect for you* [those that you do not connect with].

It was colder that Saturday than on previous visits, so I had to bundle up. As before, I tried to consider whether what I wore might influence what people might say to me. I tried to dress in a way that I thought would convey an approachable but not formal attitude: clean not faded jeans, white button down shirt, black sweater, a grey, blue, and oatmeal wool tweed jacket, plaid wool scarf, leather shoes. At the site, Evan was conversing with so-called donors. He was wearing the same green and black striped hoodie as usual, and an acrylic herringbone patterned woven cap.

With the new simplified agenda, I felt free to observe more, to take more pictures, to be more participatory. Rather than introducing myself and my aims to those who came by, I placed myself very near the collection bags and interjected any comment that came to my mind when someone put an item into a collection bag. Perhaps in another city, this method might be considered rude, but in New York, where people are always turning to each other and asking questions or giving opinions, it worked extremely well. Happily during the few hours I was there that day, I was able to chat briefly with about forty people My prompts were spontaneous, but included utterances such as:

o *Wow, you've brought in quite a few bags of stuff!*

o *Hey, that's a pretty dress. Are you sure you want to get rid of it?*

o *I had a pair of shoes like that.*

o *What's wrong with those pants?*

o *Oh, I see these towels have been used for a long time.*

o *Those purses could be consigned to a vintage shop. Why are you giving them away?*

o *That looks comfortable.*

o *You know those pills* [the small balls of fiber that collect on the surfaces of some fabrics] *can be scraped off.*

o *That looks new!*

o *Looks like you've had them for a long time.*

o *Didn't your sister want these skirts?*

o *Did you know that those t-shirts are going to be sent to Chile?*

o *Don't you hate when socks wear out in only that one spot?*

It was remarkable how easily people spoke in response to my prompts, and remarkable how unremarkable most of their comments were:

o *Oh, that skirt never really fit me right.*

o *I have too many of these.*

o *My girlfriend told me to clean out my closets.*

o *I didn't want to throw this stuff in the trash.*

o *Bringing it here is better than throwing it out.*

o *I liked it when I bought it, but I never wore it.*

o *I wore that a long time, but it's falling apart.*

o *I just decided to get a bunch of new clothes, so all of this had to go.*

o *I'm going back to Korea, and I don't want to bring all this with me.*

o *I don't know where a lot of this came from. I can't remember where I bought it.*

o *The colors used to be nice, but they look old now.*

o *I lost weight and have to get rid of all this, otherwise, I'll gain it back.*

o *I don't remember having so much crap to get rid of back in the day.*

o *Some of it I just got tired of wearing, some doesn't fit right.*

o *Usually I put my old clothes on the street, but this seems like a better idea.*

o *There's no Goodwill near me.*

o *I never really thought about what happens to this. Does it go to Staten Island?* [Staten Island, a borough of New York City was until recently home to one of the world's largest landfills.]

o *If this place wasn't here, I'd just put it all in the garbage or maybe give it away, but nobody really wants it.*

o *My kids grew out of it, and my friends' kids are too old for it.*

o *I tried selling it myself, but it wasn't worth my time.*

o *I heard that bedbugs like old clothes, so I'm not taking any chances.*

o *It feels creepy, which is weird, 'cause when I got it I thought it was cool.*

o *My apartment is so small, I don't have space to have anything that I don't wear.*

o *It's easier to get new stuff.*

If the above comments, more of which were collected during subsequent visits, were mundane they seem to reflect the dull relationships many people in consumption societies have with much of their (industrially-produced) clothing. (I cannot recall seeing any handmade items being discarded.) The flash interview method was very productive, so if this project continues, it would be an effective means for establishing patterns that either fit my inversions of Fletchers categories, or point to other reasons why people abandon/recycle their garments.

**Micro-Portraits**

During the time spent at WC, I took notes of not only the setting, and what was happening from moment to moment (as best as I could), but also my observations and interactions with individuals. Following is a some micro-portraits (with some changes to personal details for the sake of privacy) of people who gave dimension to the textile recycling scene.

**The Linty Blanket Discarder**

A young woman, maybe 25, came by wearing a grey cashmere turtleneck, a plain black wool skirt and boots. It was the kind of classic modern outfit that fashion marketing students at nearby Parsons The New School for Design or The Fashion Institute of Technology might wear. She had a slight Korean accent and was shy about talking, but did point out an item that she had grown to dislike: a pale blue shaggy-pile knitted throw, marketed these days as "fleece". She said she really liked it when she got it, but after a few uses, it started to get "all linty" and she got irritated with the way it spread that lint onto her other fabrics. We looked at it together. Indeed it had problems. Besides collecting lint, it also had a bunch of snags. It was a pretty color, it was not old, but it became intolerable. She had some other seemingly non-problematic clothes that she was discarding, but she was uncomfortable discussing them.

**The Bossy Woman and Her Husband**

It was surprising to me that a regular patron turned out to be the bossy and loud woman referred to above who had demanded multiple receipts. One afternoon while I was there she came back, wearing an animal print top, a huge fake fur jacket, skinny black pants, and spike-heeled boots. Her husband, dressed, inappropriately to the cold, wore khaki pants, a short sleeved business shirt, and trailed behind her, his face red from carrying a bunch of large bags of kids clothes and stuffed animals. I tried to engage her, but she kind of barked at me to give her my pen. I said I remembered her. She said she comes here often, that she has got a lot of stuff. But she and her husband were gone before I could get any more information out of her … taking with them still more receipts.

**The Purple-Coat Lady**

One of the first people who had agreed to talk about what she was dropping off was a heavy-set middle aged woman, dressed very casually in a purple wool-like car coat and jeans — an outfit not unlike that worn by many of the close by farmers selling produce. She was with her husband, who was wearing a fuzzy polyester (again, the so-called fleece) jacket. She said she was discharging her husband's jeans because they were beyond

repair. She also said she was a good sewer, that her mother had been a seamstress and taught her how, and that she knew she could have patched the jeans, but that was not acceptable "in this day and age". Her husband agreed, and said he had too many jeans anyway. She also said that she had tried to give them away (there were at least six pairs in the bag) through the website Craigslist, but that no one wanted them. We talked about patching, and I mentioned a linen shirt from the 1900's that I had seen recently at the Nordiska Museum in Stockholm in a show about ways that garments' lives used to be extended. That shirt had so many patches that it was hard to find anything of the original garment. She said she wished patching was ok these days, but that another problem was even if it were, the low quality of the denim of her husband's jeans would not support patching, (The last point she made, I am fairly sure is not true).

## Linda
Another person who spoke openly with me was someone who I had at first accidently annoyed. I had noticed that she, a woman of about sixty with grey shoulder length straight hair and a comfortable but elegant style, was watching me take notes. I asked her if she had something to drop off. She became immediately defensive, wanting to know who I was and what I was doing. I apologized for not introducing myself before asking her a question, and then we proceeded to have a twenty-minute long conversation. She told me that she did not have anything to drop off at that particular time, but that she was in fact a regular, and that she occasionally stood nearby the site and watched what was going on. Linda is a fashion editor, but declined to say for whom she worked. She was wearing an activewear jacket of a brand I didn't recognize that fit her more closely than a North-face or Patagonia jacket would have, and the fabric was an iridescent green-brown that was unusual compared to the typically black, navy, and unsubtle colors that are commonly used in these kinds of jackets. She was also wearing a dark blue resist-dyed Indian silk scarf that we discussed because it was so pretty. She self-identified as a recovering "fabricoholic" and when I jokingly (I thought) asked her what a fabricoholic was, she seriously explained that it was like an alcoholic but with fabric. She said she has been bringing in clothing and fabric regularly as part of her rehabilitation, and asked me a lot of questions about my work and what I had been learning. She confided that she does not like Wearable Collections because "they are dishonest about what they are doing" [because WC's communication, at the time of this study, did not clearly present itself as a profit oriented business], but nonetheless brings her discards to them because it is convenient and she likes coming to the market.

## Homeless Man, Compelling Couple
Not everyone who comes to Wearable Collections wants to give away things. At least one person every time I visited the site wanted to be recipient of clothing. Not counting a woman who drunkenly bartered and begged to buy a paisley purse (and then decided it was not worth the impromptu agreed upon price of ten dollars) all of these people presented themselves as in dire need and struggling to get by. The WC workers are not encouraged to give out clothes — it is easy to see how the site could quickly become a de facto distribution center — but occasionally Evan did, saying, "I can't say no to homeless women with children." One man, about forty years old, obviously homeless and not adequately dressed for the cold, told Evan that he needed a warm jacket. Evan was not willing to dig around in the bags for clothes, but he did say that if a coat came in he would hold it for him. Indeed, a coat came in, and Even held it for the man who came back later in the day. A similar event happened on another day, when a couple, both in their thirties and whose accents indicated they might have been from a French-speaking Caribbean country, arrived in the morning, talked with Evan, and then went to sit on a bench. Periodically, when something was delivered that Evan thought might be good for them, he put it aside. After a while, Evan had packed up a donated suitcase for them, and handed it to them from the side of the tent. In a place like New York, where there is a tremendous disparity between the super rich and the very poor, the fact that (mostly white) people are dropping off kilos of clothes, while some others, (usually black) intermittently come by for bare necessities, underscores the obvious fact that in order to recycle textiles, one must first have excess material wealth.

## The Too-Short-to-Keep Sweater Leaver
A young woman whose accent I could not place, styled in classic Gap-like basics brought in a large clear bag plastic bag packed with apparel. It was an incidental sign that her plastic bag was clear, because she was also quite forthcoming about the stuff in the bag. She was happy to pick out something to tell me about, though she could not decide what. I picked a knit sweater near the top of the bag,. She said it was perfectly good, but was too short. I asked her what too short meant, and she clarified that it was out of style. She volunteered that there were a lot of new clothes in the bag that she did not like soon after she bought them, but for one reason or another did not or could not return them to the stores from where they came.

## The Anonymous Victorinox Backpack Giver
A lot of people when stepping up to the nylon laundry bags where they leave their clothes, bags, shoes, sheets, ask a quick

question such as "Do I put this here?", "In here?", or for those into the New York Minute mode, merely "Here?". Others just put their contribution in the laundry bags and wave good-bye. One such silent person, a young woman dressed in black floppy pants and a very bulky white wool sweater, left a brand new red and black Victorinox backpack just like the ones I had seen in a shop nearby for 165 dollars.

## The Most Fashionable
I called her The Most Fashionable. The woman who earned this title on a grey Saturday in early December was literally very colorfully dressed. Arriving by folding bicycle, she was a festival of vivid fuzzy fabrics. She moved quickly. There was no time to take a picture, but in her woolen whirlwind I saw two bicycle baskets filled with food scraps and an obviously hand knit orange and red afghan-granny-square vest. A pink crocheted cap and purple scarf was caught up in her curly red hair, and she had, wool pom-poms tied to her shoes. I imagined that like a super small subset of the New York fashion avant-garde she may have even dyed the wool herself. She did not have any textiles to be recycled however: her only stop was the compost cans.

## Whole Clothes Man
A handsome man, late twenties, perhaps one of the fashion models living nearby, came over with two loaded shopping bags. One bag was glossy and printed with the narrow multicolor horizontal stripes seen on Paul Smith branded scarves and socks, but was actually from Bloomingdale's department store. He put the bags on the table, and asked if it was ok to "drop off here". Like a lot of men, he left his clothes with no apparent regrets or care, whereas it was common for women to double-check what they were giving away. Of special interest in this donation was a short stack of neatly folded, new (with the hangtags still on) "eco-friendly" organic cotton khaki pants, t-shirts and polo shirts from Whole Foods. These products, designed to have less harmful impacts, had a value no greater than any other garments that populated the piles of the rejected.

## The Old Washcloth Old Lady
The same day the Whole Clothes Man mentioned above contributed his pants and stuff, many other donors came and went. The pile of anonymous apparel grew sack by sack, eventually hypostatizing a modern fable with no clear moral. But before Wearable Collections closed the bags and finished packing them all into the truck that would cart them to New Jersey for sorting and then shipping to the world beyond, an old stooped woman who had made her way to the market with the help of her rolling-folding shopping cart opened her purse and tossed a

decrepit beige square of cotton terry cloth into one of the bags. This broken down washcloth, unlike the vast majority of the materials contributed, evidently had a long and useful life. It is the sort of fabric that Wearable Collections and other collectors do not want too much of. The more truly tired, really used textiles they bring into the recycling stream, the lower the price received per kilo will be.

## Upcycling the Experience
With this writing, I have tried to relate two simultaneous occurrences. One, the practice I have gained using ethnographic field methods, and two, the anecdotal information I collected about one aspect of textile recycling. Moreover, I have also begun to place this experience within the larger context of consumption culture, recycling and the notion of sustainable fashion.

This project was embarked upon in conjunction with a graduate level course in ethnographic field methods at The New School in New York in support of my design management research based at The Swedish School of Textile in Borås. My primary action research however is with a social business located in Madhya Pradesh, India where fieldwork on the pros and cons of small-scale textile manufacturing will necessarily employ ethnographic methodologies. As more investment is being made in using design and design management as tools for solving society's complex and unprecedented problems (Thackara 2006; Chapman and Grant 2007; Smith 2007; Ehrenfeld 2008), ethnographic skills that enable designers and managers to understand human dynamics have a critical role to play. With regard to this need for my own upskilling, I believe this endeavor will prove to be very useful.

Although I did not set out through this work to come to any particular conclusions, and it should also be remembered that my research methods were deliberately experimental and inconsistent, it seems, from the good number and enthusiasm of people who are choosing to bring their discards to just this one WC location, that there is a potential to radically increase textile recovery rates in New York City. The interviews and snap-conversations yielded mostly unsurprising reasons why people are disposing of their clothes. Despite exceptions, they boil down to people having too much stuff they do not value. There were indications that people were bringing in their clothes (and more) for recycling because of a desire to be "environmentally friendly", and no one I talked with expressed any disagreement with the assumed positive ecological value of textile recycling in and of itself. During this engagement, however, I found little or no evidence that bringing in textiles for recycling might decrease

the overall consumption of textiles. If we reach a point, in New York City or elsewhere, that people are wearing garments, and using towels, sheets, and other cloth products that are made of recycled materials instead of (and not in addition to) those made from new resources, textile recycling will have a much clearer value. It could happen. Industrially produced, and one-off clothing made from recycled materials are increasingly available. (Of the many producers, see for example sustainuclothing.com or junkystyling.co.uk.) At the moment however, even if what I heard and saw in Union Square made me feel somewhat optimistic and energized, I will keep in mind environmental economist John Ehrenfeld's remark that, "Reducing unsustainability will not create sustainability" (Ehrenfeld 2008: 20).

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# Multifarious Approaches to Attain Sustainable Fashion

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**Abstract**
Fashion is a huge industry and affects environmental, economic and social system in many ways. Exploitation of resources for ever changing trends in fashion is immense and providing these demands put enormous pressure on the environment. In such a situation sustainable practices in every human activity has become important and fashion is not less affected by this drive. Fashion professionals have to play major role to inculcate the concept of sustainable fashion with responsibility in their product line. It is important that while designing, designer should understand the benefits of sustainable operation starting with concept development level. In this paper design solutions for sustainable fashion are inferred in a design school scenario. The main idea to do so is to develop more sensible and responsible designs, which can be better solutions for sustainable fashion. The sustainable fashion was achieved to a certain extent by using available materials to its ultimate usage, using waste material, recycling of the products, planning second life for the fashion product, slowing down the fashion etc.

**Keywords:** slow fashion, sustainability, fashion design, haute couture, textile re-use, functional design

In 1918 Mahatma Gandhi started his movement for Khadi as relief programme for the poor masses living in India's villages. Spinning and weaving was elevated to an ideology for self-reliance and self-government. Every village shall plant and harvest its own raw-materials for yarn, every woman and man shall engage in spinning and every village shall weave whatever is needed for its own use. Khadi Movement was– A true approach for sustainable living through sustainable clothing. ( Prabhu R K,et.al 1960)

Fashion is a huge industry and influences environmental, economic and social systems in many ways. It is known fact that phenomenal amount of textile waste that enters landfills each year, fashion industry's sizable water-and-energy footprint is a great concern for environmentalist today. While having many economic benefits, clothing has a significant environmental and ethical impact ranging from increased carbon emissions, waste, water usage and pollution to child labour and unfair trading conditions. In February 2009, the UK Government Department for the Environment, Food & Rural Affairs (Defra) launched the Sustainable Clothing Action Plan. The research and consultation that preceded the action plan brought together over three hundred UK fashion & textile organizations, from high street retailers, to designers and textile manufacturers to battle the environmental impacts of fashion industry. (Defra 2008)

Sustainable fashion is not a trend. It is way of designing the styles as per positive future demands. (Dickson M, et al.2012), It is a part of the larger trend of "ethical fashion".

It is a global movement that involves economic, environmental and social issues. Apart from Gandhian philosophy there are various ways with which a sustainable fashion can be achieved. As per Gill Linton buying few well-made designer pieces that can be worn many times and does not look same. (Linton G, 2012) Vivienne Westwood on BBC"s Jonanthan Ross show quoted her manifesto "buy less, choose well. In the year 2007 "Slow Fashion" a sustainable fashion movement, was coined by Kate Fletcher. (Fletcher, K 2007). As per Fry, design future is concerned with humanity, and more specifically, how a design can contribute to the continuation of humanity. Design is intrinsically linked and intertwined with humankind and the myriad problems facing the current state of the world. ( Fry, T 2008).

Today, fashion is one of the most dynamic, challenging and fasest growing sectors and therefore, it influences environmental, economic and social system in many ways. The sustainability movement is all pervasive today and touches many elements of consumer's daily lives. Making fashion sustainable means taing into account more than just style, quality and cost. Therefore, it is important that while teaching design development, one should understand the benefits of sustainable operations starting at concept development level, thereby broadening the design aesthetics and the functionality of a product. The goal of design methods should be to gain key insights or unique essential truths resulting in more holistic solutions.

Today, a conscientious consumer covets and consumes products with certain ethics, and therefore, there is a need for complete reconceptualization of the practice of design. In such a scenario, the pedagogy for fashion requires certain amount of sensibility in terms of sustainability. Sustainable development requires radical changes in the way we design, produce, consume and socially interact. These changes will not only be technical, but also social and ethical. This paper deals with the experimentation in a Fashion design school in order to attain sustainable fashion. Fashion designing was explored to create designs by the Fashion design students with sustainable approach. The main objective of the study is to incorporate the concepts for more sensible and responsible designs that can be a better solution for sustainable fashion. It aims in imparting designing knowledge to design a sustainable fashion.

## Objectives
• To design the fashion garment with concern for social, environmental and economic sustainability.

• To analyse the element that was incorporated to attain sustainable fashion.

## Methodolodgy
The experiments were conducted in National Institute of Fashion Technology, Bangalore, India. Experimental designing is being taught for last three years in the form of classroom project to the students of Fashion Design VI semester. These students are not taught about sustainable fashion as a part of their curriculum and therefor pedagogy was modified to include this aspect in the form of assignment. Assignments were formulated keeping attainment of sustainability in fashion in mind.
2010 Fashion design VI batch: Fashion with II life
2011 Fashion design VI batch: Multifunctional garments
2012 Fashion design VI batch: Slow Fashion
Weekly monitoring and final analysis at the end of the design project was done for each design. Students were encouaged to engage with innovative and radical ways to approach sustainable fashion solutions employing different perspectives on sustainability. The design project was planned for 8 weeks. Following design
process was planned for achieving the design outcome.

## Design Process
• Market Research
• Client Research
• Possible Second Life Product Research
• Trend Study
• Trend Study 2 (Second Life if )
• Inspiration
• Colour Generation
• Fabric Collection
• Idea Generation
• Idea Generation (Second Life if)
• Technical Detailing of Product Conversion
• Design Collection
• Technical Specification
• Pattern Making
• Prototype Development for First Life & Conversion to Second Life if planned

(Note: This assignment was not designed as an empirical experiment to test and evaluate teaching methods and models in a strict sense).

## Development of Sustainable Fashion Design
The objective of this exercise was to develop strategic thinking in designing in order to achieve viable solutions for sustainable fashion designing. Since fashion caters to psychological utility than functional utility, the normal lifecycle of a fashion product lasts for one season. The idea of this exercise was to approach design formulation in such a way that the overall life cycle of the product can be increased, resulting in conservation of matrial, time and energy involved. For this study, few examples are analysed. The observations made are as follows:

1. **Wardrobe Staple Piece:** A rule to a wardrobe – QUALITY NOT QUANTITY!!! Clothes that liked by the consumer not only for one season but for many seasons, a garment that can be coordinated with many separates in your wardrobe, it is flatteing, comfortable, versatile, well-made can be called a Wardrobe Staple Piece. Following examples are analysed under such season less wardrobe staple pieces.

Design 1A is created by intensive surface developments. The theme worked upon was transformation and therefore layered surfaces with different visual appeal were used so that the look of the garment can be changed for different occasions and therefore can be utilised for more occasions.

In Design 1B use of traditional beads which are very expensive and carries regional prosperity symbol were used to make a garment exclusive. The garment has a characteristic of cultural connect at the same time is made in very contemporary manner thus can become a staple piece in the wardrobe to be retained for years. It can be worn with various combinations with exclusivity in design and therefore makes a staple piece.

Design 1C is a very traditional sillhoutte of Hariyan region of India, although colours and surface created gives very noble feel to it but the garment has an cultural connect an element which does not vanishes with time. This is again an example of a designer wear which can be worn in contemporary as well as in traditional context by the wearer thus making it staple wardrobe piece.


Fig 1A, 1B, 1C: Wardrobe staple pieces

2. **Multi-Functionality of Garments:** By creating garments that do more with less, multifunctional garments (also called convertibles or transformers) are articles of clothing that can be worn in more than one way or that serve multiple purposes. They can usually be altered by utilizing attached strips of cloth, ties, buttons or other built-in modifiers. As shown in figure no. 2 a top can be altered by zipper in the form of bag for a varied utility.


Fig 2: A stylish top can be converted as sack-bag

3. **Re-Construction - second life:** For achieving the psychological and functional utility of a fashion product, the design process was modified to design two life cycles for one fashion product. Also, the transformation of one life to the other was planned in the design process itself by the students. After analysing

the recorded studies, it can be concluded that the design of a product can be done keeping its second life in consideration. A thorough research about long term fashion trends is important in designing the extended life cycle of the product. A designer can incorporate simple and convenient methods to transform a product from its first life to its second life. As shown in Fig. 3A, a tunic top after complete utility can be converted into a back pack by the user with slight manipulation. Fig. 3B, a designer tube top and smoked skirt can be used as decorative cushions and bag in second life.



Fig 3A, 3B: Reconstruction, second life of fashion products

4. **Emotive Designing for Slow Fashion:** For a fashion to be used for prolonged period aesthetic is important factor. The design should possess a characteristic to be called a classic product and will not have scope of being obsolete. (Abitslow, 2011). It should have expertise or virtuosity, utilitarian pleasure, style and special focus. Fashion that appeal emotionally- possessions those are close to heart, favourite and gratifies emotional needs will last for longer period with the user and can lead to slowing down the pace of fast changing fashion. Consumers can use the fashion product for longer period for various emotional needs viz; being connected to loved ones, feeling stylish every time they wear it, finding enjoyment, feeling stylish. With this aspect designs were developed are discussed below.

In design 4A an attempt was made to use father's old shirt to make a completely new dress which can be worn frequently an innovative example of emotional connect by recycling the material thus achieving slow fashion.

