

[Original Article]

Innovation and craft in a climate of technological change and diffusion

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Abstract

Industrial innovation in Britain, during the eighteenth and nineteenth centuries, stimulated the introduction of the factory system and the migration of people from rural agricultural communities to urban industrial societies. The factory system brought elevated levels of economic growth to the purveyors of capitalism, but forced people to migrate into cities where working conditions in factories were, in general, harsh and brutal, and living conditions were cramped, overcrowded and unsanitary. Industrial developments, known collectively as the 'Industrial Revolution', were driven initially by the harnessing of water and steam power, and the widespread construction of rail, shipping and road networks. Parallel with these changes, came the development of purchasing 'middle class', consumers. Various technological ripples (or waves of innovative activity) continued (worldwide) up to the early-twenty-first century. Of recent note are innovations in digital technology, with associated developments, for example, in artificial intelligence, robotics, 3-D printing, materials technology, computing, energy storage, nano-technology, data storage, biotechnology, 'smart textiles' and the introduction of what has become known as 'e-commerce'. This paper identifies the more important early technological innovations, their influence on textile manufacture, distribution and consumption, and the changed role of the designer and craftsman over the course of these technological ripples. The implications of non-ethical production, globalisation and so-called 'fast fashion' and non-sustainability of manufacture are examined, and the potential benefits and opportunities offered by new and developing forms of social media are considered. The message is that hand-crafted products are ethical, sustainable and durable.

Keywords: innovation, fast fashion, sustainability, ethical manufacture, craft, durability

I. Introduction

Eighteenth and nineteenth century technological changes in textile and clothing manufacture stimulated the introduction and expansion of the factory system leading, in turn, to dramatic increases in the quantities of goods available on the market. Innovations in power generation, transportation and communication helped to drive developments. Meanwhile the demand for unique hand-crafted textile and clothing products collapsed and, with future livelihoods at risk, numerous craft workers, among them spinners, weavers, knitters, printers, dyers, embroiderers, lace makers and tailors, initially in Britain and, subsequently, across much of continental Europe,

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migrated to the large towns and cities, seeking employment often in the textile mills where the working environment was largely harsh and brutal, and associated living conditions were unsavoury, overcrowded and unsanitary. Alarming, this process of migration has continued into the twenty-first century, affecting principally textile and clothing workers in some of the countries lumped previously under the title 'Eastern Europe', as well as parts of Asia, Africa and South America. This paper identifies and debates the major issues associated with textile and clothing manufacture worldwide. Issues such as sustainability and ethical production are discussed. Most importantly, the paper poses the question: can the digital revolution provide a platform for the enhancement of future craft manufacture? The wider objectives are to identify the range of early textile innovations, to give a brief review of why these innovations are believed to have origins in Britain, to discuss the social consequences of the introduction of the factory system, to remark on subsequent innovations and how these are best considered as technological 'ripples' or waves of innovation (rather than as the products of second, third or fourth industrial revolutions). In addition to the belief in technological ripples, the author maintains also that numerous developments, ranging across the performing and visual arts, film, music as well as politics, entertainment, economics, and cultural change came about also due to the stimulus of technological change and industrial revolution, but these are not the focus of attention here. Rather, the focus in this paper is on the inter-related nature of globalisation, 'fast' fashion, ethical manufacture, sustainability and durability, all issues of concern to modern fashion designers. This paper argues that embracing widely adopted digital communication networks may help to switch the bulk of consumer demand towards more expensive products which are better manufactured, will last longer, and are produced under favourable working conditions, by workers paid a reasonable wage (with

no gender or age gap), using superior sustainable materials. So, consequently, consumers can be provided with full sourcing and production details on 'swing' tickets, thus showing that the relevant product had been crafted under favourable working conditions and terms of employment, from the best sustainable raw materials.

