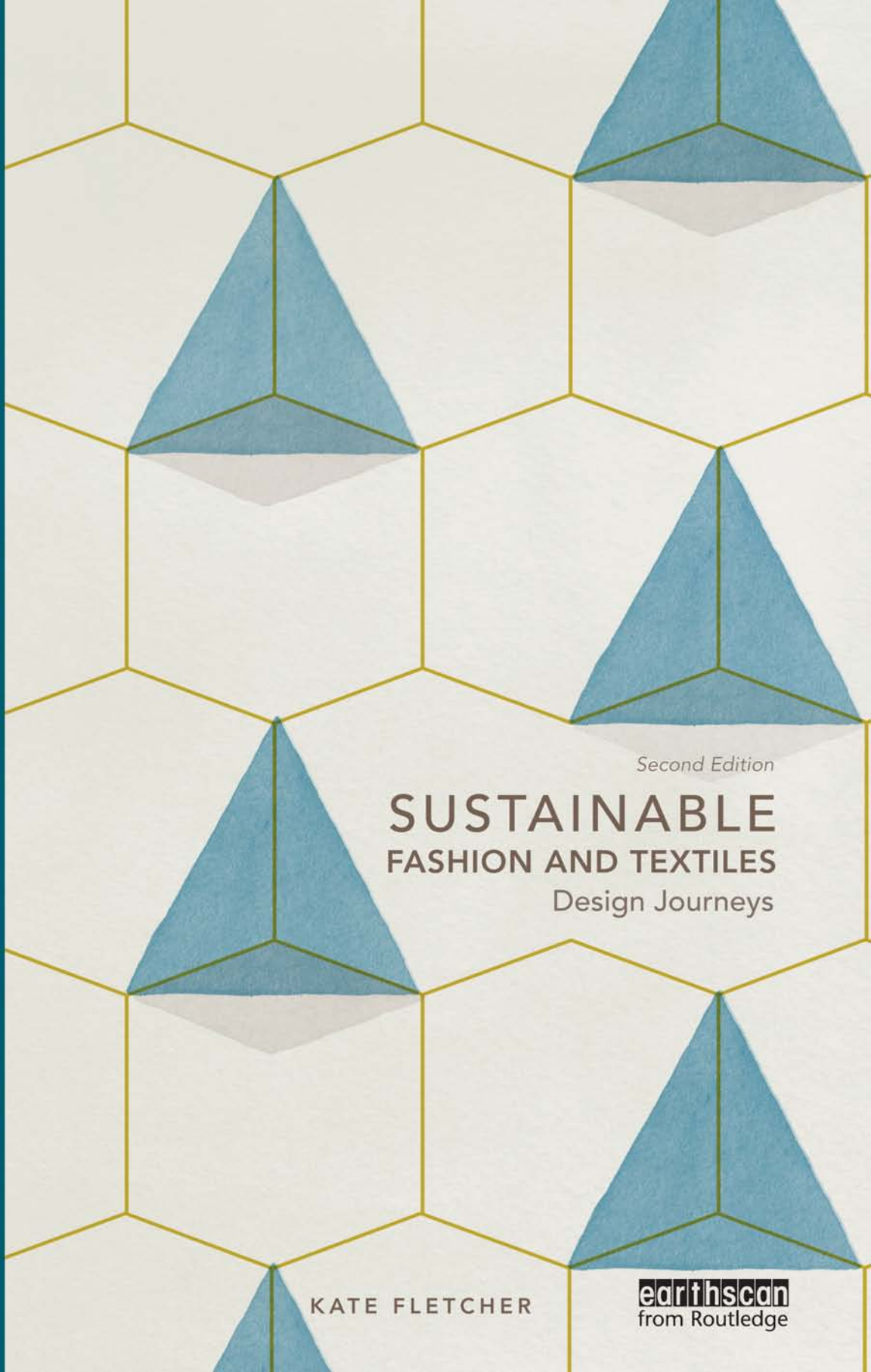


Second Edition

SUSTAINABLE FASHION AND TEXTILES

Design Journeys

KATE FLETCHER

earthscan from Routledge

Sustainable Fashion and Textiles

Second Edition

Over the last two decades, Kate Fletcher's original thinking and progressive outlook have infused fashion and textiles with ideas and practice of design for sustainability, and come to define them. Her pioneering work, rooted both in nature's principles and the cultural and creative forces of fashion and design, ranges from developing 'slow fashion' concepts to exploring 'post growth fashion' and understanding the 'craft of use'. Kate works with corporations, educational institutions and organizations to foster change towards sustainability. She has a PhD from Chelsea College of Art and Design and is Reader in Sustainable Fashion at the Centre for Sustainable Fashion, London College of Fashion.