In design 4B, cultural and emotional values were used to design a garment. Motifs were derived from the regional folk art of Kerala in India called 'Theyyam'. Client's mother's sari was used for making complete new designer outfit. The garment since has emotional and cultural connect therefore such fashion garment can be enjoyed by the user for prolonged time thus reducing down the pace of fashion.

In design 4C inspiration is taken by a custom called papad file in Jain cult where in blessing is given in the form of papad file. This garment again carries emotional connect in the form of wishes by her family, making this garment a special to be possessed for life.



Fig 4A, 4B, 4C: Emotive designing for slow



Fig 4B



Fig 4C

5. **Reduce Material & Process Using Modern Technology (seamless)**

Incorporating seam less technology for the production of mass customised garment a single fabric can be varied in styles in terms of silhouette viz; A line, tulip, and with side cowl. Length of the garment can also be adjusted as per the design and size requirement of a client. By using this design intervention consumers will have access to a variety of relatively low cost, varied style, customized apparel. It is a commercially viable design intervention as it does not involve additional requirement in terms of raw material, processing time or infrastructure. Moreover unlike conventional garment construction technology where there is lot of wastage of material for pattern development, it involves no wastage, hence it certainly leads to sustainable fashion.
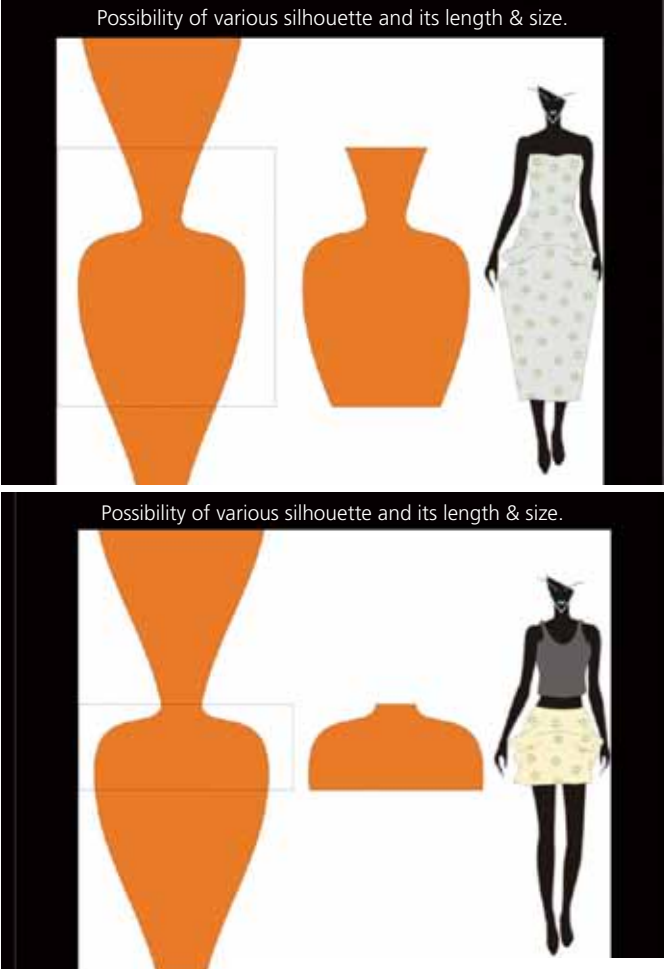


Fig 5: Knit plan using seam less technology for mass customized garments

**6. Recycle - best out of waste:** Re-cut and sew vintage clothing, or use unusual materials to create truly different fashions, recycled clothing is the greenest option. In this approach to achieve sustainable fashion designs were developed by textile materials which were of no use. In figure 6A worn out and trend out denim trousers were used to develop a jacket with trendy hood. In design 6B old phulkari suit of grandmother was redefined by developing surfaces for contemporary outfit thus using otherwise waste garment and also incorporating emotional value to the garment for prolonged utility.



Fig. 6A, 6B: Recycle; best out of waste fashion

**7. Choosing Artisans Products to Support Small Craft:** Poverty is the social and economic system that makes most of the artisans in India vulnerable depriving their access to basic need for their livelihood. Cultural diversity provides wide variety of art and craft product as daily part of their living. The art of making crafts can be used by the fashion designers thus contributing to an economic and social sustainability.

**8. Modular Clothing:** Making a garment with easily detachable finished components will give a wearer multiple options in the way it can be assembled, resulting in a feel of multiple garments without having produced that much in reality. The wearer can also modify the styling, fit and silhouette as per his/her own wish or as per the latest trend which will lead to reduced buying,

which in turn will lead to reduced manufacturing and which eventually will turn out to be less usage of raw material.

**Conclusion**

Few innovative thoughts applied by the students in design development to attain sustainable fashion were; by adding emotional value to the design, planning second life of the product, reusing material, able to make allied business like craft, using modern machine in certain instances and by increasing longevity of fashion etc. This understanding of sustainable design philosophy was able to develop important designer skills amongst the students which otherwise were never taken into consideration. This teaching experiment resulted in:

- Enabled logical understanding of the design process by the design students.
- Made the students understand sustainable design philosophy to comply with the principles of economic, social, and ecological sustainability.
- Developed Intuitive approach towards the extended life of a product in order to use resources to its optimum level.
- It enhances an ability to understand and apply long term fashion trends, endurance for classics.
- Develops ability to think design with a sense of responsibility
- Extend the endurance of the material used beyond the product's short life (trend).
- It was able to build an intuitive approach towards the extended life of a product thus driving momentum for slow fashion.
- Sustainable fashion philosophy enables designers to create unconventional and innovative designs against an obsolete fashion product.

After analysing the recorded studies, it can be concluded that the design of a product can be done keeping environmental concerns into consideration. A thorough research about long term fashion trends is important in designing the extended life cycle of the product. A designer can incorporate simple and convenient methods to transform a product for the best usage resulting in reduction of environmental hazards in a considerable way.

In today's scenario with global focus on sustainability, extending a fashionable product's life beyond the recognised horizon will certainly have a positive impact. Including the aspect of sustainability in teaching itself gives students a wider perspective to think design in a more holistic manner and to become sensitive and sensible towards environment while designing.

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# Rethinking Available Production Technologies
## – the case of a thermally insulating footwear concept

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**Abstract**
Consumption reduction is often regarded as profound for sustainability. The overwhelming studies are on the general public and its behaviour. Here we discuss a way for the company to lower consumption by avoiding inventory investments. Added value in terms of sustainability can be gained by using standard manufacturing technologies frequently found in the textile industry to produce new products beyond present paradigms. Specifically we develop knitting techniques on a circular knitting machine to enable production of a thermally insulating textile composite for a multi-component footwear system. Four cornerstones defined the project; *sustainability, availability, comfort* and *flexibility*. The first two relate here to the production, while the last two are coupled to the wearer's experience of the product.

Two key questions initiated this project. The first question elaborated on the possibility to produce an untraditional material for a new type of product on a circular knitting machine, which is generally used for high speed production of full-width fabrics. The second question explored the possibility to apply the three-layer principle - generally used in sportswear - on footwear. We show that we can answer both these questions positively.

Using an elaborated functional design tool the footwear system was theoretically divided into functional layers; inner, middle and outer, combined with an inner and outer sole. These detachable layers together create a flexible footwear system. A ready-made product, the middle layer with thermal insulating properties, was practically developed, taking use of a heat and water soaking protocol for inducing relaxation in the material and by this air encapsulation.

**Keywords:** footwear, knitting, three-layer principle, comfort, thermal insulation.

**Introduction**
Consumption reduction is commonly regarded as profound for achieving sustainability (Allwood, 2006). Talking within a textile context it is for example better to prolong the life span of the T-shirt than buying a new one (Chouinard et al., 2011). The overwhelming focus on consumption studies is on individuals, households and the general public (Newholm and Shaw, 2007). Still investments by companies stand for a

very large amount of yearly national gross expenditure in many countries. Any purchase of instruments and machinery creates a seismic wave through the economy. Energy must be used in the machine factory. Transport must be performed for moving the items from the machine plant to the buying company. Oil or electric energy must be produced for this. Raw materials must be found - minerals transformed to metals, oil to plastics and so on. All this adds to the global burden of resource use. Naturally it is also the case that new machinery is more efficient with energy, water and chemicals than older generations. Old machine parts can be reused and metals re-melt. New equipment can be placed in geographically better sites than before, minimizing distance to costumers. All this lessens the negative environmental impacts. Our focus will be when the company is in a situation investigating a new equipment purchase that is needed for the company, given its present market. Re-use of a process could be an alternative. By avoiding machine investments, prolonging the life span of the equipment, but still reaching new markets both an economical advantage for the company and a positive effect on the environment is obtained. The aim is here to give a concrete example of ways to do this. The philosophy is to use standard manufacturing technologies for cheap mass production to produce new kinds of products. Rethinking both choice of technology for a certain product and what is possible to do with a given assembly of machinery could enable an enhancement of the sustainability profile of the company. We exemplify the former issue by presenting a systemic footwear concept realised by using specialised yarns, and the latter by explicitly showing how to produce one of the components in the system by the common circular knitting technology.

Experiments aimed at developing a structure that would have thermally insulating properties and be possible to produce on the circular knitting machine. Experiments involved machine adjustments needed to enable the machine to knit the composite, the pattern of interconnecting knitting loops, material and after-treatment, cutting and assembling. Before this an elaborate design process was performed, first described.

## The Basis for the Product Development

Product development should lead to the realization of the demands and requirements which define the product and the production thereof. Here we work according to the idea of Function analysis (Pahl et al., 2007, Hubka et al., 1988) as a means to learn how to think and express the product in functions rather than in ready solutions and physical objects. By Functional analysis, function (for definitions see (Kikuchi and Nagasaka, 2003),

(Umeda and Tomiyama, 1997) and the very physical realisation in a certain object are disentangled, creating a freedom in mind. The process is inherently iterative; starting with a main function a decomposition into subfunctions is performed. These are elaborated. Eventually the subfunctions are associated with physical realisation.

The project is defined by the following four cornerstones;

• The **comfort** aspect includes creating, supporting and maintaining a comfortable microclimate under various kinds of external climate and levels of physical activity. Comfort embraces also other aspects – such as size fit, cushioning (Drez, 1980) etc. These will be of secondary focus here.

• **Flexibility** refers to the footwear system's ability to be convertible in order to suit shifting conditions. For example adapting to changes in level of activity, changing weather condition, from outdoor to indoor, from wet to dry or from dirty to clean.

• **Sustainability** focuses on resource efficiency from the perspective of the company. Striving towards optimizing production processes through minimizing the use of energy and chemicals, as well as reducing the amount of waste produced. Packing material, stock and transport should also be rationalised in order to minimize storage, space, weight and so on.

• **Availability** focuses on innovative use of existing, accessible and widely distributed production equipment, as well as developing new techniques and applications for these machines. Availability focuses on the development of new knitting techniques on existing equipment rather than development of new machines. This enables production of rare textile structures by applying and combining techniques that are not commonly used or known of.

The first two cornerstones relate to the wearer's experience of how the product meets its aim, and the last two relate to production of the product.

The concept of Gestalt – which originates in perception psychology - has been adopted by the design community (Monö and Knight, 1997). It refers to an arrangement of parts which appear and function as a whole, and whose value is more than the sum of its parts. Between the parts and the whole the meronymic relation (Persson N.-K, 2012 in preparation) holds. Meronomies are inherently coupled to emergence (Emmesche et al., 1997 ).

Properties of the whole are divided into resultant (i.e. found also among the parts) and emergent (i.e. existing only at the whole-level) with empty intersection, according to the law of Excluded Middle. Gestalt is a valuable tool which can be used to describe the product developed in this project with a continuous change and rechange of perspective of the parts visavi the wholes of the parts. The footwear as a whole consists of separate functional layers that can be used separately. Together all the parts add up to a whole footwear system, which can provide a greater functionality than each individual part can do separately.

Heuristics refers to methodologies for circumventing problems. It has a philosophical and psychological origin (Hector D et al., 2009, Silver, 2004), but has been mostly adopted in the computer community(Mullermerbach, 1985). It has a high potential within the field of product development. Our approach is closest to what is called divide-and-conquer heuristics and embraces the down-breaking of the problem into two or more sub-problems, do the same with these, until the problems at hand become simple enough to be solved directly.

Development thus requires an elaborated analysis of functions. We sketch the basis of the methodology in the following, analysing the biophysiological restrictions, the concept of comfort, the function thermal insulation - and means of realization.

### The Biomechanics of the Foot
The foot can be divided into the rear foot, midfoot and toes, where each section has its own special function. The back of the heel bears the bodyweight while standing and also absorbs shock while walking. The midfoot or spring section of the foot absorbs shock. The toes keep the balance of the foot. The foot functions as one link in a biomechanical kinetic chain (Steindler, 1977), where movement at one joint influences movement at other joints in the chain. When the foot hits the ground it is subjected to dual forces, the ground shock of heel strike and the vertical stress of weight from above.

Walking puts up to 1.5 times our bodyweight on our foot, and running three times our bodyweight (Fourchet et al., 2012, Dixon, 2008). An individual takes between 8000-10 000 steps each day (Dai et al., 2006). During walking the foot becomes longer and is stretched forward and rearward at the heel area; at the same time the waist and joint area of the foot becomes wider. During running the foot passes through both pronation (appr 25% of the time) and supination (appr 75%) (Drez, 1980). Thus movements are inherent and have to be considered in any design. The heel counter on a shoe stabilises the heel area. But

a too rigid shoe does not provide any greater protection against impact and may affect the gait cycle (Lohman EB et al., 2011).

### The Concept(s) of Comfort
Comfort is dependent on the surrounding climate (temperature and humidity), activity and clothing. Comfort can be divided in different ways. One way is to use a two-fold perspective as follows: *Physio comfort*, dependent on physical and physiological factors and embracing thermophysiological aspects such as the bodies' loss (or gain) of energy, the physical work being done by the person, and the environment (ambient temperature, air humidity and air movement), which for a garment and footwear boils down to heat insulation, air-permeability, vapour retention, water-absorption, wettabillity and water-transport ability. Added to this are also other sensorial factors such as the sensation of how the fabric feels against the skin. This feeling addresses fabric properties like prickling, itching, stiffness or smoothness. The garment fit considers the ergonomics of the clothing, its freedom of movement, tightness and weight. Fit influences the thermophysiological sensation. As an example a loose fitting garment may be perceived as cool during summertime.

On the other hand, *comfort from a socio-cultural perspective*, which includes fashion styles, emotional colours that the garment communicates as well as the suitability of the clothing for the occasion etc. This has a subjective nature and is possibly more difficult to measure quantitatively than physio-comfort.

### Air as Thermal Insulation
Vacuum provides no atoms and molecules and is a great form of insulator, since the heat can not move by conduction. Since vacuum is difficult to use in clothing, insulation uses the next best approach, which is to approximate a vacuum by minimizing the amount of matter through which the heat can move by using a gas.

In most porous insulation, the surrounding air is the gas that is used. Since air is easily moved by convection and pressure differences, an open air space does not work well as insulation. For better insulation values porous insulation is used, it holds the air in place by using small quantities of solid material as a matrix. The solid material is distributed so it occupies as much of the space as possible. The contribution of the fibre itself to the thermal insulation comes second. Many gases have better insulating properties than air. However some of these gases can effect the atmosphere and all insulation that uses alternative gases requires closed cells to keep the gas from escaping and being replaced by air, even if the gas is encapsulated it

can in most cases slowly diffuse through the plastic (Wulfinghoff, 1999).

## Three Layer Principle, Textiles and Footwear

In order to achieve a comfortable microclimate in different weather conditions and for varying activity levels, the layering principle is frequently used and validated (Ren and Ruckman, 2004, Ruckman, 2005) in various clothing systems, not least in outdoor (Shishoo, 2005), uniform (Scott, 2005), sports (Shishoo, 2005) and workwear (Scott, 2005). The three layer concept is an example of application of the functional decomposition methodology.

The three layer system incorporates layers of materials, each with a specific function, from inner to outer - transport of moisture from the body, thermal insulation and protection against wind and wetness. The layers are separable so that the system can be regulated by the wearer who can add and exclude layers to enable comfort. Fundamental in this respect is the thermal insulation, realised by encapsulation of air to achieve a comfortable microclimate.

To dress a foot resembles the challenge related to dressing the body, with the exception that footwear is often exposed to more harsh mechanical strain than most clothing systems and the sole of the footwear is partly in direct contact with the ground. While a functional clothing system consists of detachable layers which can be freely combined, shoes are often equipped with functional materials which are permanently incorporated into the shoe. The division of the clothing into detachable functional layers should be possible to be applied to the foot. This would make it possible for the wearer to divide the footwear in its functional layers, and through this reach comfort giving optimal microclimate.

Textiles play a prominent role for footwear (Kanakaraj and Priya, 2007) being used as lining, upper materials, backing and reinforcement. Even if definitions are un-sharp, most often footwear is only partly consisting of textiles having leather, rubber and plastics as main components. Woven and non-woven are the types of textiles frequently used. Knitwear often has the risk of fraying (Goel, 2010). Still examples of studies of knitted linings exist (Blaga et al., 2011).

For textiles related to footwear moisture and thermal management have been a focus for research (Neves et al., 2011, Bertaux et al., 2010) (Barker R L, 2002 ) and related to this many examples can be given of model building and numerical calculations (Wu

and Fan, 2008) (Ren and Ruckman, 2004) Hollow fibres which incorporate small amounts of air into the structure use encapsulation of air. A study (Kunz E and X., 2005) investigated which structural parameters of the 3D hollow fabrics are optimal to support ventilation and thus, thermal comfort. In (Wu and Fan, 2008) different types of fibrous battings and their positions were studied to gain knowledge about moisture accumulation and thermal insulation performance of clothing assemblies. It was found that placing the hygroscopic wool batting closer to the body and the non-hygroscopic polyester batting furthest away from the body resulted in less moisture accumulation in the system, which minimizes heat loss. In (Long H-R, 1999) the water transfer properties of a two-layer weft knitted fabric was investigated. It was found that the permeability rate is closely related to the porosity within the fabric while the transfer depends mainly upon the water absorption properties of the fibres.

Three-dimensional knits, also called spacer fabrics, have large capacity to trap air and offer extremely lightweight high-performance thermoregulation but can be regarded as advanced, and leaning upon our cornerstone of availability we use only 2D knit. Layered footwear were studied by Kuklane et al., 2000. Within the footwear community the perhaps most active field is shoes that fall within the sportswear realm. Here shoes are regarded as the most innovative field, compared to other garment and textile accessories (Thiry, 2008). Recently also socks have experienced fast development (Thiry, 2008) with for example ready-made items direct from machine, seamless toe with protruding parts. Compression functionality (McCurry, 2010) and moisture management (WSA, 2005) have also been active directions for development of hosiery. Still the scientific research literature that directly addresses textile aspects of footwear is limited. Non-direct paths have to be used.

Orthopedics and physiotherapy have naturally been interested in footwear (Dai et al., 2006, Drez, 1980). Studies has been performed in a context of prosthetics, (Sanders et al., 1998) which provides a controlled study on compression of different sock material and friction between these materials and skin. But it is not immediate how to transfer these results in the detachable footwear concept.

Shoes, development of new footwear concepts, and hosiery have been highly interesting from a military point of view (Dyck W, 1992, Rosenblad-Wallin, 1988). Even if this literature is huge the technological knitting and production aspects are secondary. Regarding shoes and socks as one system, it's not new with concepts such as SIS, sock-insole-shoe (Thiry, 2008) and boot-winter

or summer insole – outer sock, inner sock (Rosenblad-Wallin, 1988), being presented. But these do not provide a detachable system. The conclusion is that few studies explicitly apply the three-layer principle to footwear.

## Principles for a New Footwear Design and Production

To start with, the footwear system was theoretically subdivided into functional layers: inner, middle and outer layer, together with an inner and an outer sole. All the detachable layers together form a flexible footwear system, fig 1. Shape and size of one of the author's (ACJ) feet were used for modelling the footwear layers.

### Distributing Functions in Separate Layers

To enable comfort during shifting levels of activity, the footwear must be changeable. This can be done by the wearer, by adding or excluding units. This way of regulating the microclimate can be achieved only if the footwear is subdivided into detachable layers, where each layer of the footwear incorporates a function.

The project illustrates how the choices made during product development influence a wide range of aspects; individually for the user and in a wider perspective the production, its availability and environmental issues. Eventually all these aspects can be summarized in the four cornerstones that were chosen to frame this project; comfort, flexibility, sustainability and availability.
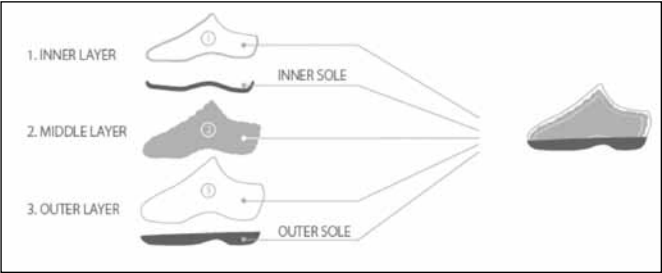


Fig 1: Detachable layers that together forms the footwear system.

*The outer layer* main function is to enable protection against penetration of wetness and wind, while still being breathable. The outer layer could for example be constructed of a plain-woven polyester which is laminated to a microporous film. The seams of the outer layer must be taped. *The middle layer* main function is to offer thermal insulation. In order to achieve this, the material of the middle layer can be designed to enclose large volumes of air, which can work as a buffer to temperature shifts.

*The inner layer* function is to transport moisture away from the body to reach thermophysiological and sensorial comfort. To achieve these properties a fibre with low moisture absorption could be used combined with a suitable knitting structure. If the inner layer is knitted as a bilateral structure, which is connected with distributed knitting loops, the inner layer will acts as two socks, hindering the development of blisters as well as more easily transporting moisture away from the foot.

The sole of the footwear is divided into two parts. The inner sole or the footbed, which is located close to the foot, compensates for the differences of the feet, and helps the body into a healthy posture as well as absorbing shock while walking. The outer sole enables protection against mechanical strain and wetness as well as absorbing shock while walking. The outer sole is moderately stretchable, which makes it easy to slip into by pulling the rear end of the sole over the heal and fixate it onto the outer layer of the footwear system. In the present study the middle layer is in focus and the following refers to the design and production of that.

### Development of Shape

Requirements related to the wearer's experience of comfort and aspects related to the sustainability and availability of the production process were equally important during the development of the footwear system. Several experiments were conducted using different materials and approaches. From this work a footwear shape, meeting the requirements of the cornerstones in varying degrees evolved.



Fig 2a: The origami inspired phase for minimizing material
Fig 2b: The three-dimensional shape of the footwear was received through folding a two-dimensional material

The initial experiments were inspired by the Japanese paper folding technique origami (fig 2).

Starting with a rectangular shape (A4) and folding this into three dimensional shaped sketch models, aimed at finding a space filling three-dimensional (3D) shape where its two dimensional (2D) shape tessellates the plane. In this way the material could be utilised efficiently and the laying of the pattern is made easy as well as that the amount of sewing is reduced.

Further test shapes were constructed in textile and modelled on the foot in order to give an idea of the shape and fit of the footwear. A range of different test models evolved during this phase. The choice of the model was based on the four cornerstones and the gestalt interplay between parts and wholes. The formation of the pattern for the footwear aimed at achieving a way to communicate how the forthcoming 3D shape would be formed, which is in line with the cornerstone concerning efficient production.