II . Early Textile Innovations

In the early-eighteenth century textile manufacture, world-wide, was regarded as a cottage industry with the bulk of spinning and weaving being conducted in homes. Often a family would own only one loom, operated by the man of the house with the assistance of a boy. Meanwhile women and girls were involved in providing sufficient hand-spun yarn, in the British context using a spinning wheel known as a 'Saxony wheel', to supply the single loom. Knowledge of fibre processing methods (largely wool and flax) had been passed down within families over several centuries and these methods were used to supply sufficient cloth to meet the needs of wider society. Although some products were exported, the vast bulk of home production in Britain was focused on local needs. However, the Saxony spinning wheel was unable on its own to supply sufficient yarn to meet the needs of 'flying shuttle' type weaving, introduced by John Kay in 1733/34. This innovation was of great importance as it spurred on innovations in other processing areas, and these followed shortly after. Probably the most important subsequent innovations were: James Hargreaves's 'spinning jenny' (1764); Richard Arkwright's 'water frame' (1769); Samuel Crompton's 'spinning mule' (1779); Edmund Cartwright's power loom (1785). These were adopted, to greater or lesser degrees, by the industrialists of the day. Numerous further technological changes, affecting every stage of textile processing followed and, in time, automation became an aspect of most industrially manufactured products, including clothing, which relied so

heavily on textiles as a raw material. There were important parallel developments in mining, canals, roads, railways, iron extraction and smelting, chemical manufacture and water and steam power and all of this led to the rise of the factory system, with cheap labour, much available capital, and willing entrepreneurs, as well as inventive activity, all driven by economic forces.

By the late-twentieth century, identical products were the definite preference of the retailing sector. Unique, one off, designs were undesirable and retail buyers preferred large orders of each product and wanted to ensure that all items of a category were identical in every respect. Ripples of technological changes continued and, by the early-twenty-first century, craft manufacture had largely been replaced worldwide.

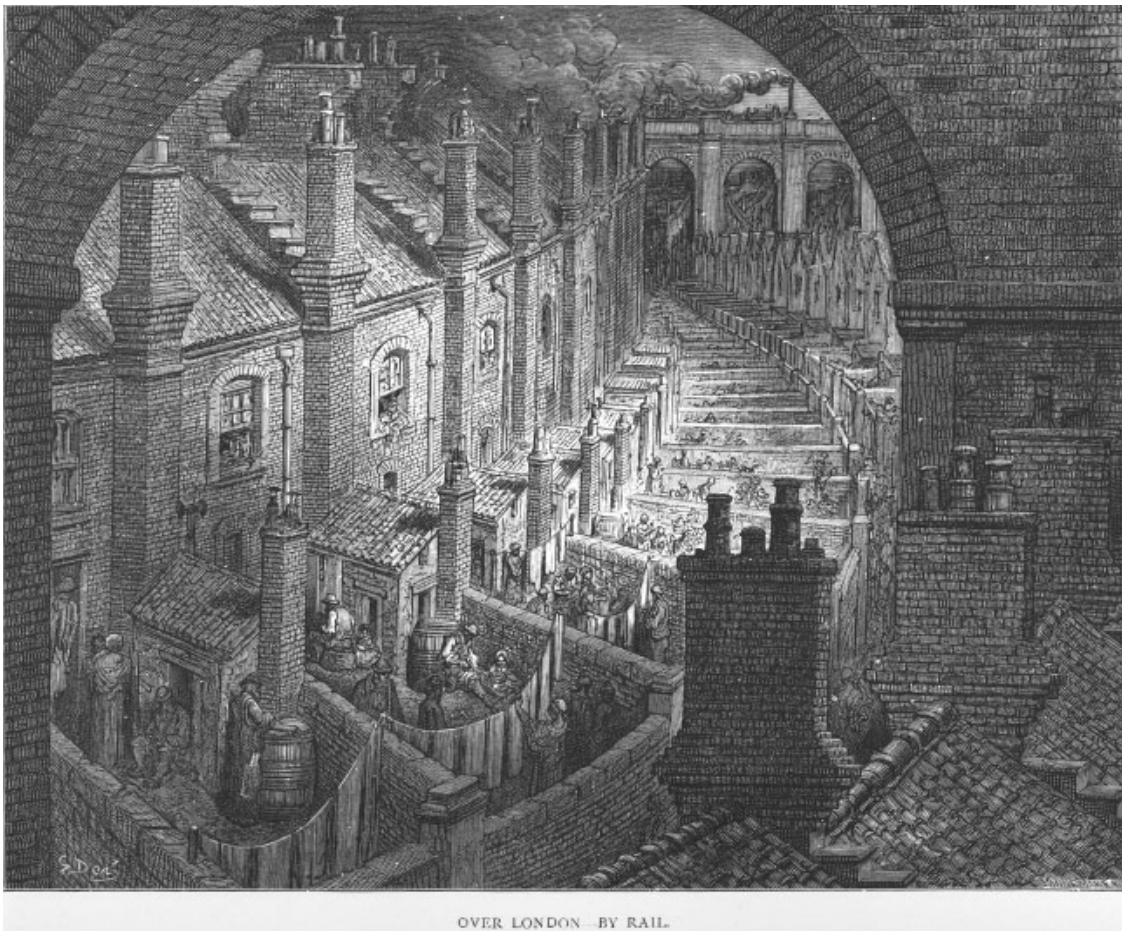
It is well known that inventive activity and innovation adoption stimulates increases in economic growth, and countries at the forefront of the Industrial Revolution benefited accordingly. Outcomes at the level of certain individuals may not have been as attractive. Craftspeople who took up employment in the new factories were required increasingly to attend to the operation of unfamiliar machines, taking on the role of technicians rather than artisans. Meanwhile designers, although increasingly distant from processing, were offered wider design possibilities and, with improved transportation networks and means of distribution, consumers were offered seemingly unprecedented product variety. This, in turn, stimulated the development of a purchasing middle class, with associated increases in consumption in most industrialised societies. Successive technological ripples have, in the main, made goods easier to produce and distribute at a lower price with greater apparent benefits to the consumer.