Now in its second edition, *Sustainable Fashion and Textiles: Design Journeys* is recognized as the defining text in the field and brings together design thinking, information about lifecycle sustainability impacts of fashion and textiles, social innovation and systems change. This edition features new and updated content which reflects on and critiques the latest improvements in the field and examines potential future developments, positioning the book deep within sustainability change.

Kate Fletcher is Reader in Sustainable Fashion at London College of Fashion and director of design for sustainability consultancy *Slow Fashion.*

Sustainable Fashion and Textiles

Design Journeys

Second Edition

Kate Fletcher

earthscan
from Routledge

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First edition published 2008
by Earthscan

This edition published 2014
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
711 Third Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging in Publication Data
Fletcher, Kate, 1971- author.
Sustainable fashion and textiles : design journeys / Kate Fletcher. -- Second edition.
p. cm.
Originally published: London ; Sterling, VA : Earthscan, 2008.
Includes bibliographical references and index.
1. Fashion design. 2. Textile design. 3. Sustainable design. I. Title.
TT507.F583 2014
746.9'2--dc23
2013022135

ISBN: 978-0-415-64455-6 (hbk)
ISBN: 978-0-415-64456-3 (pbk)
ISBN: 978-1-315-85793-0 (ebk)

Typeset in Avenir by
Servis Filmsetting Ltd, Stockport, Cheshire

For Mark, Jude and Cole

This page intentionally left blank

Contents

List of Figures, Tables and Images *IX*
Acknowledgements *XIII*
Preface to the Second Edition *XV*

Introduction 1

Part 1: Sustainable Fashion and Textile Products **5**

Chapter 1 Material Diversity 7

Chapter 2 Ethically Made 51

Chapter 3 Use Matters 91

Chapter 4 Reuse, Recycling and Resource Exchange 113

Part 2: Sustainable Fashion and Textile Systems **137**

Chapter 5 Fashion, Needs and Consumption 139

Chapter 6 Local and Light 163

Chapter 7 Speed 189

Chapter 8 User Maker 221

Conclusions 239

Image Credits *249*
Index *254*

This page intentionally left blank

List of Figures, Tables and Images

Figures

1.1 Energy and water consumption in the production of selected fibre types 21
1.2 Environmental impact of textile consumption in Europe on three indicators 22
2.1 Map of key processes, inputs and outputs in the textile production chain 57
2.2 Negative feedback loop 75
2.3 Positive feedback loop 76
3.1 Lifecycle impacts for a women's polyester blouse 94
3.2 Types of sustainable design innovation 96
6.1 Changing the scale at which we view an issue or activity impacts upon how they are perceived 164
7.1 Layers of activity in a resilient human civilization 192
7.2 Energy requirements per wearing of a polyester blouse for a range of use scenarios 202

Tables

1.1 World fibre production in 2010 10
1.2 Textile fibre types 12
1.3 Environmental cost of each stage in the lifecycle of a cotton T-shirt 23
1.4 Toxicity profile of a conventionally grown cotton T-shirt 27
1.5 Average natural fibre production per hectare 34
2.1 Types of pollution associated with dyeing a range of fibres 62
2.2 Summary of developments in dye chemistry 64
3.1 A rough guide to relative impact of textile products throughout life 93
5.1 Fundamental human needs 145
7.1 Characteristics of ecosystems in different stages of evolution 205