Minimizing the amount of material used to produce one footwear unit, including waste material cut away in the production, as well as utilising a larger percentage of the material, leads to more efficient production, and economizing with materials.

The same shape is used in all the layers of the footwear. This makes the production easier. It also gives the separate layers a common idiom, in spite of the difference in material and structure.

### Introductory Production Remarks
Since the circular knitting machines are mainly used for high speed production of full width fabrics, it is a challenge to develop a structure that will enclose air and hold it still inside the textile composite, meanwhile being possible to be produced on this kind of machine.

A circular knitting machine with two needle bars can technically produce a bilateral textile structure without connecting points and thereby the materials can be detached from each other. In order for these two sides of the knitted structure to be separated from each other and thereby be able to encapsulate air, a non-knitted filling yarn can be incorporated between the material layers, separating the two textile units and thereby creating space for the air to fill. The two textile layers are interconnected by knitting loops in selected places to divide the composite into smaller sections. The distance between interconnecting knitting points has to be optimized so that the two material units can be separated enough to encapsulate the porous material, but not

become too big and thereby lose its stability. The amount of non-knitting filling yarn that is possible for the machine to handle and lead in between the textile units had to be determined, this also defines how thick composite the machine can produce with this technique.

Knits are characterised by being flexible and stretchable structures. Footwear needs to be flexible to meet the comfort requirements, but also rigid to support the position of the foot and achieve a correct body posture. Therefore the knitted structure had to be modified to, besides being flexible, also offer enough rigidity for a footwear layer. The hypothesis that was tested was to incorporate a yarn in the construction that could pull the composite together and thus make the structure more stable. If the structure could be pulled together by the contraction of a yarn within the structure, then the height of the composite would increase, creating more space for the filling yarn to expand in and allowing the structure to encapsulate more air per area. This idea could therefore add to the product by both making it rigid as well as increasing its thermal insulation.

## Experiments and Results

### Circular Knitting Machinery
All experiments were conducted in-house with a double-bedded circular knitting machine OVJA 36 with 36 knitting systems, 20 needles per inch, npi, and electronic needle selection. It is equipped with 1872 needles in both the cylinder and dial. The machine speed is 18 rpm. It is imperative that the machine is double-bedded for it to be able to knit a two layer structure. The machine can be programmed either mechanically, or digitally by translating a drawn pattern of knitting loops into binary language (knit or do not knit). In most cases a combination of these two ways, mechanical and digital, is used. To enable the circular knitting machine to knit a double structure with a non-knitting filling material, several adjustments was made on the machine. The adjustments concerned increasing the distance between the two needle beds and lowering the knitting systems thread guides to allow the filling material to be lead into the textile structure without interfering with the needles. The loop size and the yarn speed were adjusted individually depending on the task of the knitting system.

### Knitting the Composite
Three different patterns were created to experiment with the placement of the interconnecting knitting loops. The patterns were computer drawn. The machine relates to the pattern by reading one pixel as one needle movement.

Depending on the dimension of the knitting loop the pattern has to be adjusted in order to have the right pattern dimensions of the knitted material. The loop measurements can not be foreseen exactly before the structure is knit, so measurements of the loop dimensions were made on the first finished textile (after heat-treatment). As seen on the picture (fig. 3) the patterns include areas where nearly every loop interconnects the textile layers, opposed to areas which do not include any interconnecting loops. Neither one of these scenarios was optimal. The areas that caused the least amount of problems while knitting were areas where the courses either had or did not have interconnecting loops exceeding five to ten loops without interruption. This is due to the incorporation of the non-knitting filling yarn.

Depending on the number of needles that go up into knitting position, the filling yarn is left without guidance from the needle. If many needles in a row go up, or stay down, both scenarios influence the stability of the filling yarn, risking the filling yarn to intertangle with the needles. Ideally every other needle should go up into knitting position and thus keep the filling yarn on track. On the other hand, to have many binding points in a row on a wale creates no problem since the different binding points in a wale are created separately by different knitting systems.

This ended up in a final pattern with no more than five interconnecting loops or five loops not interconnecting in a row (course). The pattern of interconnecting loops is large on the upperside of the footwear layer to enable high insulating capacity. The pattern was scaled down on the sole of the footwear layer to achieve higher stability (fig. 3). The attempt to optimize processes and minimize misunderstandings between production stations lead to the idea of incorporating as much information into the pattern and the knitting process, as possible. Therefore the pattern was designed to have lines, visualised by interconnecting loops, as a guidance to the later process stage of cutting.



Fig 3: Two sizes of the pattern

### Achieving the Air Encapsulation
To enable the composite to contract in width and expand in height, a yarn with the ability to contract must be incorporated into the composite. The idea here is to take advantage of the shrinkage property, which most often is regarded as unwanted. Three materials were tested regarding their ability to contract the composite.

The materials were incorporated into the structure in the knitting process and constituted 50% of the back layer of the composite. The materials tested were Lycra/Elastan, wool (40/2) and Pemotex (Pemotex undyed, Jet tex dull CS. 400F120×1). Pemotex is a variant of Trevira flame-retardant textured filament polyester yarns. It is a bicomponent yarn with a low melt component that results in a stiffening of the textile surface at the finishing stage.

The aim of the experiment was to see which material that would add the most to the composite's thermal insulation and at the same time stabilise the composite. Lycra is knitted into the structure in an elongated state. When it relaxes from the tension, it pulls the surrounding structure together. The wool is knitted into the structure, and its corresponding composite is subjected to heat. When the wool shrinks, this will contract the composite. Pemotex is also knitted into the structure and since it is a heat sensitive bi-component yarn, it will shrink when the temperature reaches beyond the temperature at which it has been fixated (in the expanded state). Thereby it pulls together the rest of the structure in width, and since the composite has no physical restrictions in height, it will expand in that direction, resulting in a thickening of the composite.

### After-treatment

Application of heat can be done in different ways, here we used two methods. Experiments were made to evaluate the difference between a) applying heat through puffing steam from an iron set at 200°, and b) with heat application by standardised household washing, at 60° followed by hang drying. Washing thus includes both heat, water and mechanical processing.
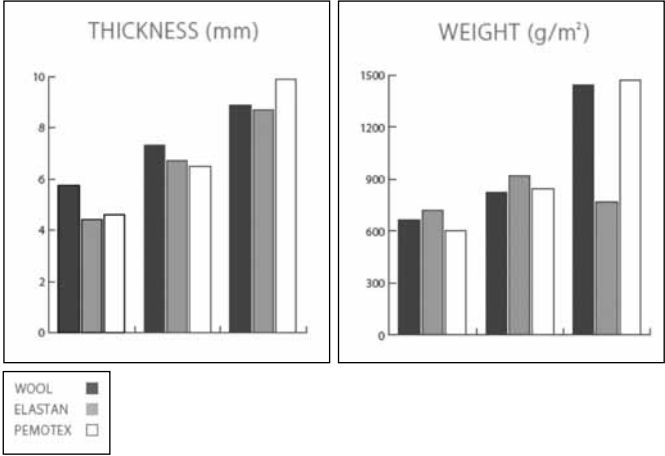


Fig 4: Results from measurements of the composite's thickness and weight per square meter after its been subjected to three different after-treatments; A: before after-treatment, B: after-treatment steam, C: after-treatment washing.

The result of the experiments (fig 4) indicates that the washing treatment resulted in the highest degree of contraction in width and the best expansion (fig 5, fig 6) in height. Of the three materials Pemotex has the most significant properties in this respect, increasing in height by approximately 100%. Consequently the thermal insulation capacity was doubled.



Fig 5a: Thermally insulating composite from above. before heat treatment.
Fig 5b: Thermally insulating composite from above. after heat treatment



Fig 6: Cross-section of the composite, before (above) and after (underneath) heat-treatment.

### Cutting and Assembling

The raw material from the knitting machine was cut along the pattern, which is formed by the interconnecting knitting loops. The tight position of the interconnecting knitting loops allowed for the material to be divided without exposing the filling material. Appropriate for this product would be to punch out the pattern parts with a continuous and heated punching-machine. Since all the fibres used in the footwear system are synthetic, the heat from the punch-machine would melt the edges, forming a closed textile edge. This would be desirable in the assembling process, avoiding the filling material from the composite to entangle and cause problems in the assembling process.

Two methods of assembling the footwear were tested; before and after the heat treatment. Finally the former was chosen, since it resulted in a more satisfying shape. The product is shown in fig 7.



Fig 7: The final prototype of the thermally insulating layer included in the footwear concept.

### Conclusions

The *tangible result* of the project is a three layered footwear concept, of which the thermally insulating middle layer was developed and produced on a circular knitting machine. The subdivision of the footwear into three separate and detachable functional layers enables it to meet the requirements of thermal *comfort*. To achieve and maintain thermophysiological comfort the footwear system needs to be convertible, to suit and shifting weather conditions and levels of activity. Adopting the idea of the three layer principle, the footwear concept uses the technique of adding and excluding functional units, and thereby fulfils the requirements of *flexibility*. In line with the *sustainability* requirement the footwear's 3D shape (pattern) is designed to utilise the material effectively in cutting, minimizing the amount

of waste and optimizing the production process. Since the pattern of the footwear is visible as a knitted pattern on the textile, the pattern for cutting is an integrated part of the fabric, which makes the cutting process easier. All units of the footwear system origin from the same pattern. High *availability* is achieved by the possibility to mass-produce the 3D shape on a circular knitting machine. This is an example of a frequently occurring machine within the textile industry. By this an example of rethinking what kind of product that can be produced on a certain machine or in a certain plant is given.

Since the material for the middle layer was developed to expand in height after the production process, the technique enables production of thicker materials than what is actually possible to produce on the knitting machine used in this project.

The *cognitive result* of the project is that it has been shown that existing production equipment can be re-used for new products, reaching new markets. By this, machinery can be given prolonged life time in a plant, avoiding the need for environmentally impacting investments. The concept of re-using is expanded not only to embrace physical objects and materials but (industrial) processes. We emphasize the importance of design in realizing sustainability. The immaterial design phase has large consequences for the material usage.

In total we have given one concrete example for the company on how to earn both a higher sustainability profile for itself and win environmental benefits for the world by not buying another machine for mass-production of the same thing.

Naturally what we have presented is just one example using the philosophy of rethinking both choice of technology for a certain product and what is possible to do with a given assembly of machinery. The hope is that it will inspire further endeavour along these lines.

### Acknowledgement

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Daniel Larsson, recently finished his BA degree in Fashion Design at the Swedish School of Textiles, where he investigated sustainable functions for workwear in his BA thesis.

All images belong to the author

# Ideas for Another Workwear

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**Abstract**
Earth's current state demands new perspectives in many fields; political, private, global and local. This article examines sustainable functions within workwear and fashion. A design process is argued to be developed within a sustainable frame concerning the whole chain of ecological, sociocultural and economical factors. The two construction traditions of a. *tailored*: pattern pieces constructed next to the body, and b. *empty space*: simplified construction using squares and space between body and garment, are investigated and contrasted in order to find elements of sustainability within aesthetic. The article argues for a greater view upon what could be sustainable aesthetic, in forms and values. This is related to a construction of clothes which allows movement and durability. A proposal is finally given which contains three various shapes and constructions for workwear trousers.

**Keywords:** workwear, sustainability, aesthetic, ecological age, construction, Wabi-Sabi.

In the *Brunel Lecture Series*, Peter Head (2011) states that by the year of 2050 everyone of us will have 1,44 hectare land to be supported from. The ecological footprint today in Sweden is 5,9 hectare per capita (Globalis 2012). These two facts demands the need of a change. But what change? We need to be more efficient in govern natural capital, producing more with less and consume better and less (WWF 2012).

We need a culture shift. Not just an easy adaptation from *conventional* to *organic* which we often seems to be willing to do when possible: we still drive cars but biofueled, we climate compensate when travelling by air plane, and we have the possibility to buy organic cotton t-shirts very cheap today, as an example an organic top costs only 10 Euro in H&M:s spring collection 2012 (H&M 2012). As already stated, we can't keep up with our current consumption, organic or conventional, since we already today uses the resources of 1,5 planet and will use 2 planets by the year of 2030 if things won't change to the better (WWF 2012). Thus, a culture shift could be seen as a needed movement into an *ecological age*, which is different from both the industrial as the former agricultural. A culture where 80-100% of all products need to be sustainably sourced (Head 2011), which argues for new ideas and proposals in every field there is: political, private, global, local and of course, one of many, in fashion.

## The Great Hunt for Function
The function of cloth could be seen as manifold; primarily the practical - the shelter-, secondarily the aesthetic and the social. These functions seems often to be put aside in benefit for the market, a channel for buyer demands and opportunities for sellers to fulfil these demands. The sellers on the market, brands, create new demands or shift them towards their own products trough branding and advertising (Klein 2001). This could be seen as a shift in function: where clothes are more and more seen as business

rather than the original functions as practical, aesthetic and social. The current trend of fast fashion is a clear example of meeting the demands of the customer, while at the same time creating these demands, where "the goods have a short-life cycle measured in months or even weeks" (Larsson, Ogheden 2009). All these functions have to be considered when speaking in terms of sustainability, and that's why only, for example, a conversion to organic cotton in production won't make a garment sustainable if there is a lack of sustainability in the rest of the chain. If sustainability is seen as a framework, different functions are co-working in a hierarchic order, dependent upon and subordinated each other. For instance, as argued in fig 1, the ecological functions are superior to the sociocultural functions which are superior to the economical functions. An economical system is not sustainable if it depletes ecological resources.
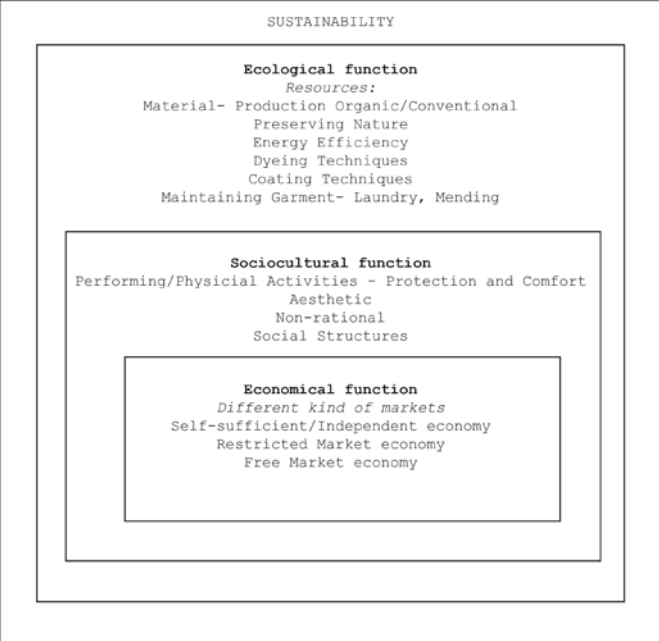


Fig 1: Proposal for a ustainable frame work.

All clothes have, more or less, a practical function but as long as our private stocks of clothes are more a result of a business function rather than functions we have a essential need for, considering different occasions of social and performing activities and continually maintaining the garments, one will easily question the practical functional of a garment.

Workwear on the other hand is primarily invented and developed for a practical function: protection, comfort and adjustments

to a certain job. Therefore one could argue that workwear has a practical function which is sustainable, which also makes it interesting as a subject to examine. There is a possibility to include several functions within the process to reach a greater view upon the sustainability issue; which concerns ecological, economical and social functions. Or to put it as Benedict (1700): "Therefore the brethren ought to be employed in manual labour at certain times, at others, in devout reading".

## Sustainable Aesthetic?

All artefacts has an aesthetic function which needs to be considered, where the practical function by itself is not enough from a holistic viewpoint. Nature is a good example containing both a practical and an aesthetic function. The knowledge of rationale and non-rationale is merged together within the experience of nature. So, if the aesthetic is important and needs to be considered, how will aesthetic be sustainable? I argue that the key is to add values that is sustainable within the aesthetic frame. A great example is the Japanese aesthetic tradition of Wabi-Sabi, often described as the aesthetic of the imperfect (Fridh 2004).

*Wabi really means 'poverty' or negatively, 'not to be in the fashionable society of the time'. To be poor, that is, not to be dependent on things wordly- wealth, power and reputation- and yet to feel inwardly the presence of something of the highest value, above time and social position, this is what essentially constitutes wabi.* (Suzuki 1993)

Another example of the aesthetic of Wabi-Sabi is the conception of cleanliness which do differs from a traditional western view. In the novel, In praise of shadows, Tanizaki Junichiro states that it's something unsanitary about Japanese aesthetic (2001), which marks a distinction between what is bacterially unclean and what is only unclean to the eye, a distinction we westerners often tends to miss out.

To discuss these conceptions is of great importance, since the greatest energy costs of a garment is found within the period of consumer use. The carbon footprint of a load of laundry, washed at 60 degrees and dried in a combined washer-dryer is 3,3 kg CO2 (Berners-Lee, Clark 2010). An outcome of our Western view upon aesthetic, and in this case our conception that very white equals clean, is the optical brightening agents, which do not add anything for the *real* cleanliness of the garments but create an optical illusion. It's not really known whether these agents are harmful for the environment, but we do know that they are very difficult to bio-degrade and that substances of the agents have been found in the seas. It's a game with nature

where we don't really know the outcome for the benefit of our aesthetic values. Fig 2.



Fig 2: 2012/01/08 White cotton shirt, b 2012/05/08 Same white cotton shirt worn every day for four months without washing. The shirt could be seen as dirty, but also as naturally dyed.

A possible outcome when admitting that our pursuit of beauty is vanity and non-sustainable is to simply reject the aesthetic values and create artefacts which only has a practical function. I argue that this will be a dead creation and therefore not sustainable. A greater option would be to shift our conception of beauty to values that fit better with a shift towards an ecological age. Fridh (2004) describes an alternative, rooted in the Zen tradition of Japan, named *the fundamental subject*, which is: Asymmetry, Simplicity, Naturalness, Subtle profundity, Freedom from being attached to anything and Stillness. Adding these values in the research of aesthetic could bring new inputs in the sustainable field. An old example is the *boro*-tradition found in Japan, a mix between the aesthetic of wabi-sabi and the conditions of simple-living farmers. Patched and sown together pieces of home-spun hemp and rags of cotton is the foundation that shaped the outcome of these garments, an aesthetic built on necessities and close attachment to the earth.

## Material

To achieve the values of wabi-sabi the choice of material is of greatest importance. The material needs to be able to tell a story, where usage and time is two factors that will purify the aesthetic. Also the source needs to be consistent with the values, hence two good alternatives are organically sourced raw nature fibres and different types of second-hand materials. The subject nature fibres is very broad and won't be discussed here, still it's good to point out the possibilities of hemp, nettle and flax, all bast fibres possible to grow in Europe and without pesticides.

As for second-hand fabrics the field is open; industrial waste, military surplus or end of the consumer line: it is often about to find a solution that fit that certain place and the possibilities nearby. The material is left-overs from former kind of usage and is always dependent on a first-hand use which requires the second-hand sourcing to be flexible and the production to be a smaller scale. The quality and quantity will vary but these circumstances will form the products; a designing dependent on necessities which could be seen as Wabi-Sabi.

## Different Spaces upon Body



Fig 3: Aesthetic for movement: Tailored and fit.

In order to develop an aesthetic with sustainable values it is good to understand the practical functions of the garment. This knowledge could lead to greater possibilities within the aesthetic.

The foundation of Western aesthetic in clothes is a constructed design method where the relation between the body and the garment could be described as tailored. Pattern pieces are often constructed to follow the body in an upright standing position, where extra fabric is cut away. Here the cloth could easily be seen as a tool, a resource to create a garment, and not containing great values just by itself, which could be compared to traditions where every bit of the cloth is precious and therefore cuts are avoided as much as possible. The outcome of the latter way of making garments often results in an aesthetic, which can be described as *empty space* or *negative space*, were the space between the garment and the body is a vital part of the aesthetic.



Fig 4: Aesthetic: Empty Space



Fig 5: Aesthetic: Fit

To argue for sustainability in one shape rather than the other might tend to be a non-rational discussion, which indeed is an important aspect. Perhaps we can't reason for an sustainable aesthetic with words, it might be beyond us, which is not the same as not important to examine, or rather, experience.

**Construction for Movement**

As argued above, in order to create a sustainable design process all functions has to work together in a sustainable way. Thus, the function of aesthetic has to correspond with the other funtions, which in workwear primarily is the practical. The garment is expected to handle tougher conditions and not tear apart.

This is often solved material wise, an example is the Swedish workwear company Blåkläder, which uses Cordura® fabric as reinforcment at selected areas where tearing often occurs (Blaklader 2012). What many manufacturers are missing is the availability of movement within the garment. When a garment doesn't follow the movement of the body the fabric will be stressed which will decrease the durability. This issue is often examined and worked through when stressing the fabric while bending the knee, as shown in Fig 6.
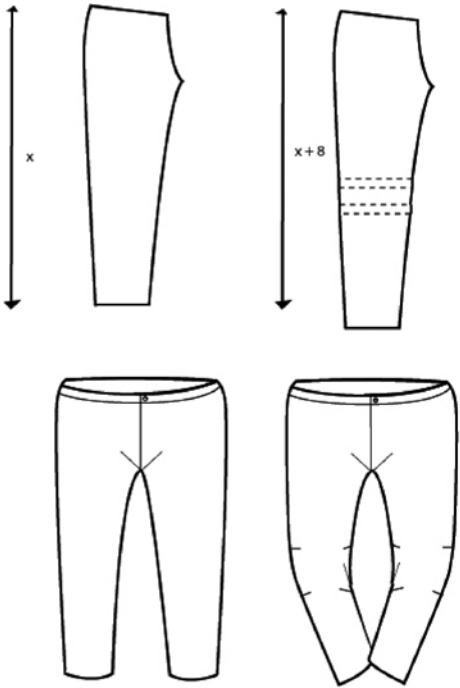


Fig 6: Improvement of knee movement in construction

Theoretically this can be explained that the body has several points which can be stretched when moving and bending parts of the body. When bending the knee the length of the knee will increase which a pair of trousers often doesn't consider. For great freedom of movement the trousers has to consider all these factors in order to prevent tearing.

Trousers often tends to have a restriction of movement when, as in Fig 7 stretching the length of the measurement z, where the width between the thighs is to short. This can be solved with extra width as described in Fig 8.
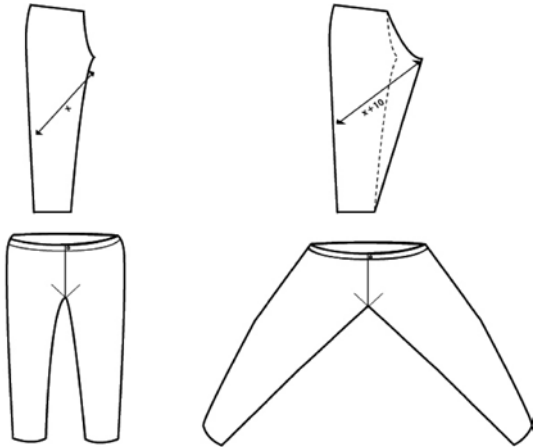


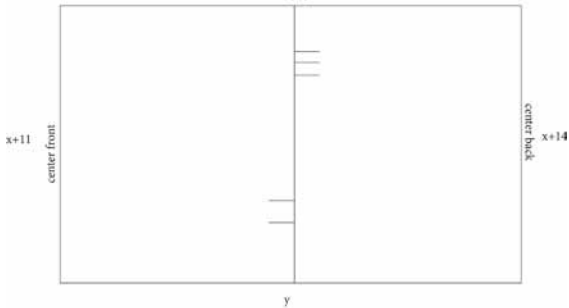Fig 7: Improvement of movement in construction



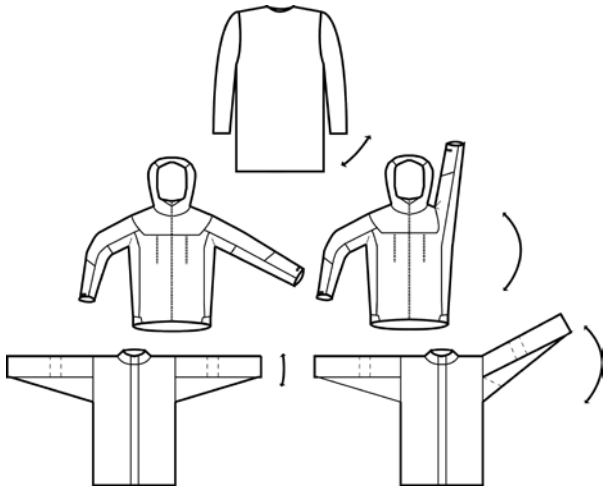Fig 8: The required measurements for movement in 2d construction.