III. Why British Origins?

As the initial stages of the Industrial Revolution

progressed, British manufacturing output in textiles surged ahead of all competitors and the British economy expanded immensely. The reasons for the British origin of the Industrial Revolution have been debated, with some observers stressing the ready availability of financial resources built up due to Britain's colonial past, including involvement in the slave trade between West Africa and the Caribbean. This may well have been a contributing factor towards the availability of entrepreneurial capital. There were also various environmental issues which may have contributed (Fig. 1); a few of these are considered briefly below.

Compared to other European countries, Britain had a relatively dense population in its small area, and agricultural changes of the eighteenth and nineteenth centuries displaced a large labour force willing to move from the country-side to the towns where textile mill owners were recruiting a labour force. Natural resources, included coal, iron, tin, limestone and water power, as well as a damp, mild weather were suited to the spinning of cotton, and it is argued that this laid the basis for industrial expansion and the founding of industrial revolution. For much of the eighteenth and nineteenth centuries, Britain was also relatively stable politically (compared to other European countries) and, most importantly, British entrepreneurs were not only receptive to the adoption of technological innovations, but they recognised also that industrial production would result in cheaper products than equivalent hand-crafted items, and these would offer a greater profit potential. Industrial revolution led to the factory system, associated closely with the mechanisation of cotton manufacture mainly in the north of England where Manchester became known as 'Cottonopolis' and was perceived by many as the first industrial city. Typically, the new factories were powered by water wheels placed in fast-flowing rivers and these were common throughout much of Britain, including in and around Manchester in the north of England.



<Fig. 1> 'Over London by Rail', a re-production of a print produced in 1872 in London: A Pilgrimage by Gustave Doré From. Dore London. (2010). <https://en.wikipedia.org>

IV. Ethical Concerns

Rapid industrialisation led to numerous craft workers losing their jobs. Many weavers found themselves without incomes and unable to compete with the relatively unskilled factory labour force, so many moved to factory employment instead. Skills, however, built up over several generations and more, were lost with the introduction of the factory system.