Images

Eco jeans in 100 per cent organic cotton with sustainable product components and production processes by Levi's 28
White 100 per cent African cotton dress by Noir 31
Organic wool tweed by Isle of Mull Weavers 33
Bette hemp dress by Enamore 35
Woven fabric in 100 per cent peace silk by Denise Bird Woven Textiles 36
T-shirt in 100 per cent Ingeo by Moral Fervor 37
Suit in lyocell by Linda Loudermilk 39
Yarn made from 50 per cent recycled London textiles and 50 per cent pure new wool, by EcoAnnie 42
T-shirts in 100 per cent Fairtrade mark cotton by Marks and Spencer 74
ONE T-shirt made from 100 per cent Lesotho cotton by EDUN 77
Pillows produced by Armenian craftspeople supported by Aid to Artisans 78
MADE-BY button indicating supply chain transparency 80
Purple hooded sweatshirt by American Apparel 81
Slip dress in 100 per cent silk by Dosa 83
Modular garments designed for low laundering 101
No Wash top from the 5 Ways Project 104–5
Stain dress by Lauren Montgomery Devenney 106
Windows blanket by LoooLo 115
Back2Back dress by Junky Styling 121
Reused yarn vest by Muji 123
Synchilla Snap-T fleece by Patagonia 129
Zero waste pattern cutting concept shirt to address wastage, by Andrew Hague 131
Upholstery fabric in wool and ramie by Climatex Lifecycle 132
Caress Dress produced as part of the 5 Ways Project 148
Organic cotton T-shirt and jeans by howies 152–3
Green contrasting stitching on organic cotton T-shirt by American Apparel 157
Modular concept top by Ariel Bishop 158
Skull dress by Project Alabama 170–1
Jacket made from 100 per cent hemp grown in England from fibre grown and processed by Bioregional 175
Fly skirt in organic tweed, part of the Ardalanish Collection by Anja Hynynen for Isle of Mull Weavers 177

Moth blanket by Joanna Notkin 178
JP Donleavy shrug, Spring/Summer 2005, 100 per cent cotton by Keep and Share 182
Eugenia dress, Spring/Summer 2006, 100 per cent cotton by Keep and Share 195
Blue velour pleated furnishing fabric by Sigrid Smits 199
Oversized labels and clothes rails in Itaylan Avlusu project swap 'shop' set up by Otto von Busch 200
One-night wonder. Design scenario from the Lifetimes project 209
Fancy pants. Design scenario from the Lifetimes project 211
Who wears the trousers? Design scenario from the Lifetimes project 213
Great coat. Design scenario from the Lifetimes project 215
Hand-stitched recycled quilt by Alabama Chanin 225
High bag pants by Wronsov a.k.a. Otto von Busch 231
Short sleeve suit, vest suit and oblique collar shirt by Wronsov a.k.a. Otto von Busch 232
do shirt by do/KesselsKramer 234
Updatable T-shirt from the 5 Ways Project 235
The story 'Colour Connections' from the Shared Use category of use practices in the Local Wisdom project 244

This page intentionally left blank

Acknowledgements

Unbounded thanks to my trusted group of friends and advisors whose wisdom, enthusiasm and indefatigable creativity continue to keep me going, including Lynda Grose, Dilys Williams, Ann Thorpe, Otto von Busch, Timo Rissanen and Mathilda Tham. My gratitude to Lucy Batchelor, whose support, friendship and illustrations have made such a difference and have been so gratefully received. Thank you to the team at the Centre for Sustainable Fashion for being there and being home, and to the many students I have taught over the years, from whom I have learnt so much. I am hugely grateful to all those who supplied images for this book and who work with innovation and passion to affect change towards sustainability in the fashion and textile sector. I thank all those people with whom I have cut my design-for-sustainability teeth over the years, in particular Emma Dewberry and Phillip Goggin. I am grateful to Laura Williamson at Routledge for commissioning this second edition. I also thank Katelyn Toth-Fejel for her stellar work on other projects, enabling me to direct attention here.

Most of all I thank my husband and sons – for book writing is nothing if not a family experience – who have embraced it and my scattered presence with amusement, magnanimity and a lot of football.

Preface to the Second Edition

In the five years since *Sustainable Fashion and Textiles: Design Journeys* was first published, many of its themes now occupy an altogether different position in the attitudes and activities of the fashion and textile sector. Where it used to be marginalized and of limited cultural capital, the power to affect change towards sustainability in the sector has now begun to coalesce around large corporations eager to protect and augment the reputation of their brands, and has also found a platform and a presence at fashion weeks stretching from London to Addis Ababa. Long-favoured themes, such as those of materials selection, resource flows and supply chain efficiencies, have become sites of innovation, not just opinion, and dominate a broad span of creative, industrial, academic and political agendas. A recent government-funded initiative in the UK for example, the Sustainable Clothing Action Plan, commissioned research into new and emerging fibres,[1] recycling[2] and garment durability.[3] Beyond the shores of the UK, these recurrent themes also prevail and include: the development of agricultural initiatives to improve the resource efficiency of established fibre crops, like cotton, for mass-market consumption by supporting farmers to adopt practices, seeds and approaches that best suit local soil conditions and climate;[4] the introduction of novel fibres such as those based on, for example, corn starch;[5] new generation dye and process chemicals and associated methods of application that now reduce both resource inputs and pollution outputs;[6] work to track and trace supply chain information to promote greater transparency of manufacturing processes;[7] cross-brand initiatives like the Higg Index from the Sustainable Apparel Coalition to develop a pre-competitive common approach for measuring and evaluating fibre and fabric efficiency, and improve supply chain performance industry-wide.[8]