Fig 9: Different traditions of construction for jacket, where freedom of movement of arm is examined and visualized. From top-left: a. Tailored, b. Tailored/Empty Space, c. Empty Space, d. Empty Space with added gusset.

Another interesting point is the constructions of a sleeve, which tends to differ in traditions. The western tradition of the suit jacket sleeve, entitled as *tailored*, gives the wearer a proper look but is at the same time not really paying attention to freedom of movement. It's made for keeping your arms downwards to the body and not for movements upwards. This could be compared to the construction shown in Fig 9, where the standard position of the arm is straight out from the body, which gives availability of movement both downwards and upwards. The outdoor clothing company Arc'teryx is paying attention to this when as a foundation in their construction method of a sleeve considering the latter of the two traditions of construction. Their jackets could be seen as a synthesis between the *tailored* tradition and the *empty space* tradition. *Tailored* gives lighter garments while *empty space* gives more air and space, which is an important aspect for the durability and maintaining of the garment; as for example the need to wash because of sweat occurred when the garment has been lying to tight next to the skin might decrease. These issues is often tried to be solved material wise with breathable fabric, still that is only one solution and a diversity of solutions is to be seen as good, especially when breathable fabrics often tends to made out from oil and environmentally uncertain coatings, such as GORE-TEX® (Sveriges Natur 2006).

**Proposals for Trousers**
When the measured needs for movement is considered, the actual shape of the garment could be anything and everything: empty space, fit, trousers or skirt. This leads to an freedom of aesthetic which could be emphasized with previous argumentation of sustainable aesthetic. The role model nature does always fit form to function (Benyus 1998), still nature could claim to possess characteristics such as beauty. It challenges our perception of the term workwear. Perhaps workwear could and should be described as a garment with a sustainable practical function, developed for a special physical activity; whether it is a skirt or trousers doesn't matter just as the volume of the garment could heavily differ. When the choice of material and the construction works together with the aesthetic in a sustainable framework it is possible to give a nuanced perspective upon the current issues of sustainability. Fig 10, 11 and 12 is to been seen as proposal to what this could be. It's a skirt, and two different pairs of trousers.

The skirt, Fig 10, is made of organic hemp, constructed as a square considering different kind of movements. A waist belt is adjusting the size making the garment an one-size. It could be emphasized as an empty space garment with a very simple construction, still fully functional as workwear, yet not an ordinary one.

The trousers in Fig 11 is a translation of common western workwear trousers, yet constructed for greater movement availabilities when walking/running and bending down. The material is sourced from military surplus towels and dip dyed in Indigo. Besides the environmentally friendly aspect of using second hand cloth, it also adds a history to the garment and a uniqueness only possible to achieve when using and maintaining the cloth for a long time.

The last trousers, Fig 12, is a blend between the empty space aesthetic and the tailored. The construction for movement is a fusion between western ideas of construction, as darts and smart pattern pieces, and the idea of empty space, using the advantage of great space in the garment. The trousers are coated with bee wax and candle left-overs, as a sustainable option in order to make the garment more tear-, rain- and wind-proof.


Fig 10: Proposal for workwear: Skirt


Fig 11: Proposal for workwear: Trousers

Fig 12: Proposal for workwear: Trousers

## Conclusion

These proposals are to be seen as one of many alternatives to cover a holistic sustainable view. These ideas must be discussed not only in workwear but for fashion as well. I find it is fully possible to work with these questions from smaller companies to larger, even though locally linked and more hand-crafted ideas could be easier to implement. A good example is the idea of slow fashion, where the ideas expressed in this article could be implemented. What is important and now, is the strive for a culture shift.

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# Proactive Fashion Design for Sustainable Consumption

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**Abstract**
This article presents a study that investigates product satisfaction in the context of clothing. The paper furthermore presents suggestions on how this knowledge can be used to create proactive fashion design for sustainable consumption. One of the main challenges in today's consumer society is how to design products that encourage consumers to engage in more environmentally responsible behaviour, sustainable consumption. This paper opens the discussion on how to change current unsustainable consumption behaviour related to clothing through a visionary, far-sighted design approach. Designers can create future-oriented sustainable designs that can transform consumption patterns towards more sustainable ones. Design for sustainability can thus be a redirective practice that aims for sustainable consumption, and the ways in which fashion design can be a proactive process with this aim will be described. This article shows why emotional satisfaction and enhancing a product's quality and other intrinsic characteristics are most important when attempting to extend the product's lifetime. Furthermore, this paper shows that services can create an opportunity to extend the enjoyable use of a product and offer satisfaction to consumers in a sustainable manner.

**Keywords**: proactive design, sustainable design, sustainable consumption, emotional satisfaction, PSS.

**Introduction**
Products configure consumer needs and use patterns; hence, design can be said to be "practice-oriented", creating certain everyday practices and consumption behaviour (Shove et al. 2007, 134–136). Current industrial design and mass-manufacturing systems stimulate consumerism and the production of disposable products (Walker 2007, 51). Fast changing trends lead to consumers' unsustainable consumption behaviour. To create a new, sustainable balance between design, manufacturing and consumption, alternative ways to create products are required to drive more sustainable consumption behaviour. Therefore, designers should evaluate how each design decision affects a consumer's consumption patterns. Understood in this way, sustainable design can be a redirective or a proactive practice that aims for sustainable practices in consumption (Fry 2009, 53).

Higher production volumes and simultaneous growing consumption have caused an increase in material consumption (Throne-Holst et al. 2007). Ever-changing fashion trends, affordable product prices and low-quality products cause consumers to engage in unsustainable consumption behaviour, such as impulse purchases, overconsumption, short use time and premature disposal of products. The increase in the purchase

of short-lifespan products results in a notable increase in waste. Currently, approximately 70 percent of disposed clothing and textiles end up in landfills, and in many Western countries clothing and textile waste is estimated to be the fastest growing waste stream (Fletcher 2008, 98). Consumers discard garments not only because they are worn out but also because they actively seek novelty. Nevertheless, product durability and long-term use are prerequisites for sustainable consumption: i.e. extending the life span of products is essential when the goal is sustainable consumption (Cooper 2005). Importantly, however, consumers associate durability with high quality and not with environmental impact.

Emotions lie at the centre of human life, and they influence most of our behaviours, motivations and thought processes (Desmet 2009, 379). Emotions also play a strong role in consumption. The interplay between wants, needs, values, attitudes and experiences is emotionally meaningful for a contemporary consumer. Clothing and fashion items belong to the category of self-expressive products, and with such products, consumption-related emotions are important to the consumer. As Richins (2009) argued, these consumption emotions are important elements in contemporary society and especially after the purchase event. The purchase situation becomes a strong positive experience for a consumer, but it is very short term in nature and has no connection to the experience of deeper satisfaction or person–product attachment (ibid). Through a new purchase event, the consumer can again experience excitement, enjoyment, joy and pleasure, at least momentarily.

From an environmental point of view, studying consumption patterns and the meanings of consumption is important when sustained positive emotions in person–product relationships are desired or solutions are sought to replace materialistic consumption with other positive emotional states. The design process should focus on sustainable consumer satisfaction with a product or with the person–product attachment process. Moreover, a new kind of product service system (PSS) should be developed that aims to prolong the enjoyable use time of the product. A PSS strategy can also offer the consumer new emotional experiences, which can postpone the disposal of the product; PSS thinking can thereby aim to avoid a new garment purchase, which is an opportunity to decrease materialistic consumption.

This article presents a study on sustainable clothing satisfaction and how designers can include those elements and attributes in clothing design that can offer the consumer emotional satisfaction and extend the use time of the garment. The paper is based on three consumer questionnaires conducted in Finland. The questionnaires have provided data and information on person-product attachments and product satisfaction in the field of clothing. Furthermore there are certain attributes that cause people to use clothing for longer or shorter durations, and these attributes were explored in these questionnaires. This knowledge functions as the basis for constructing a theoretical discussion on opportunities to create proactive fashion design. This article deepens the knowledge produced for the author's doctoral dissertation (Niinimäki 2011), contributing to the design field by defining proactive fashion design for sustainable consumption.

The paper begins by presenting the satisfaction process in the field of clothing. It also identifies attributes of clothing satisfaction. The article then presents ways to use these elements in the design process and subsequently describes how a PSS approach can offer new experiences and emotional satisfaction to the consumer in a more sustainable way. In fact PSS strategies can postpone product disposal by extending the enjoyable use time of the product or by offering new experiences to the consumer, and PSS can thereby postpone the product's psychological obsolescence.

### Research Design
This study concentrates on the consumer perspective and is constructed on the basis of three online questionnaires. The study employs qualitative research methods, and information collected through open questions has been content analyzed. Questionnaire A was conducted in April 2009 in Finland. The link to the questionnaire was disseminated among design students at Helsinki Metropolia University of Applied Sciences and the University of Lapland. Furthermore the link was available to staff at the University of Art and Design Helsinki and on the following websites: Fashion Finland, Eettinen Kuluttaja (Ethical Consumer), Vihreät Vaatteet (Green Clothes), and Kierrätystehdas (Recycling Factory). A total of 246 respondents participated in this question-naire. The vast majority, 91.8 %, of the respondents was women and 8.2% were men. The majority of respondents were fairly young: 38.4 % being 18 to 25 years old, and 41.6% between 26 to 35 years old. It can be concluded that the young female standpoint dominates the responses in this data. Open questions addressed the consumers' attachments to garments, i.e. person-product attachment. This information formed a basis for better understanding person-product relationships, and it was further used for Table 2 in defining elements for proactive sustainable fashion design.

The second data collection was conducted in March 2010. This questionnaire B was based on a 'snowball sampling' method with 204 respondents. The link to the questionnaire was randomly sent to about 30 people who were then asked to further disse-minate the link to their acquaintances. The aim was to reach different consumers from the first questionnaire. As there was a preconception that the first data mainly concerned young, ethically interested female respondents, the second survey also targeted male respondents and respondents without ethical interest. In this second data set most of the respondents belonged to the age group under 35 years old (29.4% were 18–25 years old and 48.5% were 26–35 years old), and 70.4 % of the respondents were women.

Questionnaire C, in March 2010, was a random sample (simple random sample) sent to 500 respondents selected to represent the Finnish population: female and male respondents, different age groups between 18 to 64 years old, and geographically from all of Finland (selection from the population register system, Population Register Centre). For this questionnaire 137 answers were returned, a reply rate of 27%. Despite the low reply rate for questionnaire C, the respondents represented rather equally male (42.9%) and female (57.1%). Furthermore the respondents represented rather equally 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.

In questionnaires B and C the attributes leading to satisfaction were explored through open questions. Moreover specific information on which attributes lead to short-term use of garments and dissatisfaction was collected and analyzed. This consumer-centered knowledge has functioned as a basis for better understanding emotional satisfaction in the field of clothing, as described in the following section, as well as contributing to Tables 1 and 2.

### Sustainable Satisfaction with Clothing
If current unsustainable consumption patterns are to be trans-formed into more sustainable ones, the ways in which design can offer sustainable satisfaction must be investigated. To gain a deeper understanding of the opportunities to deliver satisfaction by design and how the enjoyable use of garments can be extended, the satisfaction process must first be explained.

Consumer satisfaction is based on the size and direction of consumers' disconfirmation experience. Consumers have certain expectations of product performance related to being satisfied, and dissatisfaction results when the product performs worse than expected (i.e. disconfirmation) (Churchill & Surprenant 1982; Oliver 1980). Consumers' product expectations therefore create a frame of reference against which they judge products (Oliver 1980).

The level of satisfaction is determined by attributes connected to different use situations and the products' symbolic meanings. For example, garments in an official work environment must meet certain expectations regarding social acceptance and social codes in the expression of professional status. In the home environment, clothing provides a relaxed and soft, tactile feeling, and this experience symbolises security. With sports clothing, important aspects are functionality in action and durability in heavy use. Moreover, a consumer's own personal factors influence the evaluation frame of reference and the satisfaction attributes important to each consumer (Niinimäki 2011).

According to Swan and Combs (1976), the performance of clothing can be separated into instrumental performance (physical properties) and expressive performance. Expressive performance is linked to a consumer's psychological response to the garment, such as the experience of beauty. Instrumental requirements (e.g. quality expectations) must be satisfied first. Nevertheless, only fulfilling instrumental requirements will not result in satisfaction. Therefore clothing must also meet con-sumers' emotional needs if it is to deliver satisfaction (Swan and Combs 1976).

The set of attributes through which consumers evaluate products is limited and therefore possible to define. Some attributes are determinants leading to satisfaction whereas other attributes are related to dissatisfaction. A good performance according to attributes important to the consumer is the best route to ensuring product satisfaction. (Swan & Combs 1976.)

Satisfaction with clothing is fundamentally connected to clothing quality. Often consumers take the quality and durability of clothing as self-evident, and when asked about these issues in questionnaires, they point out that appearance is more important than durability for clothing satisfaction (Swan & Combs 1976). Nonetheless, the clothing must first meet expectations regarding physical properties and experienced quality (quality experienced in the use situation) before it can satisfy the consumer's emotional needs (emotional satisfaction).

According to questionnaires B and C low garment quality causes dissatisfaction among consumers and, accordingly, low quality is

connected to the short-term use of clothing. The first laundering is critical in experienced quality, because garments can become stretched or the colour may fade during laundering. Low-quality garments may not be usable after the first wash because they lose fit, size or colour, or the material simply looks old after laundering. Low quality also results in garments coming apart before or during the first laundering. Low durability and, in particular, weak maintenance quality are key determinants for the short-term use of clothing. (Niinimäki 2011)

Hence good intrinsic quality is optimal for ensuring consumer satisfaction and to guarantee the longevity of clothing. High quality means durable materials and high manufacturing quality. The ageing process of a pleasant, aesthetic garment requires not only maintaining high intrinsic quality but also the design of a more classical style and use of durable materials. Some textile materials look old after a short use time. The material might experience pilling or may look old after a few washes. Garments needing frequent washing may look old rather quickly; therefore, recognising materials that age in a more aesthetically pleasing manner is important. Studies have shown (Niinimäki 2010) that consumers experience e.g. wool and real leather to age in an aesthetically pleasant way. Consumers report that with high quality wool the ageing process does not show as obviously and in leather the ageing process is experienced as an attractive temporal dimension (ibid.).

Consumers respect aesthetic attributes in the long-term use of clothing, and aesthetic attributes correspond to expressive performance in clothing satisfaction. Accordingly, expressive performance affects the psychological response to clothing. The aesthetic attributes that correlate to the longevity of clothing are good fit, personal cut, nice colours and comfortable materials,as well as a classic look (see Table 1). Garment tactility is important to the wearer and a pleasant tactile experience during the use situation is one attribute for enjoyable long-term use of clothing. Garments stay in use for the long term not only because of a classical look but also because of a certain beautiful colour or a special style. In these situations, expressive performance (expressive beauty) is above average, resulting in satisfaction and postponement of garment disposal. (Niinimäki 2011.)

| The attributes that enable longevity in clothing are the following: | |
|---|---|
| Quality: | Durable materials<br>Durability in use<br>Durability in laundering<br>High manufacturing quality |
| Functionality: | Easy maintenance<br>Suitability in the use situation<br>(physiological and psychological suitability)<br>Satisfying use experience |
| Aesthetic attributes: | Beauty, style, colour, fit<br>Expressive beauty above average<br>Tactile experience<br>Comfortable materials |
| Values: | Product's values have to meet consumer's personal values |

Table I: Attributes that enable longevity in clothing

Not only quality, functionality and aesthetics are important attributes; the values behind the product are also important to consumer satisfaction. Clothing choices must connect strongly with the wearer's self-image, identity and values. Wang and Wallendorf (2006) have argued that consumers with high materialistic values seek novelty and evaluate their possessions more often than consumers with lower materialistic values. They also highlight that materialistic consumers have less appreciation for deeper person–product relationships that develop during longer use situations. Consumers' materialistic values may also connect with social status-related elements in garments and possessions. Consumers with lower materialistic values may have greater appreciation for the personal meanings attributable to the product that emerge during long-term use (Wang & Wallendorf 2006). Consumers with high environmental and ethical interests place high importance on being able to find environmental value behind a product. These consumers respect credence quality attributes – local and ethical production, eco-materials and long garment life spans – and they want to see these attributes and environmental values in the products they purchase. The value aspect is most important and consumers' value expectations should be fulfilled to create deep product satisfaction (Niinimäki 2011).

## Fashion Design for Sustainable Satisfaction

How can a designer offer sustainable satisfaction to the consumer and how can s/he propose a prolonged use time of the product to the consumer? Firstly identifying the attributes associated with satisfaction and including them in the design is the most important strategy. Secondly identifying the determinants that lead to dissatisfaction helps the designer to avoid these elements in design and concentrate on design for sustainable satisfaction. The previous section described the satisfaction elements in clothing:

  - good intrinsic quality;

  - good functionality;

  - aesthetics;

  - values in the product, in manufacturing or the company's values.

The easiest way to offer product satisfaction is to increase the product's intrinsic quality and inform the consumer accordingly. However the clothing satisfaction process is complex and not easy for a designer to control. Table 2 presents the temporal dimensions in clothing satisfaction, combining those elements and attributes that enable satisfaction to emerge or even create person-product attachments in the field of clothing. These are the elements that a designer should try to embed in design if s/he is aiming for proactive fashion, deep product satisfaction and extended use time of the products.

The following section presents several design approaches to deeper person-product satisfaction in the field of clothing. With these design strategies the designer can aim to achieve proactive and sustainable design.

## Fashion Design with Meaningful Uniqueness

Products carry symbolic meaning, which consumers use to construct their own personality and identity. Consumers use products to express themselves and want association with the characteristics, uniqueness or values symbolised by a product (Norman 2005). If products are easily personalised, the opportunity exists to connect the product more deeply with consumers' identity construction and to create deeper product satisfaction and an emotional attachment through the person–product relationship (Chapman 2009). This opportunity enables the product to be more meaningful to the wearer, making possible an extension of the product's lifetime.

Design services are one opportunity to address consumer satisfaction by deeply connecting the design outcome with a consumer's personal needs. By using digital technologies that enable individual design or measurements, meaningful uniqueness can be designed. Furthermore, unique design and "made-to-measure" services offer improved product satisfaction by meeting a consumer's individual needs and preferences better than mass-manufactured garments. The company NOMO Jeans offers computer-assisted made-to-measure jeans by using a 3D scanner (Nomo Jeans). Jeans are made individually according to each customer's measurements. The customer can also choose the cut, colour, effects and details of his/her jeans.

| PAST | PRESENT | FUTURE |
|---|---|---|
| Meaningful memories | Good functionality | Continuing satisfaction with the product |
| Meaningful associations, which create person-product attachments | Aesthetical dimensions | Product or service fulfils consumer's changing needs |
| | Enjoyable experiences during use | New elements in design |
| | High intrinsic quality | New experiences with the product |
| | Product utility | |
| | Connection to self, identity | |
| | Product meets consumer's personal values | |
| | Wearer's own effort and achievement | |

Table 2: Elements of proactive sustainable fashion design
(based on Niinimäki & Koskinen 2011)

An enterprise can also base its function only on consumer orders. The designer can create their own collections, produce a couple of sample collections and enable consumers to specify all orders and measurements on an individual basis. Garments can then be created based on each wearer's measurements, thus enabling him/her to experience greater satisfaction. This design and manufacturing strategy may also help producers avoid the problem of overproduction. Small enterprises could offer their collections in small shops carrying a sample collection and obtain orders directly from consumers, allowing them to avoid extra production.

Designer Anna Ruohonen creates long lasting and high quality fashion (Anna Ruohonen). She has created a timeless collection called Black Classic, where the designs are permanent but it is possible to order them in seasonal colours. Garments are manufactured only according to customer's order and according to each customer's individual measurements. This strategy helps to avoid overproduction. Moreover the good fit of the clothing helps ensure deeper garment satisfaction.

## Co-creation

One possibility for creating deeper person–product attachment is through a consumer's own efforts during the design or realisation process. A sense of personal achievement is strongly connected to a positive sense of self (Norman 2005) and allows the product to begin to be more important to the wearer. The consumer's own achievement through a "made by me" approach to design creates positive experiences through the sense of effort and the opportunity to realise her/his own creative skills. If the user builds the product herself/himself, s/he acquires a deeper knowledge of the product and, therefore, has the ability to repair the product (Papanek 1995). Kit-based design and halfway products give the consumer a more active role in the realisation process.

One option for including the consumer in the design or manu-facturing process is to offer her/him an opportunity to make decisions during the process. Consumers have shown an interest in taking part in the design or manufacturing process by using the Internet (Niinimäki 2011). If the design is based on a modular structure and the consumer is allowed to make her/his own choices – even from a limited selection – in creating a unique style, this process gives consumers new power and a more active role.

Opening fashion field is one way to offer the consumer more active role. Lastwear is a company that offers ready-made

garments, halfway clothing (kit-based) and patterns of their fashion designs (Lastwear clothing company). They also invest in quality and offer a guarantee on their garments, which is a good way to ensure product satisfaction.

Giving consumers more power is also possible by offering environmentally-related options. Consumers may be allowed to select a manufacturing location and different materials – and be provided with corresponding prices – enabling them to express their values through their choices. For example, many consumers, especially those who consider themselves ethical consumers, would like to buy locally manufactured garments even if they are more expensive (Niinimäki 2011).

### Fulfilling Consumers' Changing Needs Through PSS

The symbolic meanings of products are connected to psycho-logical satisfaction through a emotional response. When the product no longer offers a positive emotional response because, for example, it falls out of fashion or the wearer becomes otherwise tired of it, the consumer experiences psychological obsolescence and easily replaces the product with a new one. Accordingly emotional and psychological obsolescence results in premature disposal of a product that may still be functional.

Consumers' needs and aesthetic preferences that change over time raise the question of how to avoid the psychological obsolescence of garments. The challenge in extending product lifetimes is to achieve continuing satisfaction with the product. The PSS approach allows the creation of new experiences with a product or changes to a product to enable it to better suit a consumer's changing needs.

Positive ways that a product's lifetime can be extended include upgradability services, modification services and exchange stocks. These strategies can postpone garment disposal by keeping the consumer satisfied longer. Modification or redesign possibilities for quality garments allow for an extension of a product's life span. Many websites already advise consumers on how to modify their old garments themselves and encourage consumers to extend the use of their garments. Many small and locally functioning repair and redesign studios also already exist, where the consumer can repair a damaged garment but can also order a redesigned garment made from old ones.