Industrial workers were better paid than those in agriculture. With increased finances, better and more food was obtainable and this, in turn, led to a healthier population. On average, child mortality declined and the population became more youthful. Opportunities

for formal education were limited and, instead, children were expected to work (though they were paid substantially less than adults). Child labour was common in British textile mills, prior to the passing of laws protecting children. Various social reformers, such as Robert Owen, were appalled by the bad working conditions in most factories and campaigned for improvements. An important concern was child labour. In 1833, The Factory Act (or 'Children's Charter' as it is sometimes called) was passed in the British Parliament; this imposed various age restrictions and maximum hours, as well as school attendance, and thus benefitted child factory workers. Meanwhile some prominent early industrialists (such as Titus Salt

and Josiah Wedgwood) built housing and related facilities for their work forces.

Groups of early-nineteenth century English textile workers, known as ‘Luddites’ protested against aspects of industrialisation. The Luddite movement began initially in Nottingham and spread to other parts of the north of England. Eventually the Luddites were suppressed through military force, initiated by the British government. Over the years the term ‘luddite’ has been used to refer to those who oppose industrial progress.

Also, certain individuals of note, such as the British designer, William Morris, associated with the Pre-Raphaelite Brotherhood and British Arts and Crafts Movement, was appalled by the loss of craft techniques, and believed that automated machinery production led to inferior products (Zaczek, 1999, p. 12). It is worth remarking, with the benefit of hind sight, that although Morris’s views may not have been true at the time, they do appear to be of some relevance worldwide in the modern twenty-first century era.

By the early-twenty-first century, textile and clothing production globally continued to be profit driven, with sourcing of products from the lowest-cost locations. Invariably, purchase tickets of fashion goods (at least within the UK) did not provide the purchaser with information relating to the circumstances of manufacture (so no information was provided to the consumer on the degree of sustainability or the relevant working conditions). In fact, it appears that most large retailers and manufacturers were unwilling to be transparent in their dealings and did not appear to be prepared to engage in levels of self-regulation aimed at ensuring that their products were ethically produced under acceptable levels of sustainability. Without strongly enforced regulation this situation continued. Meanwhile it appeared that many textile and clothing consumers desired products produced ethically by workers paid fair wages in safe environments.

So, ethical concerns are still of importance in the

early-twenty-first century. The vast bulk of textiles and clothing purchased worldwide was, by early-2017, manufactured in developing economies, mainly in Asia, Africa and South America. Clothing manufacture (again, in early-2017) was exceedingly labour intensive and labour costs were a major component of total production costs. Much of the profit, however, appeared to be taken by large retailers, and the reality for many clothing workers was that they were paid exceedingly low wages and worked for long hours under unhealthy and unsafe conditions.

Fashion consumers of the early-twenty-first century demanded constant product change, and wanted newly-designed products to be available on a frequent basis. An important development became known as ‘fast fashion’ (considered in more detail in the next section), a term applied often to clothing collections, based on the most recent fashion trends, designed and manufactured quickly, available at low prices, and aimed at mainstream fashion consumers. However, it appeared that many consumers had major concerns relating to the circumstances of production.

Retail clothing prices (at least in the UK) decreased during the early-twenty-first century, and lower prices meant that less and less money went to the people who made the goods, although greater quantities were produced. By 2017, it appeared that a condition for ‘fast fashion’ was lower and lower production costs which, in turn, ensured the continuation of bad and unethical working conditions.

Currently (in 2017), important consumer concerns include: the nature of working conditions across the supply chain; levels of wages paid to the workers; enforced labour; child labour; animal welfare; a range of environmental-related issues. So, ethical issues were (in 2017) firmly at the centre of the debate concerning textile and clothing manufacture. It appeared, however, that the discussion on the ethics of fast fashion production had been dominated by those with interests associated more closely with large producers and retailers rather than garment workers.