The speed and breadth of change to the technical and organizational structures of the fashion and textile sector is essential, welcome and impressive. And yet even from a vantage point within this shifting space, sustainability continues to be elusive in fashion and textiles. It evades us not because we lack the technical expertise to produce fibre, fabric and garment more

efficiently; on the contrary, we have many of the necessary technologies to reduce resource consumption in development, if not already in place. But rather because we target our efforts (and our imaginations) at parts – at independent entities – of a system operating separately from a whole, the performance of which is not scrutinized. Yet the whole is the problem[9] – the cumulative values, discernments, habits of mind, industrial practices, business models, economic logic, deep societal forces and aggregated individual practices that make up the fashion and textile sector – and it is the whole we must understand before we consider the functions and needs of its elements. Sustainability is dependent on how the parts work together, not on how the parts work in isolation. Without changing how fashion and textiles are thought about, aspired to and perceived, both as an industrial sector and as a set of individual and social practices, the very issues that cause unsustainability will prove resilient. Our challenge is to trade in our long-held preference to improve situations by taking them apart, and instead develop the skills and thinking of synthesis, to foster change through the actions of putting things together. And in so doing, we will deal in big thinking, broad imagining and political vision, indelibly shaped by patterns of power, economic logic and social conditions.

Our present day is indexed by the forces of advanced capitalism and globalization and by consumerism, individualism, materialism, commoditization, that define and shape our daily experience of them. But these forces tell us little about the situation we find ourselves in. Instead, they speak about the quantity of our lives, rather than their quality. They convey scant information about the health of global systems, the resilience of society, or the aliveness and satisfaction of everyday life as expressed in our achievements and the cohesion of our communities. A recent study of biophysical planetary boundaries suggested that of the nine planetary boundaries identified, three – climate change, rate of biodiversity loss and changes to the global nitrogen cycle – have already been transgressed, with others approaching the threshold.[10] The likely consequences: non-linear, abrupt environmental change within continental- to planetary-scale systems. In the face of such effects, an alternative framework for life is essential and pressing. The study's conclusions state that such a framework can be found if we, 'shift our approach . . . away from . . . minimizing negative externalities, toward the estimation of the safe space for human development'.

It is into this animated, stirring space of persistent global challenges and a shifting of approach that the second edition of this book is offered up. As with the first imprint, the book's ambition remains to foster a more relational, complex and holistic understanding of sustainability processes and

aspirations in the fashion and textile sector that leads to both action and change. Here, facts are important, and the pages that follow contain many; but to make the acquisition of information our sole goal is a backwards step, for we also need to become practitioners of the relevant skills. For what is the point of knowing something, if we fail to understand what do with it? We need to train a critical eye, a questioning habit; to foster the skills of anticipation, rigorous imagination and resilience. Further we need to cultivate a sense of personal responsibility, an aptitude for listening and watching out for each other. Such an aptitude is undermined too easily by ready-made sustainability solutions – a label, a checklist, a ten-point action plan – that invite us to outsource our responsibility and let others do the figuring out for us. Yet it is in the act of figuring things out for ourselves, that our world becomes more intelligible to us, and we can begin the process of becoming more responsible for it. The process of sustainability is a process of internalizing the business of watching out for each other.[11]

