SCIENCE, TECHNOLOGY AND SUSTAINABLE FASHION AND TEXTILES

With consumers becoming increasingly demanding, considering the environmental impact of the clothing industry is all the more important. **SANDY BLACK** describes current research into meeting both environmental and consumer needs

The Fashion Paradox

The concept of sustainable fashion appears to be a contradiction in terms given that fashion is an endemically wasteful system. The paradox surrounding the fashion and clothing industry is that this inherent wastefulness translates into an economic driver for employment and global trade – it represents the fifth largest economic sector by activity. Approximately 40 million people are employed in the textiles and clothing industries worldwide of which up to 19 million are employed in China, 2.7 million in the EU and 400,000 in the UK, – around the same as the aerospace and automotive sectors combined (OECD, 2004). These figures exclude those employed in the retail industry, which in Britain is responsible for importing around £13 billion net worth of clothing (BATC, 2006). The turnover for UK woven and knitted apparel manufacturing declined by nearly 50% in the period from 1997 to 2006, but nevertheless, 80% of companies export their products. However, despite 90% of clothing sold in the UK being manufactured overseas, the high street retailers control a significant proportion of volume production through their design, specification and sourcing roles from UK headquarters. Retailers therefore play a highly significant intermediate role in connecting fashion design, manufacturing and the consumer, and have increasingly been called to account by the media on their environmental credentials and social responsibility policies.

The Fashion Industry Context

Fashion is a highly complex business with long supply chains stretching around the world – clothes today are well travelled commodities with brief lives. The fashion industry is characterised by fluctuations in demand, speculative manufacturing, short runs, fast turnover and a diverse range of products channelled through a fragmented and frequently changing supply chain distributed over many global locations. Risk factors such as changing trends and unseasonal weather result in stock remaining unsold and eventually disposed of by incineration or landfill.

Since the mid 1990s and changes in international trade agreements (including relaxation of export quotas), increasing globalisation of manufacturing has taken place, with new countries, such as Bangladesh and Vietnam, entering the industry. Cheaper off-shore labour costs have made it difficult for UK and European companies to stay competitive at a time when clothing consumption has increased and prices have declined. Greater competition has led to faster fashion cycles, pushing the price of fashion products down, whilst simultaneously increasing production volumes, with the consequent environmental impact. Fashion consumption in the UK has grown significantly in recent years: there was a 37% increase in the amount of clothes purchased per capita between 2001 and 2005 (Allwood et al., 2006) and this trend has continued. A recent study for the Department for Environment, Food and Rural Affairs found that "Even amongst the most pro-environmental [consumers], clothing choices most often derive from considerations of identity and economy rather than of sustainability impact" (Fisher *et al.* 2008). Many purchases are made on impulse, with much clothing never worn before being thrown away. In addition to the impacts from manufacturing and transportation, for much of the everyday wardrobe the most significant environmental impact arises from the use phase of the garment life cycle: clothes cleaning, drying and ironing.

Fashion has become a powerful construct in society, for example as a communication medium and social catalyst to express belonging or difference. A further paradox is that despite (or because of) its fast cycles, the industry has been slow to change and adopt new technologies. How can changes be made to the fashion system in order to reduce its environmental impact whilst sustaining trade and employment? How can environmental issues be reconciled with the importance of fashion in meeting our personal and symbolic needs, over and above clothing's functional role?

Science, technology and Fashion

Collaborative and cross-disciplinary research can provide solutions to some of these entrenched problems, through radical thinking. Research within the London College of Fashion (LCF) Centre for Fashion Science takes a design–led approach to catalyse connections between new and old technologies, craft and industry, science, design, art and technology, thus attempting to reconcile the paradoxical – sustainability and wellbeing with desirability and fashion. One example of this phenomenon in action is given by the work of designer and artist Prof Helen Storey (Co-Director of the Centre for Fashion Science at LCF) and polymer chemist Prof Tony Ryan of Sheffield University, in their recent collaboration entitled 'Wonderland'. This project sought to communicate the 'problem of plastics' in the environment in a positive and engaging way and, through dialogue between fashion and science, and developed a soluble

One step knitting process of seamless sweater *(Photo: Sandy Black)*

> *Future fashion products must address the complex issues of sustainability and still satisfy our personal, economic and social needs.*

plastic which would decompose benignly. These were worn by fashion models poised above tanks of water, to carry the visual message around the world.

The fashion industry is one of the few remaining craft-based industries; the manually operated sewing machine is still the principal means by which garments are made. Retail clothing stores cater for a range of product variables numbering tens of thousands of products per season per retailer, but these ranges still do not satisfy the needs of a large proportion of the population due to narrow scope of sizes and poor fit. To address a wider spectrum of individual requirements it is essential to create greater responsiveness and agility through development of new production processes. So-called 'mass customisation' in fashion (in which mass production processes are reconciled with personalised choices in apparel or footwear) is becoming technologically feasible: online retail systems have emerged (for example Nike ID trainers) with the ability to respond to individual consumer choice whilst maintaining the benefits of mass production. In addition, body scanning technology is starting to impact made-to-measure clothing in the US and the UK. By better satisfying customer needs it may be possible to reduce the rate at which fashion products are consumed and replaced.