However, there are different aspects of the debate concerning fast fashion and ethical manufacture. It must be remembered also that textile and garment manufacture provided income to support numerous families in lesser-developed economies. If too strong an argument is placed against manufacture in Bangladesh, for example, because of appalling working conditions, retail chains may simply search for ‘appropriate’ manufacturers in Laos, Cambodia, Vietnam or west Africa, so manufacturers and retailers need to be put under pressure (from consumers) to change behavior no matter where production is located. It is suggested here that this could be done through the introduction of ‘compulsory’ information relating to production circumstances, being included on the swing tickets of all garments purchased; if satisfactory information is not provided then the consumer will hesitate to purchase.

V. Fast Fashion

The term “fast fashion” is applied to clothing collections, based on the most recent fashion trends, designed and manufactured quickly, available at relatively low prices, and aimed at the bulk of fashion consumers. Suppliers are chosen very carefully, and they must be able to respond quickly to changes and to make acceptable profit margins. It is important that the entire chain is closely coordinated and works together in a collaborative way to ensure that there is no delay. Simplicity of products is also of importance, with the use of basic fabrics, yarns and fibres. Technically sophisticated textile development does not appear to have a role to play. It appears that production corners are cut, hems are as thin as possible and fabrics as open as possible. Long-term wear and durability are not concerns. All in all, fast fashion does not applaud the aesthetic appeal of unique, crafted products. Durability is not an issue.

Traditionally, fashion organizations delivered two collections per year, each collection aimed at a season,

either Spring/Summer or Autumn/Winter. In the late-1980s, however, many retailers started to provide collections outside the context of the two-season calendar. Also, the so-called ‘throwaway’ market evolved, involving exceedingly low-priced basic products. After the 1980s, the ‘throwaway’ market developed into what was known by the early-twenty-first century as ‘fast fashion’. The principal difference was that fast fashion was up-to-date and adhered closely to fashion trends. By the second decade of the twenty-first century, leading fashion retailers were delivering up to twelve collections per year, each aligned closely to relevant fashion trends.

Quick response is an important aspect of fast fashion, with product specifications and designs finalized closer to delivery than was the case previously. The development of fast fashion has had financial benefits for retailers, including increased turnover and savings made due to the shorter time taken between order and delivery. Fast fashion relies on constant change of products as well as the flow of information throughout the supply chain. Twenty-first century fashion consumers expect newly-designed products to be available on a frequent basis, and innovations in communications technology have helped to achieve this.

Important social issues related to ‘fast fashion’ include: whether the garment is durable; whether it is made from renewable raw materials that are organic in nature and have been fair traded; whether the garment was produced close to the market, with no air transportation involved; whether the garment is sold with unnecessary packaging; whether the garment can be washed at low laundering temperatures; whether it is biodegradable or can it be recycled. These factors relate to what has become known as ‘sustainability’ (considered in the next section).

VI. Sustainability

In the early-twenty-first century, sustainability and ethical manufacture were regarded as closely related.

Fast fashion had led to increased quantities of clothing produced and consumed, and this increase in consumption had implications for the environment and the preservation of resources. The term ‘sustainability’ has been used often to refer to the degree to which products and processes safeguarded the environment for future needs. Sustainable manufacture acknowledges the needs of the present without compromising anticipated future needs. A concise historical review of perspectives on sustainability was provided by Scoones (2007), and sustainability across a range of Asian countries was discussed by Kesavan and Swaminathan (2008). Considerations relating to sustainability in the early-twenty-first century include: increased quantities consumed and disposed of; water, energy and pesticide use associated with different fibres and the circumstances of their production and processing; the ‘carbon miles’ associated with transportation of fibres or products; the use of hazardous chemicals and their effect on the safety and health of workers and consumers as well as the environment. Health and environmental aspects of textile and fashion manufacture, were reviewed by Claudio (2007). A discussion of issues relating to sustainability in textiles and fashion in the early twenty-first century was provided also by Hann (2014).