I live in gratitude that the first edition of this book found resonance with so many designers, fashion and textiles professionals and students. I am thankful for their support and constantly inspired by the work they do. The book continues to be in active use in commercial design studios and is the principal text in academic seminar rooms investigating sustainability in fashion and textiles where it maintains a course between defining and evolving the field. It was also transformed into an exhibition called 'Fashion Footprints: Sustainable Approaches' at the Centre for Contemporary Art and the Natural World in 2010.[12] Many ideas in the book have also helped seed and contextualize various programmes and projects of research. Concepts that have found especial traction and 'stickiness' include: the framing of materials questions within ideas of diversity which promote an array of alternatives over a single preferred solution (Chapter 1); the application of systems thinking to opportunities for change in the sector, which helps give context to present-day choices and their effects (Chapter 2); the exploration of use phase, usually the territory of anthropological studies or home economics, in a book about fashion and textiles (Chapter 3); the holistic and interconnected treatment given to material and social flows (both Part I and Part II); and perhaps most significantly, the use, throughout the book, of design thinking to explore and expose to view opportunities for innovation through a focus on needs, speed, participatory practice and localism (Chapters 5 to 8). Indeed, combinations of and excerpts from these latter chapters have been reprinted numerous times in edited books, anthologies, scholarly journals and popular magazines and in several languages, reflecting their ongoing relevance and unique perspective.

In the second edition, the book's original structure has been maintained, the contents updated and new material added throughout, including, for the second edition, a chapter of reflections and conclusions. I am often asked for a definition of 'sustainable fashion and textiles' and while I remain absolutely convinced that sustainability requires not one but many narratives, stories, visions and definitions for different audiences and contexts, I offer a lone definition here, which I hope others will then make their own: *sustainability in fashion and textiles fosters ecological integrity, social quality and human flourishing through products, action, relationships and practices of use*. I am also sure that these narratives require that we pay special attention to the words we use; for language helps shape our thoughts – our words influencing how we perceive and imagine the world. It seems to me that when, for example, we only speak of sustainability in the fashion and textile sector in terms of materials and process efficiency and optimization, it directs our thoughts down a route where we think these are the things that matter. When we only give quantitative data and language a platform, it makes us think only in terms of things that can be numerically measured. And when we only talk about sustainability as a supply-side concern, with a lexicon of technology, indexes and global value chains, it will always remain a production issue. Instead, in the pages of this book I try to use language that leads us to multiple ideas about fashion and sustainability, to ideas that convey a patchwork of material, individual, economic, social and political creativity and action. Such multiplicity reflects the themes we are exploring, stitching connections between them as moral, ideational, political and technical challenges. Please pick up your needle and join in.

Kate Fletcher
Bollington, March 2013
www.katefletcher.com
@katetfletcher

Notes

1 Turley, D.B., Copeland, J.E., Horne, M., Blackburn, R.S., Stott E., Laybourn, S.R., Harwood, J. and Hughes, J.K. (2009), *The Role and Business Case for Existing and Emerging Fibres in Sustainable Clothing*: *Final Report to the Department for Environment, Food and Rural Affairs (Defra)*, London: Defra.

2 Morley, N.J., Bartlett, C. and McGill, I. (2009), *Maximising Reuse and Recycling of UK Clothing and Textiles: A Report to the Department for*

Environment, Food and Rural Affairs, Oakdene Hollins Ltd, London: Defra.

3 Gracey, F. and Moon, D. (2012), *Valuing Our Clothes: The Evidence Base*, WRAP, Online http://wrap.org.uk/clothing (accessed 1 March 2013).

4 Better Cotton Initiative, Online http://www.bettercotton.org/ (accessed 1 March 2013).

5 Farrington, D.W., Lunt, J. and Blackburn, R. (2005), Soya Bean Protein Fibres: Past, Present and Future, in R.S. Blackburn (Ed.), *Biodegradable and Sustainable Fibres*, Cambridge: Woodhead Publishing, pp191–220.

6 See for example, *Ecotextile News* (2010), Water Saving Dyes Make A Big Splash, 39, pp20–23.

7 Historic Futures, Online http://www.historicfutures.com/ (accessed 1 March 13).

8 Sustainable Apparel Coalition, Online http://www.apparelcoalition.org/ (accessed 1 March 13).

9 Ehrenfeld, J.A. (2008), *Sustainability by Design*, New Haven: Yale University Press.

10 Rockström, J., Steffen W., Noone K., Persson Å., Chapin III, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. and Foley, J. (2009), Planetary Boundaries: Exploring the Safe Operating Space for Humanity, *Ecology and Society*, 14(2), article 32, Online http://www.ecologyandsociety.org/vol14/iss2/art32/ (accessed 1 March 2013).

11 Ideas of attentiveness are explored in Smith, J. (2012), Road Map – Other Ways of Thinking About Auto-mobility, in R. Tyszczuk, J. Smith, N. Clark and M. Butcher, *Atlas,* London: Black Dog, pp118–123.