A design based on a modular clothing structure also offers the possibility to create services to upgrade garments. This strategy offers the opportunity to update the appearance in a sustainable way (Fletcher & Grose 2012, 82). It is possible to play with the

clothing elements to create unique combinations of colours or shapes to develop a new look. The consumer does not need to then buy a new garment; instead s/he can simply change some parts or elements in the garment to have the experience of newness.

Garment exchange or renting services offer possibilities for consumers to make changes to their clothing in more sustainable ways. New and interesting examples of clothing membership clubs exist. By paying a monthly membership fee, a consumer can select a certain number of garments to use, giving him or her the opportunity to change the appearance in a more sustainable way. This type of business strategy has emerged e.g. in the field of children's clothing. Consumers can rent children's outfits and when the child outgrows a size, the parent can obtain larger-size garments from the clothing club.

The company Beibamboo offers children's wear made of high quality and environmental friendly bamboo material (Beibamboo). It is a rental service, from where children's wear can be rented and used for as long as it fits the child. The clothing is then simply returned to the company by post and a new order for larger clothes placed. Between each user the clothes are professionally cleaned, disinfected and treated for stains. Combining a renting service with eco-products maximises the environmental benefits of this approach.

High-quality products can be targeted for shared and intensive utilisation, such as for renting and leasing. Products appropriate for renting and long-term use must be made of high quality and durable material, because their producers view them as investments. This approach decreases the total environmental impact of manufacturing and consumption. PSS thinking as such guides manufacturers to consider more profoundly the durability of their products. In a PSS, the consumer purchases functions, product meanings and satisfaction instead of simply products. Accordingly, a PSS approach offers ways to decrease overall clothing consumption by dematerialising the satisfaction of a consumer's wants.

### Global Manufacturing + Local Services

It is possible to combine global material recycling systems with local strategies to extend the use time of the product with a PSS approach. Accordingly closed loop strategies combined with strategies to extend the product use time can result in a new sustainable balance: slower production and consumption cycles. This approach would in fact dematerialize both production as well as consumption. By including local services in the product

design process, it is possible to deepen the product satisfaction through longer use.

One example of this strategy is employed by the company Patagonia. Patagonia not only takes back its own products, old garments to be recycled into new fiber material, but it is also ready to repair damaged ones: consumers can send damaged garments to the factory to be repaired. Furthermore the company co-operates with local tailors, who offer their services to mend the Patagonia garments (Patagonia). Patagonia thereby combines a local strategy to extend the use time of the product and to keep the consumer satisfied with a global closed loop system, and the company is implementing its producer's responsibility voluntarily.

### More Information

To meet consumers' expectations in terms of quality or value, it is most important to provide them with the right information. The values behind the product or the company are important attributes in product satisfaction for quite many consumers. Hence transparency and more information about design solutions and manufacturing processes should be offered to consumers. This information is easily provided via the internet, and many companies already use this possibility.

According to the current study the main reason to dispose of garments is low quality. Quality is nearly impossible to evaluate at the time of making a purchase. Even the price of a product does not obviously correlate with the product's intrinsic quality. Consumers report that they are ready to pay more for higher quality and durability if they could estimate these aspects at the time of purchase (Niinimäki 2011). Producers could offer information not only on quality but also on a product's intended lifetime. Manufacturers could also provide information on how many washes the garment will take and still look good. This information could help consumers quantify a product's quality and allow product prices to be set on the basis of high quality and long product lifetime. In sum, providing consumers with more information better ensures that s/he can identify those values in the product that best meet her/his own value base, and this is more likely to guarantee deep product satisfaction.

### Conclusions

The business thinking in contemporary society is based on products' rapid replacement and extremely effective manufacturing systems. Current industrial systems for designing and manufac-turing garments lead to unsustainable consumption behaviour. Taking into account consumer satisfaction widens our thinking

and offers new possibilities for changing the system. If sustainable development is a goal, it is necessary to find ways to slow consumption through sustainable design.

This study investigated product satisfaction in the context of clothing and this knowledge was used to understand and define proactive fashion design for sustainable consumption. It opened views into the process of consumer satisfaction. A main issue that arises when aiming to extend the life of garments is to increase their durability and intrinsic quality. Moreover, fulfilling consumers' other expectations regarding the garment's aesthetic and functional attributes is important to ensure product satisfaction. Finally the issue of value is most important with regard to deep product satisfaction: values associated with the product, the manufacturing process and behind the companies have to meet the consumers' own value base so that the consumer feels completely satisfied with the product.

By identifying the reasons for the short and long-term use of clothing, it is possible to find new ways to create sustainable designs that can result in a redirective practice directed towards sustainable consumption. Proactive fashion design for sustainable consumption takes these reasons into account, thus enabling clothing longevity. Satisfying consumers' expectations regarding quality, functionality, aesthetics and value is a key to extending the use time of a product. Moreover, the emotional side of consumption must be understood to provide more sustainable ways to ensure customer satisfaction.

The PSS approach provides an opportunity to extend the enjoyable use of a product and thus avoid psychological obsolescence and a garment's premature disposal. Stimulating a sense of meaningful uniqueness and achievement through design services or "self-made" approaches is a promising route to enhancing consumer satisfaction. If a consumer is satisfied, then strengthening the emotional bond between the product and consumer is possible. In turn, this meaningful attachment is the best way to postpone a product's disposal. When the product or its use is somehow special to the consumer, s/he will take good care of it to extend its enjoyable use time.

Service thinking and PSS can also dematerialise consumption by offering new ways to fulfil consumers' emotional needs for change, including concepts such as upgrading, renting, leasing, change stocks or investing in membership clubs. Designers must then focus not only on long-lasting and durable clothing designs but also creating new types of product–service systems to fulfil consumers' changing needs in a more sustainable way.

The most promising sustainable design strategy is the combination of product design with service elements: PSS strategies are therefore a future path to proactive and sustainable design.

Sustainable design can be a redirective or proactive practice that aims for sustainable consumption. We need visionary and far-sighted design approaches, empathic understanding of the consumer and his/her emotional needs, and a new kind of green business thinking to do things differently. Designers can create future-oriented sustainable designs that can transform consumption patterns towards more sustainable ones. This is especially important in the field of clothing and fashion.

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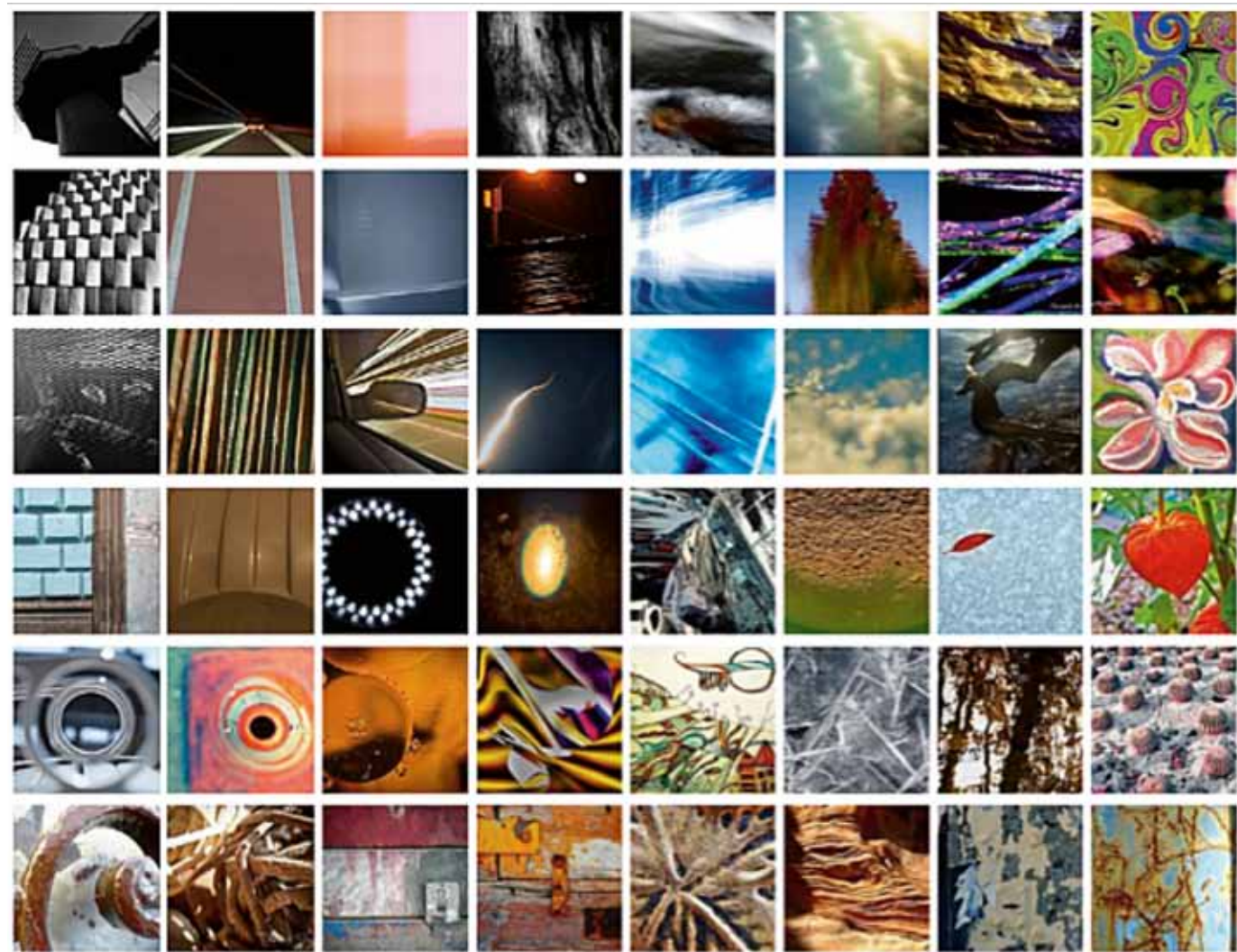
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All images belong to the authors

# HeadCrowd: visual feedback for design

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**Abstract**
HeadCrowd is a collaboration between the School of Mathematical and Computer Sciences and the School of Textiles and Design at Heriot-Watt University. It investigates how rich web and mobile applications may be employed to provide designers with near instantaneous and highly visual feedback from thousands of potential customers, or crowds. We are exploring the use of state of the art rich media applications to add quantity, speed and statistical accuracy to the study of semiotics, and the use of visuals in fashion as communication.

The project seeks to add to participatory design and market intelligence processes by enabling rapid and iterated co-design cycles between crowds and designers based on visual forms of communication so as to mirror the highly visual nature of fashion design inspiration. Such a scheme shows applications for sustainability in fashion if it can give crowds a concrete sense of ownership of the design process and provide enthusiastic target markets, thereby offering potential to significantly reduce the risks of producing unwanted product.

The paper provides an analysis of prior knowledge before describing the first two stages of the project, in which a pilot browser has been constructed that allows observers to navigate a vocabulary of 500 images which have been ordered into 48 similarity stacks using a mixture of human and crowd sourced sorting techniques. A first test involved the presentation of 20 terms to observers and asking them to choose 3 images from the browser to represent each term. Analysis of the resulting pilot data has given insights into the communicative certainty that a selection of 3 images from a vocabulary of 500 can provide for certain types of terms, and amongst certain groups of testers. It has also prompted deeper analysis of the pilot browser.

To put the communicative value of visual feedback to the test, the current research phase is preparing the reverse experiment of asking a fresh cohort of participants to associate images back to the original terms, and various interfaces are currently being constructed to facilitate the presentation of visual choices from phase 1. The similarity relationship between test images is investigated and visualized before a case is made for comparative experiments of raw selection data and versions of visual summaries in this second research phase, in order to test which way of data presentations best convey the intended visual communication.

**Keywords**: visual feedback, rich web applications, participatory design, sustainability

## HeadCrowd: visual feedback for design

HeadCrowd is a collaboration between the School of Mathematical and Computer Sciences and the School of Textiles and Design at Heriot-Watt University. It will employ rich web and mobile applications to provide designers with near instantaneous and highly visual feedback from thousands of potential customers and collaborators, involving them in the development of products that will have added value to them, thus contributing to sustainable design solutions.

Visual prompts for designers are routinely used in commercial forecasting, and individual ambitions in fashion design are encouraged by a growing number of websites promising co-design, and while web 2.0 and similar and subsequent platforms have opened these new possibilities of participation to designers, forecasters and consumers, the semiotics of visual feedback, and the potential challenges and advantages surrounding its use for creative conversation between different stakeholders, has so far been under explored. Using visual feedback and participatory design as a way to ensure less fast and more sustainable fashion therefore needs to be explored to ensure that the technology goes beyond its potential of just another marketing tool in an ever more competitive market, starting with the exploration of current thinking in the areas of co-design, semiology and visual feedback.

### Co-design

In 1980 Toffler posed the term "prosumer" (Toffler 1980) for a consumer who has taken on some responsibilities of work that was previously done for them in the production of a product or service which they simply consumed. Our understanding of Co-design fits well with Toffler's idea as the consumer in Head-Crowd takes on some of the responsibility for the design by influencing its iteration.

Many of Toffler's predictions (made from the trends he had observed up to 1980, pre-Internet) have come true. One particularly pertinent to the Head Crowd project is "De-massification of the Media", which describes how people's interests are fragmenting into groups and their interests are becoming more specialised. This more individualised consumption of media is an aspect of the current trend in social media. It is hoped that the "Crowd" in the Head Crowd project will consist of interest groups who may become aligned with specific designers. Designers may be able to develop a following among the larger crowd which coalesces around their specific designs.

One aspect often mentioned alongside co-design is mass customisation (Piller et al. 2005). Some of today's prosumers are catered to by businesses which offer services allowing individuals to specify their own individual requirements. These requirements are usually limited to a set of options but the levels of customisation can be quite sophisticated with Adidas e.g. allowing individualised specification of sports shoe construction and Lego encouraging a user to create their own Lego set with instructions and box graphics.

In contrast, the system envisioned by the project is one where rather than customisation catering to individual specifications, cycles of co-design are to be facilitated with crowds providing input as reaction to designs proposed by designers.

An example of an existing business gathering the opinions of an internet crowd on clothing designs prior to manufacture is the vintage-style clothing online retailer, ModCloth.com. On "Be the Buyer" (Modcloth.com 2012), garments not yet in production are shown and members of the site, who need not necessarily be customers, can give their opinions to influence whether or not they are, in fact, produced. The opinion can be in the form of positive or negative votes and a comment. The comments are in free text but guided towards several specific areas such as colour and "wearability", with a majority of comments focusing on the former.

It is hoped our proposed system will be taken up by retailers and used to improve on-line promotion of designers and products, generating measurable gains in the marketplace in the short term. However, Sanders & Simons (2009) assert that additional benefits may accrue from co-creation in the form of long term gains in brands and even social gains including improved quality of life and improved ecological sustainability.

A major factor in co-design is the context in which the co-design activity takes place, or the design space. Sanders & Westerlund (2011) describe this as encompassing three aspects: The actual physical space in which the activity happens, the experience and practice of those taking part in the co-design activity along with any current ideas that they are working on, and the domain of all possible solutions to the current design problem. Sanders & Westerlund point out that the first two of these aspects are clearly important in the eventual outcome. In the case of our envisioned system these would equate, in the first case, to the environment provided by the application on terms of communication tools for the designer and the crowd. The second aspect would be some function of the designer and the crowd's previous design or co-design experience and their expectations. Sanders & Westerlund also make the point that consideration should be given to how the co-design activity will be recorded and how that record will be communicated. It is hoped that the record of each co-design process in our proposed system will add value to an associated final product.

### Crowds and Crowd-sourcing

Surowiecki's "The Wisdom of Crowds" (2004), gives many examples to support his thesis that the collective judgment of a crowd is often superior to that of an expert. He does make the proviso that for the crowd to be relied upon it must be diverse, large, and independent. The independence of each member of the crowd is a property to which Surowiecki assigns particular importance. Examples of when crowds have been seen to fail occur when independence breaks down and individual opinions are influenced by a group mentality such as during stock market bubbles.

Indeed in this regard the aims of the Head Crowd project face a tension. A designer may value the "wise" judgement of the crowd and be expecting added value to accrue in any new design based on crowd feedback. However, another hope of the project is that the crowd will fragment into followings for the different designers. If that occurs, and such an individual following begins to form a group mentality, then the "wisdom" of the crowd could be compromised. If this does happen it is hoped that the value added (and purchases made) within the designer's following will outweigh any loss of global value in the finished design due to any degradation in the global crowd's judgement. Indeed it may be sensible for the feedback from the designer's following to be collected and analysed separately from the global crowd. The designer could receive two separate streams of feedback and make design decisions accordingly.

### Semiology and Communication

It can be argued that the work of this project seeks to establish a visual language for fast intuitive visual feedback. In that case a brief examination of some principles of linguistics and semiotics is appropriate.

Semiology is usually taken to be the study of signs and symbols. Chandler (2002) defines semiotics as "…the study… of anything which 'stands for' something else." When the web site summarises hundreds of such visual messages, will what the designer reads in the message truly reflect what the crowd was trying to say?

Saussure, in his theory of language, as described by Culler (1976), argued that, in language, signs are an arbitrary combination of signifier and signified. e.g. there is no natural reason for the word, dog, to signify what we recognise as the furry animal that barks. This raises the prospect of an involved and time-consuming language learning process to be gone through before the users and designers can communicate. However, with the abstract image set it is hoped to capitalise on current visual conventions already within the experience of the crowd and the designers to allow communication both to take place initially and to develop.

The work so far in the project has focussed on using abstract images to capture meaning. We have been unable to find any studies involving transmission of meaning using abstract images. However visual communication is already often done with symbols. Signs without words at airports and on our roads are clear evidence that symbolic visual communication works. Otto Neurath (1936) developed a language of pictures to be used in education. Indeed pictographic languages such Japanese use characters originally derived from stylised drawings. Hebecker & Ebbert (2010) have investigated the development and recognisability of free-drawn symbols in response to stimuli terms using a Pictionary-like online game. A communication channel using established signs or emoticons could be a valid component of a visual feedback system.

### Image Browsing

Heesch (2008) makes the point that with content based image retrieval a user is required to provide a query. The query can be an example image, a sketch. (This is equally so when providing a text query in a system where images are labelled). However, the user may not always know how to formulate their query. They may not have a representative image to hand or may not have adequate skills or tools to sketch one. Equally any keywords they come up with for use in a label-based system may be misleading or too prescriptive. Indeed they may not really know what they are looking for. In these circumstances allowing the user to browse an organised collection of images can allow them to find an image that fits their requirements however vague those requirements were, initially.

Halley (2012) demonstrated that for a large set of monochrome texture images the Self Organising Map (SOM) browser is a good solution and significantly better than two other browsers to which it was compared[1] in terms of time taken for a user to find a given image.

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[1] The two other methods were "Rapid-fire", a method proposed by Wittenburg et al. (1998), and a 3D MDS-based browser, suggested by Rogowitz et al. (1998).

## Visuals to Words

Taking into account what we already know about visual feedback, HeadCrowd considers design feedback capabilities of images in their own right, but uses the written word in experiments to verify what feedback was intended and picked up by giver and recipient of that message respectively. To minimize the predetermination of visual choice, the project uses a large image set, thus allowing for as free a selection as possible, and asks feedback givers to select three out of 500 visuals for each term described.

The first technical phase of the research concentrated on shaping prototype interfaces that allow fast and intuitive navigation of big numbers of visuals to facilitate selection by crowds; this essentially meant developing algorithms and protocols which automate the organization of large rich data sets. Easy navigation of these data sets was key to obtaining results that are relatively unaffected by fatigue, and our current work has made use of research on perceptually relevant image browsing by Halley (2012). That work showed that the Self Organising Map (SOM) browser was more effective than other ways of organising images to allow retrieval of a given image.

## Visuals

In order to arrive at an appropriately large and varied image set, some 1800 images tagged as abstract were screen scraped from Flickr.com account holders who make their images available with a Creative Commons licence. Although only images tagged as "abstract" were used, a large number of miss-tagged images had to be discarded manually as they included images of people, full conventional depictions of objects and writing. Duplicates were excluded by a process of screening the image pixel data, which meant sorting the images by average red, green and blue pixel level and then displaying the images in order side-by-side in screens of multiple images. (One duplicate was found). Images which were very similar in composition to others were eliminated by hand so as to try to prevent a number of similar images occupying spaces in the set thus reducing the breadth of the available image "vocabulary".

## Limitations of Pilot Visual Data Set

A number of difficulties of this modus operandi were identified through analysis of the first pilot selection data: A small number of near duplicates found in the final image highlighted the limitations of the pixel level elimination exercise, and can also be attributed in part to human fatigue when faced with the scale of image selection needed for this experiment (1800 images narrowed down to 500). Furthermore, they indicated to the

team that the number of Flickr accounts (or other appropriate sources) searched for images needed to be greater for future data sets.

Fig 1: Screenshot of image selection for 'smooth'.

An example of near duplicates are the small and big glass apples on the screen in fig 1 which shows the full image selection by 20 observers for the term "smooth"; typical for the appearance of near duplicates in the pilot data, observers here clearly demonstrate their capability of identifying distinct images as similar despite their obvious and stark differences in scale, whereas an automated image sorter working on pixel levels could not. Since they are therefore treated as entirely unrelated images as far as electronic tagging is concerned, their obvious similarity will have to be considered as a limitation when evaluating statistics on frequency of identical image choices.

This observation highlights the demand to use more sophisticated automated image sorting in future experiments.

Another realisation of the pilot data analysis was that a significant number of images made their way into the final 500-strong image set despite not actually following the project's definition of abstract as they show people, full conventional depictions of objects or include writing or accepted symbols.

Fig 2: Screenshot of image selection for 'involvement, interest'.

Again, this deviation from the originally intended selection criteria can partly be explained by human fatigue in the face of having to scrutinise such a large set of relatively small images, but it also calls for a tighter set of criteria for future image sets and further investigation of whether the margin for human error in privately tagged image collection makes them suitable for use in a controlled experiment.

However, while clearly a potential limitation of the current image set's usefulness, we were able to use the existence of these non-abstract images in the pilot study to evaluate the varying efficacy of different image types for certain purposes, and certain groups when communicating visually: Selections for the term "involvement and interest" by the 20 pilot testers (see fig 2) for example demonstrate that descriptive images rather than truly abstract ones are popular when observers are asked to associate images with emotional terms, as opposed to choices for material terms such as "smooth" (fig 1), where instances of semi-figurative images are notably lower. This trend holds firm over all 10 emotional and 10 material terms in the visuals to word pilot.

## Organising the Images into Manageable Interfaces

While HeadCrowd seeks to employ computer technology whenever appropriate, it recognizes earlier research that indicates the importance of a human basis for such an undertaking: The Self organizing Map (SOM) browser, as developed by Halley [2012], is effective because it is based on collected judgements of humans about which images are similar to each other. For a small number of images this can be done by having observers freely group the images into however many similarity groups they wish, and 20 observers organized the first 100 images of this project in this way. Each time a given image is grouped with another given image, that specific pairing of images is given a similarity score of 1 before the score is added up and then divided by the number of opportunities there were for that pairing to have occurred. The resulting similarity matrix for the initial 100 is 100 rows by 100 columns and can be used to categorise the images based on their perceived similarity.