By the early-twenty-first century, cotton fulfilled around half of textile needs, world-wide. Alarming, cotton was the most pesticide-intensive crop. It also demanded large amounts of agricultural land, a further cause for concern considering the increasing demand for food stuff production from the world’s growing population. When processing cotton fibre (to woven and dyed fabric), a range of softening agents, dyes and bleaches were used; these were detrimental to the environment. Such chemicals were toxic to both producers and consumers. By the early twenty-first century, finished goods often needed to be transported thousands of miles by air, road or sea, and this consumed oil, petrol and diesel, all detrimental to the environment. Such costs must be considered when

assessing the contribution of textiles and associated products to global warming.

Consumption invariably involved frequent laundering, using much water and energy. Low prices led to more clothes being bought, and this, in turn, led to more clothes being thrown away (which generated difficulties when the chemically laden items were disposed of as land fill). Cotton was not the only undesirable fibre in the sustainability debate. There were also issues of sustainability relating to wool production and the clear majority of man-made fibres. Fibres more sustainable than cotton include hemp, jute and ramie. A substantial review of relevant issues was provided in an Editorial in *Textile Outlook International* (“Editorial”, 2013).

High Street clothing prices in western Europe, declined during the early-twenty-first century. Lower prices meant that less and less money went to the people who made the products, although more products were produced. Consumption also involved regular laundering with the use of more energy and water. In fact, Claudio observed that around two thirds of the energy used in the life cycle of a cotton T-shirt involved the laundering of the product, invariably at high temperature (Claudio, 2007). Low prices induced consumers to buy more clothes, though this had led to more and more clothes being thrown away. Around one million tons of clothing were thrown away annually in the UK, in the first decade of the twenty-first century, most to landfill; this caused a major environmental hazard, for with every shower of rain the chemicals and dyes used in the discarded clothing got washed into the ground and thus polluted waterways. As noted above, cotton is not the only culprit in the sustainability debate. There are also issues of sustainability related to most other fibres.

Both manufacturers and governments have a role to play in improving matters. Each stage of processing should be considered. Manufacturers should reduce chemical usage at all production stages, espe-

cially dyeing, and should ensure also that sufficient health and safety standards are maintained throughout production. Governments and relevant agencies need to be vigilant in implementing existing legislation especially where it relates to hazardous chemicals use.

VII. Discussion

To ensure sustainability of future profits retailers need to take part in frank discussions relating to environmental and ethical issues, and they need to show a willingness to find solutions which are acceptable to consumers, retailers and all interested participants along the supply chain. Importantly, retailers should ensure that sustainability is part of their supply chain. Both retailers and manufacturers need to engage research professionals to conduct research aimed at solving the numerous ethical and sustainability problems associated with fast fashion. Designers should consider using different fibre types, and should think also in terms of products which are more durable than those produced worldwide currently. Most importantly, it should not be assumed that ethical and sustainability concerns cannot co-exist with modern fashion production.

A range of important issues which should be of concern to all societies involved in fashion consumption as well as national governments and relevant legislative organisations can be identified. Substantial recent increases in levels of clothing consumption, encouraged by increased fashion change as well as the availability of cheaper goods is not ethically, socially, economically or environmentally sustainable. The intensity of cotton production, together with the associated energy use and use of pesticides is a problem which needs to be addressed. Working conditions associated with garment production in developing economies must be improved. Energy consumed during both production and use needs to be reduced. The lack of sustainability of most man-made fibres

needs to be addressed possibly through the introduction of alternatives. Relevant levels of fashion carbon miles should not be ignored. Animal welfare is an important concern to many consumers worldwide, and this too needs to be addressed. The use of hazardous chemicals in the working environment needs to be reduced.

There have been numerous product innovations in textile and clothing manufacture in the early twenty-first century; some were indeed manufactured and were made available to consumers with the monetary resources to purchase. Meanwhile, other product innovations in digital technology were more widely adopted, at relatively low cost, by consumers worldwide, and this has stimulated dramatic developments in communications technology.