12 Centre for Contemporary Art and the Natural World, Online http://www.ccanw.co.uk/past-exhibitions.htm (accessed 1 March 2013).

Introduction

This book explores sustainability issues in fashion and textiles. It does this from the perspective of design. Here design is understood in its broadest sense, not just as a stylist or shaper of things (though this too has an important role), but also as a promoter of social change. Thus, while this book is about design, it is not just for designers. It is relevant to anyone who is interested in taking action and cultivating change towards sustainability. *Sustainable Fashion and Textiles: Design Journeys* explores this action and change through the complex, creative and consumerism-dominated world of fashion and textiles.

The aim of this book is to promote a broad, pluralistic view of sustainability ideas, issues and opportunities in the fashion and textile sector. The goal is to showcase a wealth of alternatives for building long-lasting environmental and social quality through the design, production and use of fashion and textiles that go beyond traditional ideas or expectations. After all, the challenge of sustainability – that is, of integrating human well-being and natural integrity – is such that we can't go on as before. Business as usual, or more to the point, fashion as usual, is not an option. So what should we do instead? The answer, described in the pages that follow, can be found in embracing a multiplicity of starting points, involving many different people, operating across a range of different scales and rhythms. The effect is to produce an array of more diverse, engaging and resourceful fashion and textiles that provides a creative practice for designers and users, secures employment for millions of workers and gives manufacturing industry an opportunity to trial and develop cutting-edge technologies and approaches that dramatically reduce resource use.

This book offers eight different starting points or 'design journeys' from which we can begin to explore these opportunities. Each journey is explored in a separate chapter and covers different, though interrelated, sustainability ground. The journeys described in this book evoke a sense of a landscape. As an analogy, the world of sustainability themes in textiles and fashion is a place of mountains, valleys, plateaus and swampy ground. The mountains rise up like beacons or navigation points and show us ideals, values and direction (where do we want to head?). The valleys in between represent where we are now, at the beginnings of our journey, in the rich, fertile and enthusiastic soil of ideas and possibilities, and still perhaps a little unsure of how the landscape will unfold. The swamps and plateaus represent the difficult terrain where progress is slow. Perhaps it is uncharted territory, a dead end or the start of a potentially exciting new area of investigation. Yet no matter how bogged down we become or whichever vantage point we climb to, we have a sense that no part of this world exists in isolation from the rest. The landscape is a whole and it unfolds before us, changing, eroding and rising up over time.

The design journeys in this book begin in Chapter 1 by navigating the complexities of sustainability impacts of materials, and conclude in Chapter 8 with a voyage into participatory design and open-source initiatives relevant to fashion and textiles. None of them deal with entirely new or futuristic ideas. All of them, or at least almost all of them, already exist to a greater or lesser extent in the fashion and textile sector today. This book draws them together into a holistic, multilayered and more sustainability-oriented vision

for the sector. This is a radical vision, but not an extreme one. Such a vision, in the words of industrial ecologist John Ehrenfeld, 'brings us back to our roots – the meaning at the origin of the very origin of "radical" – and is the natural way to go'.[1] This roots-based, nature-inspired and interconnected vision is developed throughout the book.

There are multiple value systems or world views that influence the approach we take to sustainability.[2] Perhaps the most common is described by pursuing an approach of 'more of the same, but more efficient' and involves making incremental changes to our present-day institutions and practices to bring about improvements. Other approaches frame sustainability as contingent on 'something different'; that is something different to greater efficiency, also involving fundamental personal, social and institutional change. This book steers a course between these two views. It is structured around ideas from the 'something different' paradigm but infuses this framework and ambition with many of the pragmatic, resourceful techniques and experience that have been developed from incremental change in today's fashion and textile sector. The result is a collection of long-term and short-term solutions that help us ground our work in intergenerational sustainability values and yet still be able to make decisions today that are simple, practical and insightful.