To eliminate the dangers of human fatigue while sorting, this nuclear, human sorted image set was then enlarged to a visual "vocabulary" of the desired size of 500 by a crowd sourcing method devised by Halley [2012] and also employed by Padilla et al [2012]. It presents a "bootstrap" SOM of the 100 hand sorted images to observers sourced through Amazon Mechanical Turk (MTurk) who use this bootstrap SOM to provide similarity judgements on small packets of the further images (termed the augmentation images). Each MTurk observer is shown 20 of the

augmentation images, 1 at a time, and asked to select bootstrap images they judge to be similar to the query image.
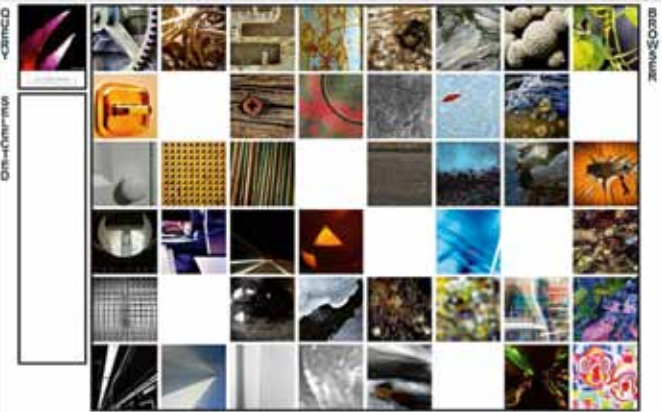
Fig 3: A screen seen by an MTurk observer during the augmentation process.

Fig 3 shows a screen seen by an MTurk observer during the augmentation process, where they are shown the query image (top left) and have to choose between 2 and 4 images from the bootstrap SOM as being those most similar to the query image. The data from the observed likenesses between the 100 bootstrap images and the 400 augmentation images was used to calculate the augmented 500x500 similarity matrix. It is this larger similarity matrix on which the pilot study SOM browser is based. For the purpose of presenting this SOM on an iPad to the observers in the pilot study, an 8 x 6 grid was chosen. Fig 7 shows the full, 8 x 6 stack SOM browser.

Fig 4: The full, 8 x 6 stack, SOM browser on iPad

The image on the top of a particular stack in the SOM browser is the image in the stack which is nearest the centroid position of the perceptual similarity space represented by all the images in that stack. Once an observer clicks on one of the images on this top level, that centroid image, together with all images that were associated as similar (and have therefore been assigned to its stack) are shown on a screen for the observer to choose from. (See fig 5).

Fig 5: The stacks beneath two adjacent images (flash and ring of light) just left of the centre of the SOM browser. Note two glass apples in separate, but adjacent stacks.

A detailed analysis of all pilot image choices will need to consider their position on the SOM browser as a possible determining factor for selection or non-selection by an observer. Already it emerges that although the 48 top level (6x8 iPad interface) images only make up less than 1/10 of the entire image set, their representation in final image choices is nearer 1/7, suggesting their prominent position has made them more likely to be chosen by observers.

However, image position in the stacks and on the SOM browser interface is, of course, far from random as it correlates to the complex interrelationship of similarities that was assigned to images by initial hand sorting and MTurk augmentation:

Visualising similarities between images in stacks, and images in adjacent stacks through 3D MDS visualisation of the similarity space.

A highly navigable way to observe how images had been assigned to similarity stacks by hand sorting and MTurk augmentation is to visualise the perceptual similarity information for the 500 images in a 3D multidimensional scaling (MDS) view. The view can be used to "swim" back and forth amongst the images plotted in 3D similarity space. See Fig 6, relating back to SOM data obtained through both sorting exercises.

Fig 6: Screenshots of the distribution of the 500 images plotted in their perceptual similarity space in a 3D MDS view. The right hand screen shot was taken after the visualisation was rotated about 90 degrees.

The 3 dimensions depicted in the 3D MDS view describe over 80% of the variability in the similarity data and can also be viewed in clusters. (See fig 7)
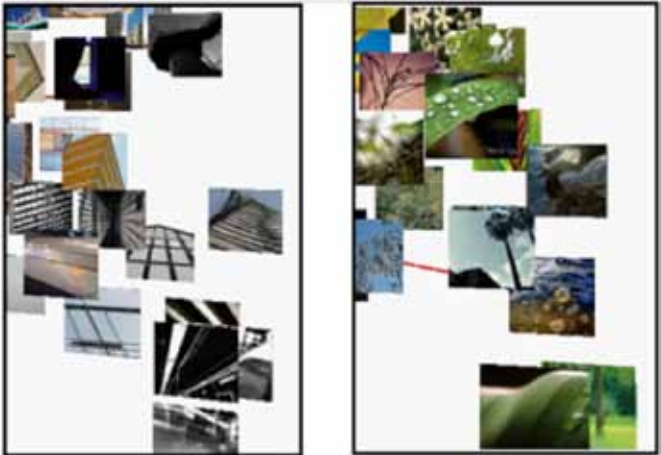
Fig 7: Two clusters of images from the 3D MDS visualisation. The cluster of images on the left is very much on a structural theme while the cluster of images on the right is on a natural theme. Much work remains to analyse the relationship between position and selection of images.

**Communicating Visually**
With the aim of discovering whether meaning can be reliably communicated between participants of different backgrounds using a fixed set of images we are conducting a selection experiment in two phases:

**Phase 1 Visual to Word Pilot**
Phase 1 of the pilot has already been completed and involved the presentation of 20 terms to 20 observers, asking them to choose 3 images from the SOM browser to represent each term. The terms comprised of 10 descriptive words sourced from non-experts as being descriptive of fabrics or products [Methven et al 2011] and 10 emotional terms sourced from the "Geneva Emotional Wheel" [Scherer 2005].

20 Observers (10 male, 10 female, 10 designers, 10 non-designers from mixed (European and Asian) backgrounds in the 20-30 year age bracket) were shown the 10 descriptive terms followed by the 10 emotional terms in a random order and chose 3 different images from the SOM to represent each given term. The experiment was presented to the observers on an iPad, and their responses were recorded on a central server, making data collection and analysis easy, for almost any size of future sample. Analysis concentrated on criteria and research questions based on semiotic and sociological questions surrounding the image set and selection behaviour of the distinct observer groups in the pilot:

Quantitative evaluation of the pilot data, namely considering the frequency with which a particular visual was chosen by more than one observer to describe the same term, was identified as a key measure for assessing how fixed (and strong) the communication value of an image is amongst respondents. Some interesting general trends emerged as well as some specific ones when filtering image choices by specific groups, and for specific terms:

Fig 8: Screenshot of results processing spread sheet.

Taking the average from all 20 observers on all 20 terms, 62.42 % of choices were singular, meaning that 62.42% of the images that made it into the 60-strong selection for each term had not been associated with this given term by more than one observer. Across all 20 terms and 20 observers, just 19.33% of images were chosen by two individuals as being descriptive of the same term, 8.75% of images were agreed on by three observers, and 5.67% were selected 4 times as being illustrative of the same meaning.

Regarding this result according to the Saussurian concept of signifier and signified means that observers in the majority disagreed about the visual signifier for a given signified; in other words, the result indicates the image set's relatively low certainty of communicative value and may be seen to confirm that a lack of codification in visuals renders them a less suitable or certainly less unambiguous tool for imparting intelligible feedback than language, and should therefore be avoided. However, HeadCrowd is aimed at developing tools for a design discipline that works on highly visual inspiration rather than relying on textual description, and looking at the pilot data in more detail and according to certain search criteria, allows an interesting qualification of the rather negative first impression on communicative value of visual feedback:

When considering all of the 20 observers' choices separately by type of term, it emerged that singular choices, seen above as an indicator for low communicative certainty of an image, accounted on average for 69.50% of selections for the emotional terms but for just 55.33% of images when observers had been asked to describe textural terms.

While fashion undoubtedly consists of a whole lot more than cloth stitched into shape, it means that the terms that are arguably more immediately meaningful to fashion design found more agreement across all 20 observers on which image might represent them. In fact it seems somewhat remarkable that almost half of the image choices for textural terms were agreed on by at least two of 20 individual observers, each faced with choosing just 3 per term from a bank of 500. Despite this outcome, emotive terms cannot be discarded in this study of visual feedback for design as they are frequently present in aforementioned forecasting and mood boards alike. The conclusion we must draw from this part of the pilot evaluation is however that particular care must be taken when eliciting and evaluating feedback on these more ephemeral aspects of design.

Even less agreement on the most appropriate visual signifier of a given term can be detected when looking at the pilot data from certain social groups' (or distinct crowds') point of view:

Sorting the choices by gender, males top the list of disagreeing by choosing on average 79.17% of images just once while

females display just 74.33% of singular choices. Looking at the pilot data according to professional background, designers and non-designers interestingly do not on average display a less or more unambiguous attitude to using visual signifiers (as might have been expected given different work practices as regards visuals) as both groups share an identical 77.17% of singular image choices.

Looking at the pilot data in detail rather than by averages confirms some of the above described trends, e.g. when "solid" scores the lowest percentage for singular choices (i.e. the highest level of agreed communication) across all 20 observers with just 40%, while "involvement/ interest" scores 100% of individual choices, meaning total disagreement of communication value. Detailed scrutiny of the pilot results also shows some startling deviations from the norm as females score just 50% of singular choices on "tenderness and love", showing an unusually high level of choice overlap for an emotional term, while 93.33% of designers' choices for "delicate" are not matched by any fellow professionals, though material terms generally generated more agreement. Minute scrutiny of the results will continue to identify all factors that may have had a significant influence on choices. Amongst these is the way in which the 500 images were presented on the iPad interface:

Is the number of images in the full set proportionate to the choices allowed each observer, i.e. can observers easily handle 500 images?

Do observers of a certain background (female, male, designer, non-designer) favour certain types of images to communicate specific things? A thorough analysis of mood boards and forecasting images will be conducted to help answer this query.

With the help of eye-tracking equipment, can we determine whether the position of images on the iPad SOM browser has an effect on its frequency of selection, e.g. top left hand corner rather than centre of page.

As indicated above, does the position of an image on the SOM browser have an effect on its selection, i.e. are top level stack images selected more frequently than those buried deep in stacks, thus requiring the observer to click through to them.

Are the images chosen more than once distinct in terms of position within the iPad interface or within certain stacks?

As this semiotically motivated analysis of the pilot continues, HeadCrowd's premise to use visuals as suggestive parts of a cumulative whole (the visual aggregation) is being researched in terms of a computer's capability of calculating and representing what such a collage of image choices might look like, when informed by a set of collected human judgements about image similarity. A pilot aggregation of the 60 image selections per term according to a raft of popularity and similarity factors has now been designed to be used to facilitate the reverse experiment of eliciting term selections in response to images, or as Saussure would say, selecting a signified to the signifiers presented.

**Visualisations of the Responses in Phase 1**
The responses were visualised in two ways: All the chosen images for a given term were displayed simply in order of image ID number. Images that were chosen more than once were displayed multiple times to indicate this. (See Fig 1 and 2)

The images chosen for each term were displayed in 3D similarity space with the size (area) of each image being increased proportionately to signify its popularity. (See Fig 9).

**Visual Summaries of the Image Selections**
As the eventual volume of image feedback selections by an internet crowd is envisioned to be very large, unmanageable in fact for visual feedback, a way of summarising the selections was needed as an alternative to simply listing the images. To this end a cluster analysis was carried out on the chosen images based on their similarity data. The responses were divided into 10 clusters. The image nearest to a cluster's centroid in the similarity space was chosen to represent that cluster in a summary collage which will then consist of just 10 images of size depending on each cluster's popularity. The position of the images is determined by their position in the similarity space, projected into two dimensions. (See fig 10)
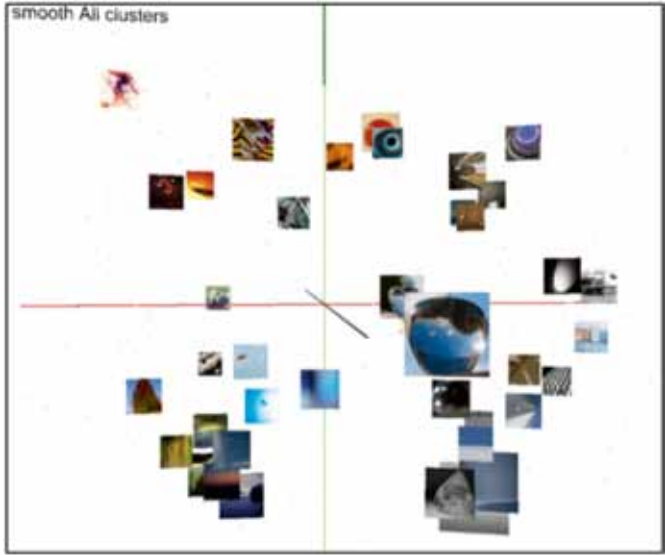


Fig 9: screenshot from 3D visualisation of the image selection for 'smooth'. This shows the full selection (all clusters) with size (area) varying with popularity. Note two glass apples.



Fig 10: Summary collage of image selection for 'smooth'. Each image represents a cluster of images. The size (area) of an image represents the population of the cluster. See all image selections for 'smooth' in fig 1

The next phase of the pilot will be a comparative study showing the raw (60 image) selections and their automised summary collages to a fresh set of observers in random order, asking them to indicate which of the 20 terms they think the given view represents. It will provide firmer answers as to how well meaning can be conveyed using mass selections from large image set. Showing raw selection data and aggregated summary separately to the same observers will indicate whether summary collages are more or less effective than full sets of image selections at conveying meaning, with potentially wide ranging consequences for the usability of crowd-sourced visual feedback for design.

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# Value Innovation and Demand Chain Management – keys to future success in the fashion industry

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## Abstract

Value innovation is a key in developing competitive advantage in most industries. Value innovation is both related to the physical products and accompanying value-adding services. Logistics has evolved from an order qualifier – that is a necessity – to an order winner. Increased focus on the consumer and co-creation with the consumer as a vital partner lead to alignments and rethinking of the channel structure. The supply chain evolves into a demand chain! Deeper knowledge about the why, how, and when of consumer buying behaviour is a main ingredient in demand chain thinking, and the starting point in designing and developing segmented demand chains in the fashion market. These chains are built on partnership and trust oriented relationships. The game of power is increasingly replaced by the game of trust. This is a necessity when the competition shifts from rivalry between companies to rivalry between chains. In this position paper we discuss visions of the fashion future, and how to develop innovative concepts that deliver added value to the consumer. The "old school" of distribution economy, and the concept of convenience, are the basic theoretical grounds, and we argue that innovations could be reached when investing in consumer insights and closer relationships in the demand chain.

**Keywords:** added value, distribution economy, demand chain management, demand networks, convenience, consumer behaviour

## Introduction

The fashion industry is in an interesting and challenging development. Some of the fashion companies have even served as archetypes for development of new business models in the Fast Moving Consumer Goods (FMCG) market. The industry is an interesting field also for the evolving business models based on closer integration between logistics and marketing, especially in terms of consumer and consumption processes. In Sweden, the fashion industry is facing a decline (Svensk Handel 2012). Many fashion customers begin expressing a feeling of "saturation" and search for other kinds of added value than just another garment to buy and wear. We see a clear change in the contemporary fashion market. On one side, competition is increasing on almost

all markets around the world. On the other side, globalization and new tools and techniques for transportation and physical movements make it possible to build new and more efficient distribution channels. And from a consumer perspective, communication technology, such as the use of smart phones and applications, have become a natural part of everyday life. These two facts could be seen both as threats and opportunities and they lead to an interesting challenge for the fashion industry. Value innovation is the key word for winning the future battle of consumers.

But innovation requires more than novel use of techniques and awareness of competitors; it requires change of business models, organization structures and behavior, a better understanding of the customer and perceived value, and, above all, a change of mindsets (Ericsson 2011a). Change of mindset is the most difficult thing because it requires unlearning, i.e. getting rid of the old ways of thinking and replacing it with new paradigms. It is easy to put up new fancy strategies and goals, but very hard to implement them (Ericsson 2011b). Unlearning is at least 10 times as hard as learning! Therefore, change management has to be a major part of all efforts to improve effectiveness and efficiency in individual firms as well as supply chains.

Information and Communication Technology (ICT) is one of the major enablers of value innovation and achieving business visions. There is a constant interplay between visions and tools, and as Christopher Columbus once said: "Men is limited not so much by his tools as by his visions" (Ericsson 2011 a). Figure 1 shows the interplay and the mutual dependence in the evolution of visions and tools. Today, ICT enables design and development of new, creative business models. During the 1990s the concept of eLogistics was developed as a toolbox for implementation of integrated logistics, ICT and process management (Ericsson 2000). eLogistics is the cornerstone in the development of today´s demand chain approach.

### Visions and Tools to Become Innovative
The understanding and definition of innovation is multi-faceted. Peter Drucker (1985) stated that an innovation is a change that creates a new dimension of performance. In retailing, an innovation is often seen in that way, and it is something necessary for business survival and growth (Reynolds and Hristov 2009). The ICT development is one of the major triggers of innovation and also an important enabler in the transformation from the old industrial to the new digital world. The availability of new tools within ICT is increasing rapidly both from a B2B and a B2C perspective. The trick for management is to know which ones to use and for
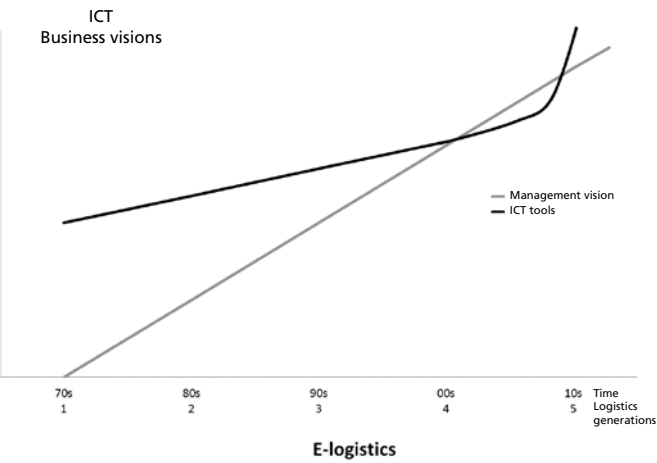


Fig 1: The concept of eLogistics, Ericsson 2000.

what purpose. Implementation has to be driven by business needs and not by technology. One way of succeeding is to look at the consumer needs and wants through the lenses of what they actually do in their everyday life and how added value is perceived. Today there is a need for a new paradigm that suits the shift to the knowledge society. Islands of rethinking and new frames of reference are popping up in the vast ocean of business strategy and management. It is time to develop a holistic approach to transformation in order to bridge the troubled waters separating those islands. Fashion is a suitable field to elaborate on, since it is open to innovative thinking and the business is put up to a great challenge.

### The "old school"
The overall aim of this paper is to try and see how bits and pieces fit together to create a new pattern and understanding of a complex structure in the field of fashion and retailing. In order to distinguish between fads and lasting, innovative concepts, one must understand what kind of methods and tools to use, and how training and education should be performed in order to change the mindset and design the transformation process. One important tool in this development is to go back in time and renew the ideas from the "old school" of distribution economy, before marketing and logistics became separated disciplines. Another important tool is, as mentioned, transportation technology and ICT, which together with awareness of contemporary consumer behavior and the increasing need for convenience can create a leverage effect on business.

### The Evolution of New Business Models in the Fashion Industry
The necessity of moving from a supplier oriented push approach, to a consumer oriented pull approach, is one of the mantras in today´s research and business literature (Darling et al 2009). The quest for the fashion industry to understand and deliver added value is closely connected to this change in management perspective. The question is how to implement change (Ericsson 2011 a, b). It is easy to understand the rationale behind the expression "we have to shift from looking inside-out to looking outside-in". Hans Stråberg (CEO of Electrolux) once put it in this way: "We have to stop trying to sell what we can produce and start producing what we can sell". In theory this seems logical and sound, but doing it in practice is a long and tedious journey. It requires change of business model, renewal of structures and behavior, shift of mindset and a lot of courage and persistence. Change management requires solid, practical experience in order to be successful.

### In Order to Look Forward We Have to Look Back
Winston Churchill is said to be the man behind this statement, and we believe that one way of succeeding in change is taking a more holistic approach, and learn from the past and the knowledge we have regarding both marketing and logistics disciplines. One of the keys to success in creating new business models is, as mentioned to "go back to the future" in terms of reuniting marketing and logistics. "In the good old days", up to the mid 1950s, the distribution concept covered both "demand creation" (marketing) and "demand fulfillment" (logistics). Logistics was referred to as the "physical flow" of products and marketing was seen as the "information flow" to create exchange (that is change of ownership or possession) between buyers and sellers.

The term information can be misinterpreted to stand for a "one-way street" and therefore it is better to talk about communication, which is, by definition, a "two-way" street. Communication is the tool to involve the consumer in the system and to get a real understanding of the buying and consumption processes. According to The Nordic Textile Journal "fashion communication is a challenging subject for research efforts. It is truly multi-disciplinary and trans-disciplinary, as the socio-economical and socio-cultural context is crucial, but to create and spread the message, it involves the sciences of media, management, logistics and technology" (editors 2010, p. 2).

The physical flow in fashion retailing today is accompanied by an integrated flow of information and services that increase the value of the product to the consumer. Hence, the strict boundaries between the flows are blurring which has to be taken into account when designing the offer to the consumer, the "value package". The value package consists of the "hard core" which can be evaluated quality-wise in terms of traditional "according to specification" measures. The core is surrounded by several layers or "shells", i.e. value-adding services. The first layer consists of "order qualifiers", services necessary to permit the company to enter the "play-ground", such as lead time, availability etc. The second layer consists of more intangible services that serve as order winners, such as attitudes toward consumers. (Ericsson 2011a). Both layers are judged by the consumer, and in many cases, convenience is (conscious or subconscious) the standard for success or failure. When evaluating a purchase, consumers often value a convenient purchase, meaning: easy to pay, a variety of products, time to think and make a smarter choice, sustainable in not having to travel, flexible delivery options, open 24/7, timing, and time saving (Sundström 2007). Customers of today could be in a physical store, trying out a pair of jeans, and at the same time wanting the convenience of searching on the internet for a matching pair of shoes. They might even want to take a look in the closet at home to see if the existing pair of shoes matches the jeans. With mobile technology and a simple application this could quit easy be a service offered to the customer, but is to our knowledge not yet implemented. Why? The lack of inter functional approach to added value. The increasing focus on the consumer and "perceived value" as the starting point for design and development of segmented distribution highlights the necessity of an interdisciplinary and inter-functional approach to value creation and innovation.

There is a shift from the traditional functional (silo) orientation in the companies to a process oriented flow approach, which could be a starting point to change. Relationships in the supply chain have to move from arms-length adversary behaviour to close partnership relationships based on trust and confidence (Ericsson 2011a). The trust game is replacing the power game (Kumar 1996). This is true for certain types of products in certain types of relationships, but "one size does not fit all". Commodity types of products need one type of channel and innovative products need another (Fisher 1997). However, segmentation based on type of product is not sufficient; the segmentation has to be based on buying behaviour as well. And the buyer behaviour changes. In one instance the consumer wants to buy in a shop and bring along the products right away, in another he/she wants to buy online and get the products delivered at home or to be picked up in a store. Which one it will be depends on what is perceived as convenient at the time.