By 2017, there had been numerous process and product innovations associated with textile and clothing manufacture. Smart textiles, for example, were impressive in how they could perform to fulfil needs not previously associated with textiles and garments; but production of these had reached only a very small percentage of total textile manufacture, and it was doubtful if these and associated innovations would become widespread by the third decade of the twenty-first century. The extent of acceptance, adoption and use of digital communication technology was another matter, however, and appeared to have reached worldwide acceptance in a relatively short time. Digital innovations associated with improved communication worldwide had probably undergone the speediest and most widespread diffusion of all innovations associated with the history of humankind. It is proposed here (in 2017) that this means of communication is used to improve awareness of the benefits of turning to craft products, and how production such as this can address issues relating to sustainability and ethical production.

It is suggested here that the use of social media could make consumers aware of the issues. Consumers could thus be given the opportunity of purchasing

goods which they feel can accommodate their own views on ethical manufacture and sustainable production. In turn, consumer pressure could ensure indirectly that retail buyers are forced to consider hand-crafted products, as well as all ethical and sustainable aspects of production when negotiating with garment producers/suppliers. Further to this, such a negotiating stance could ensure the improvement of the terms and conditions of employment of the numerous textile and garment workers worldwide.

VIII. In Conclusion

In the second decade of the twenty-first century, textile and clothing manufacture continued to migrate to areas of poverty and deprivation where labour costs were low and entrepreneurial pay-back high. By the early-twenty-first century, environmental and ethical issues together with pressures for sustainable manufacture had become major forces worldwide and, against this backdrop, it is argued here that this may provide scope for an expansion of craft-based activity in association with the more recent developments in digital technology and the dramatic expansion and wide-spread use of various social-networking and communication media. It seems that consumers worldwide would be receptive to products more durable than those produced currently. Such products would be more expensive, but would also be more ethical and sustainable.

Consumer demand can be a powerful tool to adjust the types of products being produced, but this demand needs to be channelled. Currently (in 2017), the bulk of consumer demand is for industrially produced fashion-oriented items; invariably these are produced under licence (for large retailers/manufacturers) in factories located in lesser-developed economies, by a workforce paid as little as possible and working in conditions which would, as best, be regarded as undesirable in developed economies. Following several factory disasters, large manufacturers/retailers, based

mainly in Europe and North America, expressed their desire to review production conditions, wages and related matters, and expressed a willingness to offer compensation packages to the workforce and associated families affected by any recent accidents. However, the belief among manufacturers and retailers that transparency of information would lead inevitably to the lowering of profits appears to be widespread, and buyers for large European and North American retailers and manufacturers, despite their protestations, appear to support the retention of the *status quo*.

By 2017, worldwide, consumers were under pressure to demand frequent style changes in products, and manufacturers had simply responded to this demand by providing mass produced items, made with the cheapest materials and in the fastest time possible. Since the time of the Industrial Revolution, up to the early-twenty-first century, there had been a lowering of demand for hand-crafted products and durability was no longer regarded as an important characteristic. However, pressures relating to ethical and sustainable production have created different market conditions, and these new conditions can (in 2017) be addressed seemingly by craft producers.

As designers, visual artists, manufacturers or citizens, we need to convince consumers to move away from the pressures created by 'fast' fashion, and that better manufactured (crafted) products, using better (and more sustainable) raw-materials, are more durable and will thus last for a longer time (compared to their fast fashion alternatives), but will take longer to produce and will cost more. Such a communication could come about through exploiting the extensive communication channels offered by recent advances in digital technology. Also, it is important to communicate that hand-crafted products are ethical, sustainable, and durable.

The beneficial consequences of implementing these proposals could include the continued development or re-instatement of craft skills and apprenticeships in textile and clothing manufacture, as well as the intro-

duction of ethical and sustainable production at local levels. Globalisation may be restrained and local cultures may become increasingly differentiated. However, there may also be various short-term detrimental effects, and the actions suggested will need to be debated further by relevant experts. Overall, however, it is felt that the benefits to local cultures will far outweigh negative consequences.

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