Current Research

Research projects within the Centre for Fashion Science investigate emerging materials and technologies for new fashion applications. The aim is to create innovative products and processes for fashion within the context of sustainability. Convergence of digital technologies and diverse disciplines has opened up unprecedented possibilities for new design and manufacturing processes, helping to create the paradigm shifts required. Two current projects, Considerate Design (led by the author) and Catalytic Clothing (led by Prof. Helen Storey), are outlined below.

Considerate Design is a concept and toolkit being developed to support designers to tackle life cycle impacts of fashion product design and manufacturing, to aid trading-off in design and manufacturing decision making. Few fashion designers realise the environmental impact of their design decisions, so this project helps embed sustainability in their design process and is developing tools to assist in evaluating the viability of personalised fashion. The toolkit will be appropriate to different scale companies, from individual designer-makers to design teams within large clothing retailers. In a fast–moving industry such as fashion, sustainability is a concept which paralyses, rather than motivates, designers. Considerate Design aims to break down design for sustainability into elements relevant to fashion through considering:

- the environmental impact of the clothing production supply chain;
- the end user; and
- the lifecycle of the product.

This will be applicable within the constraints of bespoke, small batch production or mass manufacturing.

The Considerate Design for Personalised Fashion project has developed pilot products (which integrate body scan data

with processes including rapid prototyping technologies in new ways to create personalised fit. The proposition is that personal engagement in product choices increases satisfaction so that the product will be used for longer. Eliminating processing steps along the way is a key component of the research, such as through developing seamfree constructions. A collaboration with partners from engineering design at Cambridge University and the Open University has applied process modelling software to these fashion case studies to assess the design cost and risks associated with personalised products, which are being developed to the next stage.

Seamless personalised sweater *(Photo: Sandy Black)*

Catalytic Clothing is an exploratory project in development which aims to harness for the first time the massive surface area represented by our clothes, when taken together in urban environments. Given the air pollution created in cities, especially NOx, the Catalytic Clothing concept proposes to use a mass of humans working together to purify the air by wearing clothes to effectively remove noxious pollutants from the atmosphere through treated or specifically developed fabrics with nano scale functionality (such as embedded titanium dioxide). These clothes will later release the pollutants, which will be treated as part of the laundering process, using specially developed cleansers, before entering the waste water system. It has been estimated that 40 people walking across one metre of pavement could purify two metres of air space in one minute. A campaign of engagement with industry partners and funding bodies is underway, together with feasibility studies at Sheffield

Silver Hook Bag by Steven Harkin and Frances Geesin
(Photo: Steven Harkin)

University to test a range of possibilities for fabric treatments and compositions, funded by the Engineering and Physical Sciences Research Council. Unusually for science based projects, it is proposed to engage the public through communication of the potential of the project at the same time as the scientific research is being conducted.

Future scenarios

Increasing convergence of diverse technologies will have an impact on the future of textiles and clothing. Over the last ten years new multi-disciplinary approaches to textile research have emerged; as micro-, nano- , bio- and information technologies and biomaterials have continued to evolve, there is an array of new possibilities for enhanced functionalities within textiles – from new fibre structures, composite materials and coatings at the nano and micro scale to the visible integration of electronic assemblies into clothing.

The UK has led innovation with several different patented technologies for embedding responsive functionality in textiles, including electronic functionality via integration of conductive fibres into fabric structures, particularly in the medical monitoring and sportswear arenas using textiles for sensing and switching functionalities. Wearable electronics

Evolving textiles soft glove prototype by Philip Delamore *(Photo: David Sweeney/LCF Digital Studio)*

will not however become mainstream until the technology meets genuine needs, becomes invisible and intuitive, and the aesthetics merge with the technology itself.

As consumers expect and demand more from their clothes, – nanotechnologies and microtechnologies may provide new developments in textiles. Environmental impact analyses need to be conducted in tandem with these innovations to avoid simply adding to the environmental burden. Targets to aim for would include fabrics which last longer, stay cleaner, and use less energy and resources to make; decompose benignly; can renew themselves and recharge their functionalities. Some of these are currently in stages of development around the world.

Fashion can be a powerful catalyst for engagement and social change. It is not proposed to eliminate fashion for the economic and symbolic reasons outlined above. Future fashion products must however address the complex issues of sustainability and still satisfy our personal, economic and social needs. It is therefore essential to rethink systems, products and processes, utilising both existing and emerging science and technology, to increase satisfaction but ultimately reduce production and consumption and thereby contribute to reduction in resource depletion, carbon emissions and environmental damage.

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