The buying moment and the pre- as well as post-purchasing activities have to be turned into positive and exciting experiences. Consumer convenience is one of the keywords for creating value. A customer described as a convenient consumer is no longer seen as a "bad" or "lazy" customer (Sundström 2007). On the contrary, a convenient consumer could be seen as a "smart" and "rational" customer. This trend leads to the deduction that convenience as a notion will become increasingly important to most of the Western customers. Novel research on convenience also has indicated a link between gender and convenience as an added value. Workman and Cho (2012) found young male consumers in clothing shopping more convenience oriented. Results further indicate that male fashion customers have higher motivational attitudes in impulsive, quality, convenience, and price shopping orientations than other groups. We also know that men tend to adopt new technology in its early phase, while women tend to wait until the technology proves useful in everyday life (Venkatesh and Morris 2000). These are well known facts in marketing, but they have up to now been underestimated in logistics research and practice, where the "one size fits all" paradigm has been ruling. Reunion of marketing, consumer behaviour, and logistics creates a real win-win situation.

## A Holistic Approach and Reunion of Disciplines
When the concepts of logistics and marketing drifted apart during the 50s a lack of mutual understanding started to evolve both in academia and in business. Today´s turbulent and highly volatile market, especially in the field of fashion, requires a reunion of the disciplines. Electrolux states that "there is no value in a fridge until it is in the hands of the user". This highlights the necessity of a cross functional and even interorganizational approach all the way from design, via product development, purchasing, manufacturing, marketing/sales and distribution (including returns management). Hence, the holistic concept of "concurrent design" is evolving.

The same type of holistic approach is necessary also within the fashion industry. There is no value in the products until they are in the hands of the consumer. Also in the fashion industry, there has in many cases been an underutilization of concurrent logistics knowledge. However, there is a shift evolving which was initiated by companies such as Zara and H&M. They have introduced new, highly agile business models based on state of the art logistics. They have been so successful that they can serve as archetypes and role models even for heavy industry. The program "Fashion Logistics and Demand Chain Management" at the University of Borås focuses on this evolving concept and its applications.

First, the shift of focus to the consumer means much more than simply getting more quantitative data regarding the consumers buying behavior. You have to understand the reasons and motives behind the actual purchase. Or, to cite the CEO of Hemtex: "You have to put yourself in the consumer´s shoes". It is necessary to understand both the consumer and the consumption process in its socio-cultural context. This means going much deeper than most logisticians and supply chain managers do, even though they sometimes brag about their "consumer focused approaches". On the marketing side, consumer culture theory (CCT) has been an important development in order to understand the consumers (Arnold and Thompson 2005), and focuses consumers' desires as mediated by culture (Illouz 2009). When it comes the fashion field, critics are heard, and Karin M Ekström (2010) argues that fashion communication "needs a more critical stance, involving a stronger consumer orientation. The understanding of fashion and how fashion is communicated needs to be understood from a consumer´s perspective" (p. 5). She also points out that consumption occurs in a socio-cultural context and that consumer socialization is a concept that aims to understand the context in which consumers live.

Today, there are many ways of improving and increasing communication with the customer. However, market information is still too much seen from a mechanistic point of view on the logistics side. "Technical" approaches, like Efficient Consumer Response (ECR), Quick Response (QR), Point Of Sales (POS) and Point Of Demand (POD), and, more recently RFID, have been launched as solutions to the communication problem. ECR can improve cooperation and alignment in the field of inventory management and replenishment and Collaborative Planning, Forecasting and Replenishment (CPFR) can improve cooperation regarding assortment planning and manufacturing. However, this is not enough. POS data are always about yesterday´s sales to each firm´s existing customer group. Potential customers are just as valuable as the existing ones. How would you know about potential customers who never come? We also need to get a grip of missed sales as a consequence of stock outs and lack of products that are demanded. Zara tries to approach this by relating part of the bonus to salespeople to the value of qualitative and not only quantitative data they submit. Too much focus on mechanistic tools may lead to underinvestment in the real customer knowledge and the quest for added value. Implicit as well as explicit needs and wishes have to be taken into account, and truly understood. And, also, what consumers cannot tell you might be just what you need to develop successful new products and sustainable value. The consumers´ ability to guide the development of value is limited by their experience

and their ability to imagine and describe the perfect purchase. As Henry Ford once stated: "I cannot ask the customers, they just want faster horses". We believe consumer convenience is a keyword in finding added value. Leonard and Rayport (1997) suggested that we should "Spark innovation through empathic design" by observation, that is watching consumers use products and services.

Efficient and effective alignment of demand and supply requires that the chain of activities that communicates demand from markets to suppliers is integrated and fused with the traditional supply chain. So, the first requirement is exchange of consumer information. The easiest form of this is automatic replenishment on the basis of sales data. But not everything that has been sold has to be replenished. We all remember the story about the green cars. The cars had been a nuisance for sales people for quite some time and they had really tried to get rid of them. Finally, after heavy promotion and discounts they were sold. Logistics people saw the 0 in stock, thought the car was a massive success and ordered an even larger batch from manufacturing! Internal communication and understanding is just as important as external.

## The Key to Success in the Field of Fashion - a demand chain management approach
Inter organizational processes are the cornerstones in demand chain management. The number of processes and their names can be debated (see e.g. Cooper et al 1997). Ericsson (2011) defines four core processes that have proven their value in practical applications. One is Time to Market (TTM) which refers to product development and commercialization. Another is Time to Cash (TTC), the fundamental and basic process in traditional logistics that focuses on the order fulfillment process from initiation of the order to delivery to the final user. The third is Supplier Creation and Retention (SCR), a process with growing importance in an increasingly turbulent environment where price and low purchasing costs no longer are the most important issues. Just as companies have to develop and manage relations with their customers, they also have to manage supplier relations. Fourth, Customer Creation and Retention (CCR) highlights marketing as "the science and art of finding, keeping and growing profitable customers" (Kotler 1999). Customer and consumer insight are keys to lasting and sustainable profitability. Market research and the customer intelligence part of marketing have to be more emphasized and, slowly, this reorientation appears to take place.

## Smarter Consumers Require Smarter Demand Chains
With the help of ICT, consumers have information access that enables them to make better decisions. One example, still in its infancy, is the use of GPS and direct offering and communication when the customer checks in at a location, or, by permission, receives a SMS when passing a store. Smarter consumers require smarter demand chain solutions. Fewer consumers listen to the messages from sellers. Instead they listen to each other, use internet and mobiles to manage their consumption. In a study based on interviews with 30624 consumers in 13 countries (IBM Retail User Group 2011) it is stated that only 18% of the interviewed listen to traditional advertising, instead they listen to friends, family and other consumers. The increasing use of social media such as Facebook and video hauls also change the market arena. Ekström (2010) points out that "there is a need for more research studying how fashion spreads across social groups also including families" (p. 10).

Research shows that the smart consumer wants to buy from retailers that exist in several channels: brick and mortar stores, web, mobiles and Ipads. The design and milieu and the personnel in the shops have to adapt to the new consumer behaviour and expectations. It has to be convenient, nice, service-oriented and easy to shop. In a way it is going back to basics in treating the consumer as an individual and renews old virtues like service and convenience. The retailers have to embrace the new development and live up to the consumers´ individual needs and wishes. Consumer insight should be the starting point for implementation of new technology. Technology that can also be used to – in a respectful way regarding privacy – map the consumer´s individual needs and learn how to serve him/her as an individual and not a part of a "Grey mass".

When the consumer wants to search for information and shop in different channels, it is obvious that the demands on logistics increase. One day you want to buy on the net and pick up the goods in a store. Next time you may want to buy in a store but the goods have to be delivered to your home or working place. In all cases it has to be convenient to get the delivery. The product has to be in the shop or in a nearby storage when the purchase is done. Today´s smart consumers require diversity, simplicity, excellent service and an efficient, transparent supply chain that ensures the lead time required. Attitudes are changing, demography is changing and we live in a turbulent time, when everybody is trying to win the consumer in different ways. Innovation regarding business models, structure and behavior is the key to success!

The BAFARA approach (Buy Anywhere, Fulfill Anywhere, Return Anywhere) indeed matches the convenience needs from the customers, but requires alignment and interplay between sales and logistics in order to exploit several information and distribution channels. The key is transparency; that consumers, order and products are available and visible in the whole chain of suppliers, warehouses and stores. This is a challenge because all too often we are locked in old silo structures with isolated systems for stores, e-commerce and warehouses. Proactive retailers can turn the store into a show room, a test room and experience centre for consumers that want to check out, test and so on. This can lower the need for inventory to the extreme "one of each" – a test collection. The sale is executed via self-service stations or mobile e-commerce sites. But the consumer wants the products rather quickly, so lead time is a key issue. The lead time is a key issue, but must be seen from the customer's point of view – sometimes a convenient delivery is that of two hours; sometimes it could be that of five days. It depends on the individual, the situation, and the motive for the purchase.

In this area the B2C business has a lot to learn from B2B. For instance, several companies have solved the problem with erratic demand that is impossible to forecast by building virtual networks of companies that open up their inventories even for competitors (Narus and Anderson 1996). For example, there are two types of demand for spare parts. One is the "normal" that is related to scheduled maintenance. In this case, a lean supply chain may be appropriate. The other is the emergency situation when something happens to e.g. a truck out on the road. What is needed is a "fully flexible" supply chain (Gattorna 2010).

### Segmented Supply Chains
We need a portfolio of segmented supply chains based on categorization of products and customers with different require-ments regarding where, when and how to shop and get deliveries. Systems for sourcing, replenishment, and ordering and returns management have to be restructed. As said before, this requires a higher degree of consumer intelligence and segmentation based on consumer buying behavior and consumption process.

In the fashion market, this leads to at least three different set ups:

One for traditional sourcing before the season. Fashion buyers may rely on their knowledge and experience of the market and order before the season. Real conversations between these buyers and manufacturers with their own consumer insight may be very helpful here (see eg. Fisher 1997).

Another channel relates to apparel classics such as white shirts, polos, T-shirts, underwear that can be replaced rather automatically on a never out of stock approach. Quick decisions are taken by responsible buyers based on sales and stock data. Seasonal swings and also changes in color and styles have to be taken into account.

At the other extreme are very fashionable short-season items for which there are no replacements at all. Very close cooperation with manufacturers is necessary to take advantage of volatility and to adapt products to desired changes in colour, size, and shape. Seamless cooperation between retail and manufacturing can lead to added profits on the basis of successful products. Rapid response and short lead times are needed which means that manufacturing has to be closer to the market.

### Conclusions
In this article it has been argued that added value in the field of fashion could be reached by integrating the "old school" of distribution economy and concurrent knowledge regarding convenience into a holistic approach of demand chain manage-ment. Innovations and prospering success could be reached when investing in consumer insights, and closer relationships in the demand chain. Fashion industry need to be more flexible and prepared to segment, not only different channels, but also within the same channel, adapting to smaller customer segment's need of convenience as an added value. Our firm belief is that a weak expansion in most cases can be explained with a low investment in consumer knowledge and lack of adjustments according to different segments.

On a larger scale there is the problem of too much uniformity between all kinds of shopping centres and malls, which all look precisely the same, as a consequence of scale economies of large fashion chains and the internal control systems they have established. Apparently, this trend has not been reversed by the multiplication of multi-brand corporations (Jacobs 2004). And, finally, even the most advanced form of cooperation between retailers and manufacturers won´t help in developing more radical fashion innovations, like the introduction of new prod-ucts (e.g. mini- and maxi skirts, cat suits etc) or styles in the past. Room for genuinely creative thinking has to be opened up and stimulated in the organization.

One of the core ingredients in creating value is to analyze the value package as discussed above.  Knowledge about the consumption process and the how, why and when of the actual purchase has to be turned into a picture, a visualization,

of the value package. This image can be used as a target for design and development of the segmented supply chain with its accompanying information flows and relationship patterns (Ericsson 1996; 2011). In most cases, the physical products get more and more similar and also the first layer of services, the order qualifiers, are getting similar. What is important is to get the order winners right. They can turn the consumer experience from satisfaction to ecstasy!

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Light and Shadow Play by Barbara Jansen and Marie Ledendal.


Pouffy the Breathing Pouf by TWENTY121.


Rhythm exercise _ 13in1 by Barbara Jansen


Stringling by Stephanie Carleklev.

Photo: Henrik Bengtsson

*Ambience '11*

...WHERE ART, TECHNOLOGY AND DESIGN MEET

# Ambience'11

**Katrin Tijburg**
**Project Coordinator**

In November 2011 the scientific conference Ambience'11 was successfully held in Borås. This was the third conference in the Ambience series and the second one in Borås. The theme of the conference was the intersections and interfaces between technology, art and design. With a foundation in artistic practice, the conference became a meeting place where art, design, architectural and technology communities came together to discuss and share ideas.

An exciting mix of scientists, artists, designers and innovators from all over the world came together in Borås to present their projects, exchange experiences and inspire one another, said Agneta Nordlund Andersson, Chair of Organizing Committee. She added that both during and after the conference new networks had been created which generated new contacts and interesting collaborations between the University of Borås and other participating universities and research institutes.

The visiting researcher presented their work both with paper presentations and with displays of objects in an exhibition at the Museum of Textile History. The curated exhibition added a new dimension to this scientific conference and was very well received by visiting guests, who could interact with many of the exhibited objects. During the three day conference the 150 delegates experienced traditional Swedish food, an electronica concert, conference dinner at the City Hall in Borås, a dance performance produced by the Fashion Design PhD Student Ulrik-Martin Larsen and a nightly tour of the Swedish School of Textiles and its unique textile labs.

Find more information about the conference and download the conference proceedings and exhibition catalogue at www.ambience11.se.

# INTERACTIVITY

In November 2011 students of ENSAD Textile Design Department visited the conference at the University of Borås, AMBIENCE 11. INTERACITVITY is a pedagogical project we developed after our visit. We asked the students to express themselves on this idea of interactivity, which is a keyword in the field of smart textiles. We selected six projects reflecting the links between textile design and technology to imagine states of materials.

## Breath of Lights
Julia Bourel

Three modules of increasing size come out as a shell in hatching, showing the light in its nascent state. The envelope is made of ceramic remains fragility of a shell. Inside, a soft, silicone skin inflates as we intensify the brightness. A powered air increase the lamp to allow a slow propagation of light: the more it grows, the more the light intensifies.



## A Source of Pleasure, or an Anxiety?
Axelle Beaujean

The question, or dilemma, of food sometimes dominates the routine of our daily lives. We must constantly make choices and compromises, taking into account both the dietary requirements and restrictions of our palate's desires and what we assume our greatest needs to be.  While we always need to know what we are really eating, the line is sometimes blurred between animals and plants. The bulk of our food comes from the food industry with many highly processed products. The endless list of colourings, flavourings, preservatives, texturizing agents and additives seems to weigh down on our perception of what is actually real. This culinary chemistry can be at times very disturbing, but it has become an important part of our food culture and daily intake, as time-poor eaters reach for a quick fix. The search for the quintessential food, that is, retaining only the cell and the molecule as the essence of taste, would work with the right mix of protein, fat, carbohydrates, a blend of suitable textures and the most refined tastes. By annihilating the form, this becomes a feasible design that would allow you to imagine something that no one has ever eaten before. Imagine that one day, in a normal everyday situation, we do not have the urge to consume any animals or vegetables. The ultimate objective is to "grow" food directly by limiting as much as possible the traditional stages of processing (breeding, butchering, packaging) in our meals. The science behind food design will be to grow the cells and to create cell tissue that is entirely edible, by anyone. The process of implanting cultured cells into food is so that they develop and give the food an edible touch. The idea is to produce sheets of material, whether animal or plant (as we do with the fabrication of synthetic skin) directly in their final packaging, allowing a shortcut between the final stages of traditional food production.

**Acoustic Blanket**
Jennifer Hugot

The idea of this product is based on a three-dimensional honeycomb structure. It's made of wool to isolate from noise and cold. Micro speakers would be integrated and connected into alveoli in order to provide an all-over acoustic pattern. You can plug your Ipod into the blanket, stretch the textile to add volume or squeeze it close to you to lower the volume and keep the music only for your ears.
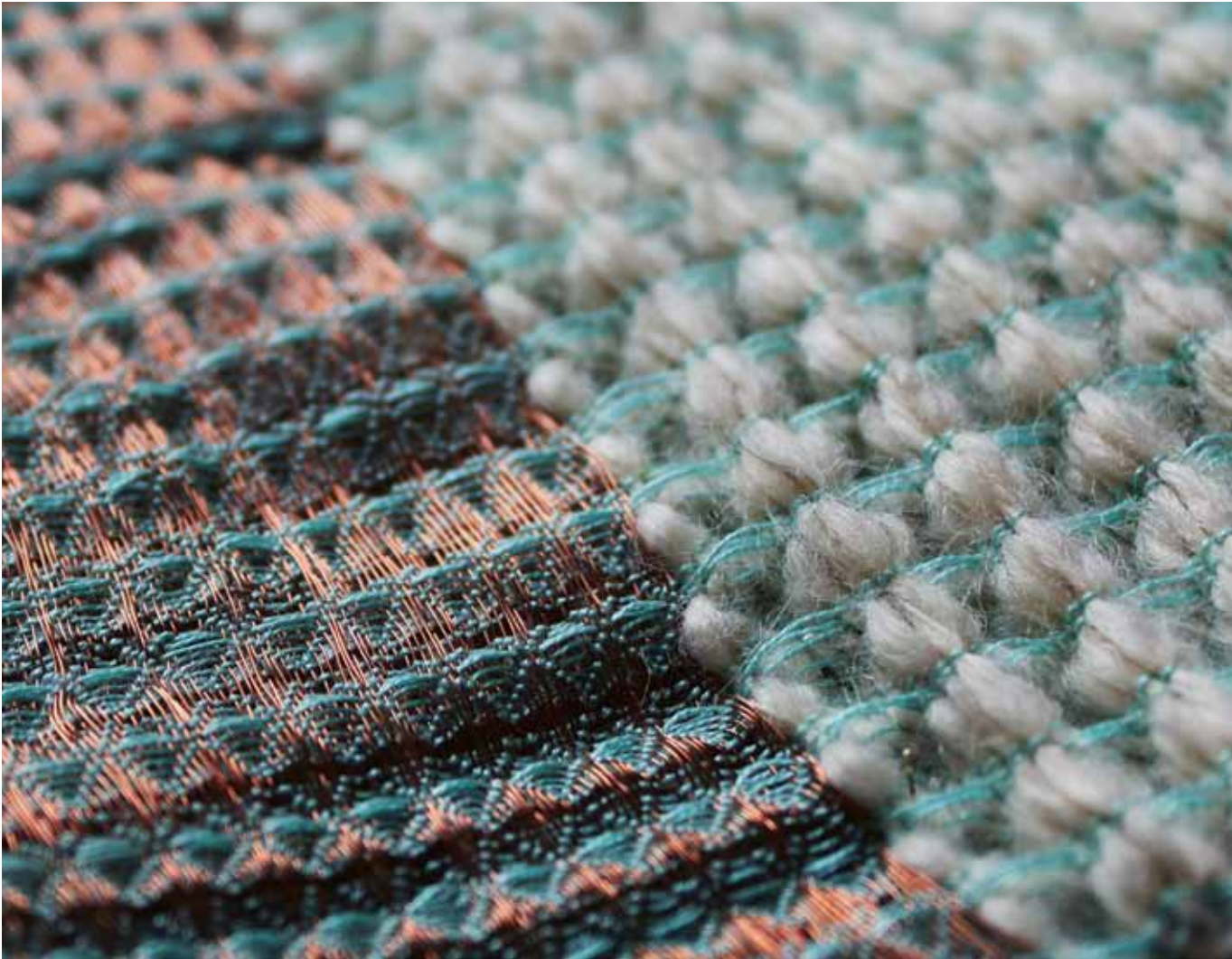


**Dimensional Knitting**
Clément Bottier

This project is an exploration in creating volume with knitting through thermoforming. Textile is not a field limited to surface design; it can be manipulated to become more dimensional and voluminous. The samples are made from polyethylene, knitted into cords, which are then knitted into dimensional shapes.

The objects are melted in an oven, and then moulded into their rigid form. The material of the knit and how it is processed opens many possibilities. Given a stability and rigid three-dimensionality, knits can be used as materials for furniture, products, even architectures.

**Colorful Dialogue**
Lola Mercier

Imagine a bar where the cosy atmosphere and the soft light would be conducive to privacy, meetings, and discussions. The glass top tables would be located in confined spaces. From the glass emerges an image of coloured shapes, light, and movements that evolve according to sound frequencies. Sound sensors integrated in the screen send information to a computer that converts them instantly into graphic images. From our conversations, the autonomous table comes to life and generates new trails of colours that blend and fuse with the effects of vibrations and undulations. In the colour variations, several hues, shades, and tonalities create a dialogue amongst each other.
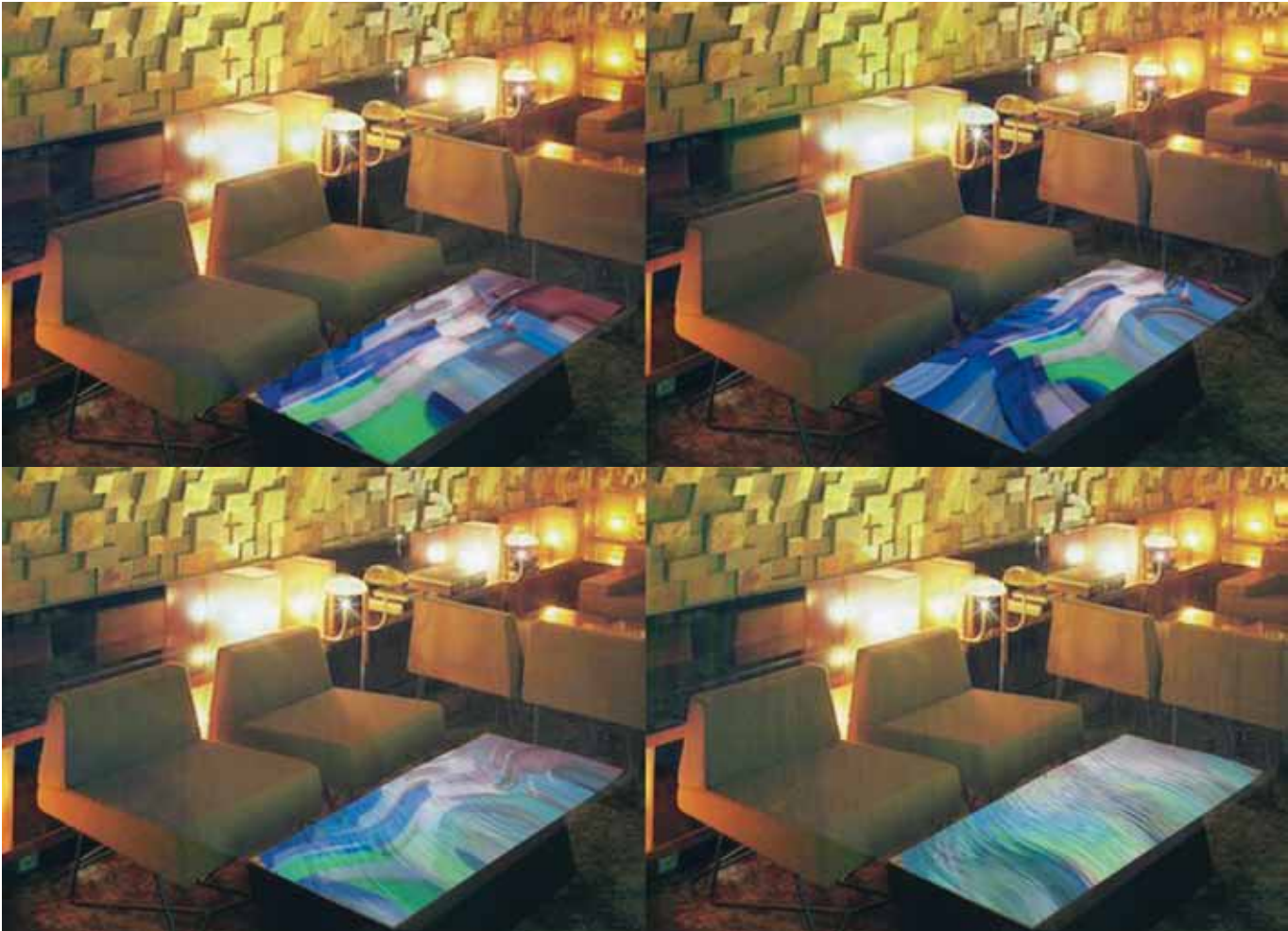
There is a majority of bright colours and pastel colours that contrast with gray and bleached. The bright colours vibrate, bring light and wake up the cosy and lounge atmosphere of the bar. Indeed the coloured light that emanates from the table create drop shadows and softly colours the room with progressive atmospheric lighting.The sound becomes visual, the trace of the noise or the word, if we listen to each other, spreads by images. We become spectators of our conversation and creator of an image always new. The louder the sound is the faster the shapes change, until the saturation result in hubbub of visual noise forms. These two parameters interact together. Moreover, one can come away with a recording image of our conversation as a digital file in a USB key.

**Light Memory**
Maude Hannart

This project is based on the principle of photography at an architectural scale: a study about light's movements and their capture on the wall. The research consist in developing a light-sensitive or photo sensible concrete. From the window lights leave marks on walls like a superposed photography. Surfaces become more and more bright showing their trajectories, creating a relation to space and time.
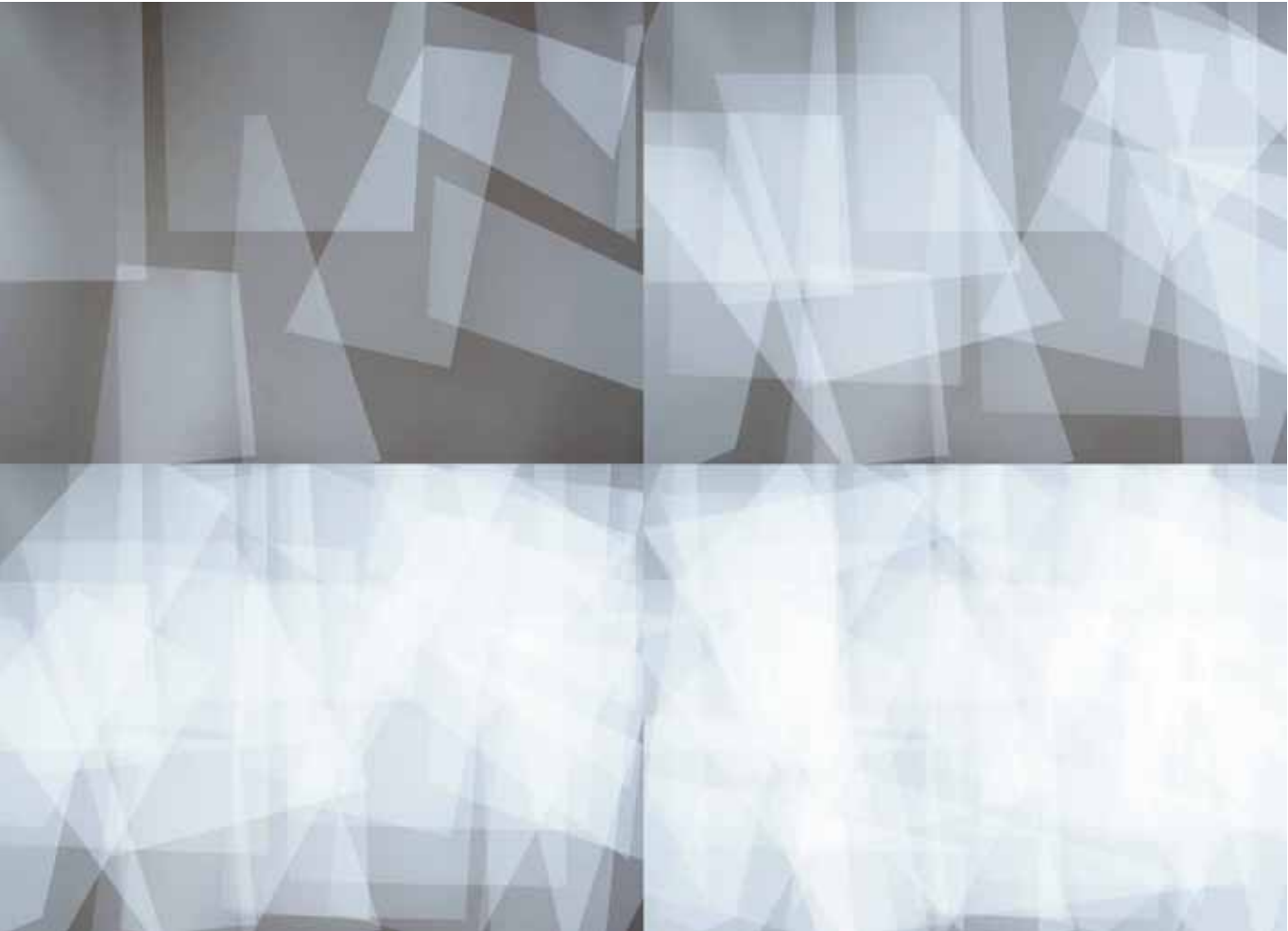
Elisabeth Tosti holds a Master of Science in Public Administration. She is a former Government Official at the Ministry of Education and the Ministry of Science, Innovation and Technology in Denmark as well as a consultant at the Danish Association of Masters and Ph.D`s. She is currently the Scandinavian representative for the International Working Group on Global Organic Textile Standard.

# From the Brundtland Report to the Global Organic Textile Standard

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This article is an essay that outlines the political movement towards sustainability in the context of the development of the sustainable fashion industry today.

**Keywords:** Global Organic Textile Standard, The Brundtland report, political power, business civil society

### Sustainability
In 1983 the General Secretary of United Nations asked Gro Harlem Brundtland, former Prime Minister in Norway, to serve as President of an independent Commission to report on the important challenges facing society globally.
The main goal for the Commission was to recommend strategies to secure and enhance the environment of countries at different stages of social and economic development. These strategies should provide a realistic approach taking into account human needs, resource availability and environmental limits.[1] The Commission finished their work in 1987 and the report is referred to as the "Brundtland report".

In the report, sustainability is defined as:

*"….fundamentally a process of changes in which exploitation of resources, rules for investments, developments in technology and institutional changes all are in a correlated balance and enforce the presence and future possibilities in responding the needs and hopes of the human beings."[2]*

Since the release of the Brundtland report much has happened but the commitment of the Commission as well as between the Commission and civil and public society is one of the main reasons why the definition of sustainability in the Brundtland report is just as relevant as it was almost 30 years ago. It remains the official definition of sustainability to this day all over the world.

### The United Nations Conference on Sustainable Development
In 1992 United Nations held the first Earth Summit in Rio. This summit represented the continuation of the Brundtland report. Some 178 countries signed up to Agenda 21 – a blueprint and a framework for a rethink of economic growth in the interest of social equity and to ensure environmental protection.

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[1] Brundtlandrapporten s. 7
[2] Brundtlandrapporten s. 54

Image: Shutterstock

For the first time in history the United Nations addressed the important role of local governments and communities. Paragraph 28 of Agenda 21 – declared that local communities and governments must be inspired to formulate local strategies for sustainable development. At the same time new processes in political thinking appeared, opening doors for NGOs to achieve their political goals.

Instead of the autocratic state acting on its own behalf, modern political thinking took on a more reflective approach towards dealing with the management of sustainable development. By inviting NGO`s and citizens` groups to the table to help in the development of the local Agenda 21, it was assumed that people would act by taking responsibility.

The keyword for that kind of thinking is the deliberative state[3], which is organized around the assumption that by engaging civil society a new normative thinking will appear in everyday life that will help promote the "good life" of sustainability.

Hence, it is no longer smart just to throw your waste on the street. It is no longer smart to smoke. It is smart to ride your bike, and not drive your car. If you want to be acknowledged as a good citizen, taken seriously by society you have to follow these new normative rules of thinking and live in a responsible, sustainable way.

The main challenge is to secure the inclusion of all social groups in society, not only the elite who are defining the trend and making the first move. If this is not successfully achieved, major groups will be excluded and protest will emerge that violate the principles of sustainable development. The philosophy of normative thinking will remain as a residue in political thinking only providing an ascetic way of life for the latter-day Saints.

This is the main reason why not only governments but also NGO`s play a key role. The ethical and environmental approach of business plays a major role in the achievement of sustainable development and can enable the inclusion of all social groups.

The citizens of Scandinavia are some of the most enthusiastic purchasers of organic products. In Scandinavia the political level has responded to this interest by ensuring that certified organic standards for food and to some degree also for cosmetics are fully implemented. Despite the interest for organic production in the area of organic food and cosmetics, organic garments and textiles have just been a "footnote" in the margins of the political agenda in Scandinavia.

Of course there are several reasons why politicians highlight the organic food and cosmetic industry. One of the main reasons is that the organic farming and the cosmetic industry succeeded in telling the history of sustainability - again as a part of the journey to the good, sustainable and conscious life.

In the area of the organic textile industry the story has still not been told in a way in which citizens take for granted the purchase of organic apparel. But the agenda is now moving forward.

**The Fashion Industry in the Political Agenda**
In connection with the Copenhagen Fashion Summit in May 2012, I was invited to the Copenhagen pre-meeting, together with stakeholders and decision makers from all over the world. The group`s task was to formulate strategies and policy options for governments to encourage sustainable fashion by:

• Providing an appropriate regulatory and economic framework within which the fashion industry can works sustainably;
• Promoting trade and innovation that protects the environment and ensures respect for human rights and labour standards;
• Ensuring that consumers are provided with accurate information and price signals.

Once again we are making history. One hundred delegates from the conventional and the sustainable fashion industry were together with government officials from the EU-Commission and the UN. Decisive recommendations for the future of the sustainable fashion industry and for the political agenda were defined.

Twenty years after the 1992 Earth Summit in Rio, the UN is again bringing together governments, international institutions and major groups including business to agree on a range of smart measures that can reduce poverty while promoting decent jobs, clean energy and a more sustainable and fair use of resources.

This year the fashion industry will join the RIO +20 Summit in June 2012.

The willingness for cooperation is not the result of a single event; many factors have come together to shape a new future for fashion.

From an environmental and ethical point of view we are facing a crisis. The conventional fashion industry is ranked as one of the most polluting industries in world. It is also an industry associated

with very poor conditions for large numbers of workers throughout the supply chain.

From a normative point of view, sustainable fashion is in flux. In the 1980s and 1990s sustainable fashion was only a question of sustainability. Today most manufacturers of sustainable apparel are aware of other important issues, such as quality, designs and price. But the sustainable fashion industry is essentially "slow fashion", battling against conventional and unsustainable "fast-fashion". On the one hand this situation is due to the accepted view people have of sustainable fashion, which also includes recycling and second hand clothes. On the other hand, it is a simple question of inadequate economies of scale; the demand for sustainable fashion is inadequately developed and for this to change some of the largest manufacturers in the conventional industry will need to lead the way.

From an economic point of view conventional businesses are looking for new opportunities for generating income. The normative agenda influences the scope for new business possibilities and as a consequence of the economic crisis, conventional businesses are increasingly aware of the sustainable fashion sector as a new way to boost turnover and get noticed.

From a political point of view, it is time to take action to safeguard the environment, specifically to minimize the combined risks to global security that climate change and population growth present to society.

The argument above reveals the classic distinction between the economic and political arena: the official technocratic system and the system of social and cultural behaviours expressed in peoples' lives. In the official system the drive for sustainability is used as a tool achieve something beyond the immediate objective, to reduce risk as well as earn money.

In the social and cultural world the purpose is to focus on our behaviour and on our own conditions. From this perspective, and in an ideal world, the artist can create art on their own terms and the designer can make designs that satisfy their own conditions, but we are not living in such a world and many compromises are made between the professional technocratic system and the social and cultural world, simply to secure the survival of humanity.

Beside these conditions in managing political power, we are also facing the power of nature when talking about sustainability. This power has been ignored for hundreds of years by human

society that defines itself as superior to nature. Now we are facing the end of nature's patience and we have to cooperate with equal respect for nature before it is too late. The eight recommendations from the Copenhagen Fashion Summit 2012 effectively respond to the issues outlined above, brought together in a way that only the fashion world can present:

1. Encouraging the integration of sustainable fashion curriculum into pre-school, primary, secondary, university and vocational education and research.
2. Supporting consumer engagement and behaviour change and campaigns.
3. Supporting expansion, standardisation and accessibility of transparency product disclosure.
4. Enforcing guidelines for product communications and marketing to discourage and penalize green-washing.
5. Stimulating voluntary agreements with industry covering extended producer responsibility.
6. Providing economic incentives for sustainable fashion products and services.
7. Restricting harmful substances.
8. Developing a multi-stakeholder platform and provide funding for the exploration and implementation of the recommendations provided in this document.

Writing this article in May 2012, it is too early to know what the political result will be when the European Climate Action Commissioner, Connie Hedegaard, presents the recommendations at the RIO+20 summit in June 2012.

It is very important to monitor what actions are taking following the RIO+20 Summit in the context of an emerging political agenda. Taking the definition of sustainability in the Brundtland report into account, all eight recommendations are important in achieving sustainable development throughout the fashion industry. As a concrete example of how it may be achieved, I will outline the development of Global Organic Textiles Standard, which is a unique example of how to take action and be responsible for global welfare, to define and encourage human behaviour that is an integrated and integral part of securing a sustainable fashion future for nature and humankind.

**How to Take Action – the story about Global Organic Textile Standard**
In August 2002, people from all over the world met at the Intercot Conference in Düsseldorf in Germany, where a workshop was launched with representatives of organic cotton producers, the textile industry, consumers as well as standard

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[3] Holm, J (2007).

organizations and certifiers. The main topic of the workshop was the need for a harmonized and globally recognized organic textile standard – one that covered all the key issues that must be resolved to achieve sustainability.

At that time numerous different standards and draft standards existed in the niche market for organic textiles. Different standards cause confusion, especially for consumers and retailers, whilst for producers the differences were an obstacle for international exchange and recognition of sustainable textiles.

At the meeting three major players in organic textiles were represented; Organic Trade Association (OTA) from USA, Der Internationale Verband der Naturtextilwirtschaft (IVN) from Germany, the Soil Association from UK. Japan Organic Cotton Organization also participated in the meeting, but their interest was restricted to cotton.

As a result of the workshop the four organizations made an agreement with the aim to work towards harmonization of the various standards and to ensure the continued progress the International Working Group on Global Organic Textile Standard (IWG) was founded.

Two years later in 2004 at InNaTex in Wallau the IWG signed an agreement that defined the approach to establishing a common standard and in 2005 the first version of the Global Organic Textile Standard was released, followed in 2006 by the establishment of the GOTS certification system. Since 2006 nearly 3000 facilities all over the world have achieved GOTS certification.

In line with the Brundtland Report GOTS` vision is to ensure that organic textiles will become a significant part of everyday life,



Harmonisation process

enhancing people's lives and securing a sustainable future for the environment.

GOTS mission is to develop, implement, verify, protect and promote the Global Organic Textile Standard (GOTS). This standard stipulates requirements throughout the supply chain for both ecology and labour conditions in textile and apparel manufacturing, using organically produced raw materials.

Organic production of fibres is based on a farming system that maintains and replenishes soil fertility without the use of toxic, persistent pesticides and fertilizers. In addition, organic production relies on high-welfare animal husbandry and excludes genetic modification.

In developing GOTS, strict and binding requirements were established regarding ecological and social parameters. At the same time GOTS took into consideration the need for a standard that is practicable for industrial production of textiles using organically produced fibres and appropriate to a wide range of products. Taking both aspects into account, GOTS defines organic textiles as being processed with the minimum possible environmental impact and with the lowest possible use of natural and synthetic chemical inputs that can leave residues.

GOTS is a dynamic standard that foster constant progress towards development of better textile processing methods. In this continuous improvement process, GOTS collaborates with international stakeholders, including the textile and apparel industry, chemical suppliers, organic farming and environmental organizations, workers' rights groups and labour unions.

GOTS believes that a voluntary global standard established and kept under review in partnership with international stakeholder communities ensures widespread global acceptance. As an international standard, GOTS removes barriers for international trade that arise from many different national standards.

GOTS reconciles the need for the textile industry to have one global standard with consumers' need for transparency. The increasing recognition of GOTS and its acceptance worldwide confirms that these needs are being met.

A standard is only as effective as it is credible. In addition to trust, verification is crucial in building credibility. The certification bodies regularly audit all parties involved in the manufacturing of GOTS-certified textiles through comprehensive on-site inspections in order to verify that all GOTS environmental and social

requirements are met. In order to further protect the credibility of GOTS any evidence of misleading use of the GOTS label or reference to GOTS certification is investigated and sanctions are imposed wherever necessary.

GOTS' goal is to contribute to sustainable development and to cooperate actively with all relevant stakeholders. A concrete example of GOTS willingness to cooperate with different stakeholders is the cooperation with the Nordic Fashion Association Initiative of Clean and Ethical (NICE). GOTS sponsored a certification prize for the winner of the Nordic Fashion Association Sustainable prize at the Copenhagen Fashion Summit in May 2012. The winner of the prize was the Danish high fashion designer Susanne Rützou, who is now invited to collaborate with GOTS-Scandinavia in making a GOTS-certified high fashion spring collection for 2013.

### GOTS Meeting the Political Agenda
Scandinavia has in many ways been the pioneer in the field of organic production, but regarding organic textiles and apparel the US Government has provided a boost to the sector.

In spring 2011 the United States Department of Agriculture publically announced that all organic textiles and apparel could only be sold as organic in the USA if the garments were certified by GOTS.

At a stroke, GOTS was approved as the only accredited organic label for organic apparel in one of the largest markets of textiles in the world.

In the Nordic countries the Governments rely on the Nordic Swan as the certification standard for organic textiles. But this seems not to be the position of the Swan in the future. On behalf of the Nordic Ecolabelling standards the Ecolabelling Office in Norway released a proposal in April 2012 where in it is proposed that the Nordic Swan is harmonized with the EU label. As a consequence the standard will change from a requirement of organic raw materials of 100 percent to a requirement of just 10 percent.

That will leave the Nordic market without a government approved organic standard for apparel, because the Customer Ombudsmen in the Nordic Countries has stated that an organic product must contain a least 95 percent of organic raw-materials if it is to be sold as organic in the Nordic Countries with the recommendation that certification must be made by an independent third party.

The decision taken by the Nordic Eco labeling offices would perhaps be understandable if it were justified by a lack of resources. However, the argument used is that there is a lack of organic cotton on the world market. From an economic point of view this is strange, because we all know that production depends on demand from the market. High demand because of high requirements will call for higher production.

Beside the political decision, it is my assumption that the decision of harmonization with the EU-label also is a question of how the fashion industry is organized today.

In a period of approximately 50 years the textile industry has become more and more global and international competition in the textile industry is a fact. A manufacturer who would like to ensure survival cannot rely on either the home market or the Scandinavian market.

At the same time several countries dominated by textile production do not have a legal infrastructure that can sufficiently ensure an objective and adequate quality test. Since the supervision of organic textile production must be performed to a high standard, it becomes risky if the certification of organic textiles depends on the national environmental legislation and possible accreditation-systems in every country.

As mentioned above a standard is only as effective as it is credible. This is why one of the keywords in the certification system of GOTS is third party certification, made by impartial certification institutions accredited by GOTS. Today sixteen certification bodies, accredited by GOTS are working all over the world.

The certification procedures of the Nordic Swan to some extent rely on the countries' own environmental legislation without securing impartial certification from an independent third party[4]. From a legal point of view such procedures are arguably inadequate for a standard approved by the Nordic Governments.

About a year ago GOTS invited the Nordic Swan to collaborate in developing the Nordic Standard to be similar to GOTS. However, the recently announced proposal and the arguments being used suggest that the possibility for further collaboration in the future is insecure.

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[4] I participated in a meeting, held by The Ecolabeling Office in Denmark on 18th of November 2010 and I directly asked one of the officers about the certification procedures of the Nordic Swan in connection to textiles. He stated that to some extent the Nordic Swan relies on the countries' own environmental legislation.

## Conclusion

For almost 30 years the discussion about how to secure a more sustainable world has been on political agenda at UN-level, at EU-level and at National Governmental level. The UN Sustainable Summit in 1992 had a major impact on shifting the direction of political thinking. Drip by drip the normative rules have influenced national governments and civil society alike.

As the former Secretary-General Kofi Annan announced: "It is the absence of broad-based business activity, not its presence that condemns humanity of suffering."

It is time for business to take seriously their responsibility for the future of the next generation and it is possible to do this in a way which is not just smart, but also realistic from an economic point of view.

Taking the eight recommendations from the pre-meeting of The Copenhagen Fashion Summit we now have a framework for how the three-way partnership between governments, business and civil society can cooperate and work together to support a sustainable fashion industry in an exciting and modern way.

Political power can help to manage the demand for sustainable textiles and garments, for example when official institutions buy work clothes and uniforms. Already today almost 3000 businesses are ready to respond to the demand.

As a concrete step for a more visible and high profile position of GOTS towards civil society, GOTS entered the fashion scene by delivering the certification prize to the winner of the Nordic Fashion Association sustainable prize - a high-fashion designer.

By setting the standard that high fashion can be GOTS-certified GOTS clearly demonstrates that normative assumptions about the sustainable and good life will not be relegated to the ascetic way of life for latter-day Saints.

In line with that it will soon be smart to wear organic apparel among the fashion trend-setters.
And the definition from the Brundtland report will be taken seriously in the fashion Industry.

Dedication:
This article is dedicated to future generations, among them my two daughters Anne-Sofie and Katrine.

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# Contributors

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- There is no page limit specified for contributions, but it is recommended that the material is presented in a form that is succinct, attractive to read.

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(Breward 2001)
In reference list:
Breward, Ch. (2001). Manliness, modernity and the shaping of male clothing. In: Entwistle, J. & Wilson, E. (eds.). *Body dressing.* Oxford. Berg, pp.165-181.

*Example, journal articles*
The reference:
(Studd 2002)
In reference list:
Studd, R. (2002). The textile design process. *The Design Journal,* vol. 5:1, pp. 35-49.

*Example 1, websites*
The reference:
(Victorian and Albert Museum n.d.)
In the reference list:
Victorian and Albert Museum (n.d.). *Fashioning diaspora space.*
[Online] Available at: http://www.vam.ac.uk
/ Research & Conservation
/ Research / Research Project: Fashioning Diaspora Space
[Accessed 19 April 2010].

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The reference:
(Scalway 2009)
In the reference list:
Scalway, H. (2009). Essay: *Means and meaning.*
[Online] Available at: http://www.vam.ac.uk/
collections/fashion/features/diasporas/movingpatterns/
essay1/index.html [Accessed 19 April 2010].

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