Sustainable Fashion and Textiles: Design Journeys brings together information about lifecycle sustainability impacts of fashion and textiles, practical alternatives, ecological concepts and social innovation. The book defines the key relationships between sustainability and the fashion and textile sector and it also challenges the sector to change. Arranged in two parts, the first four chapters of this book represent key phases of the textile product lifecycle. Chapter 1 explores the impacts of cultivating or extracting textile fibres; Chapter 2 focuses on the production phase of the lifecycle or conversion of fibre to product; Chapter 3, the use phase; and Chapter 4, issues associated with end of life. Each of these chapters explores opportunities to improve the sustainability of that lifecycle phase supported by data and case studies and reframes the issues in a holistic context. The remaining four chapters focus on the sustainability of fashion and textiles at the systems level and explore opportunities to influence the root cause of many sustainability problems. Chapter 5 considers the relationship between fashion and consumption, including fundamental human needs and flourishing. Chapter 6 explores the possibility of developing local products and those that are more resource efficient (i.e. light). Chapter 7 investigates issues associated with speed and in particular describes slow fashion. And finally Chapter 8 surveys participatory design and examines its potential for promoting sustainability.

While each of the chapters in this book is complete in and of itself, they are not autonomous or separate from each other. The first four lifecycle-focused chapters clearly relate to each other in a dynamic way; and the final four seek to influence the overall system of which the first four are a part. Thus, the chapters' real value comes from what they represent together; innovative ways of thinking about fibre, fabric and garment based on sustainability values and a broad, interconnected view of design. This broad view of design has been described by the scientist Herb Simon: 'Everyone designs who devises courses of action aimed at changing existing situations into preferred ones'.[3] So in the context of this book, any actions or ideas that help facilitate change towards sustainability are embraced as design. This is a broad category and includes the work of community groups, big companies, individual consumers as well as professional designers. What the authors of these actions and ideas have in common is that they are using practical skills and creative thinking to innovate (normally with a group of other people) to produce products, ways of working or visions compatible with sustainability. Giving form to sustainability in any or all of these ways is vital if it's to become a reality. As the Nobel Prize-winning economist, Amartya Sen, said: 'it is difficult to desire what one cannot imagine as a possibility'. The hope is that this book can help us both desire and imagine sustainability better.

Notes

1 Ehrenfeld, J.R. (2004), Searching for Sustainability: No Quick Fix, *Reflections*, 5(8), pp1–13: p10.

2 Pepper, D. (1996), *Modern Environmentalism: An Introduction,* London: Routledge, p37.

3 Simon, H. as quoted by Thackera, J. (2005), *In the Bubble*, Boston: MIT Press, p1.

PART 1 – SUSTAINABLE FASHION AND TEXTILE PRODUCTS

CHAPTER 1 Material Diversity

Materials play an emphatic role in our current understanding of the ways in which fashion and textiles can contribute towards sustainability. They are, more often than not, our starting point for change and also a valuable commodity for farmer, designer, manufacturing industry, consumer and recycler which works to reinforce their central role. Indeed materials have been a focal point to both recent waves of interest in sustainability issues in fashion and textiles. In the first, in the early 1990s, natural and recycled fibres dominated trade shows', trend forecasters' and industry journalists' views on sustainability. In the second, which started in the mid part of the 2000s – and continues today – organic, Fair Trade and rapidly renewable fibres continue to lead

populist ideas about sustainability innovation, with many companies basing their collections on choice of 'alternative' materials. The fact that materials seem to dominate our ideas about environmental and social responsibility is perhaps not surprising as, after all, the fashion and textile industry's product is material 'stuff' – fibre, fabric, textile product and garment. For all of these reasons this chapter, which investigates the sustainability issues associated with textile materials, is the first in this book. Its aim is to quench the thirst for information about resource consumption, energy use, pollution potential and social impact of textile fibres, providing an information-rich resource that can support design choices. But this chapter also has a broader and deeper goal, to frame knowledge about fibres in a way that promotes a change in perspective: to challenge us to think beyond materials and to link a fibre with its lifecycle, a material with a user, and an industry with the ecological and cultural systems that support it.

In this chapter, the sustainability impacts of producing textile fibres are linked to the ecosystem-inspired idea of diversity. The fusion of fashion and textiles with ideas and terminology cribbed directly from nature appears throughout this book. The purpose is to use ecosystem properties and dynamics – like diversity – to help give direction and an overarching sustainability perspective to the many small design and production decisions that are made on a daily basis, and the hope is that we can then begin to design textile products and production systems that are as sustainable as the ecosystems they are modelled on. This chapter uses the idea of materials diversity to guide and promote the long-term health, resilience and effectiveness of the fashion and textile industry. Diversity is, as the saying goes, about 'not putting all our eggs in one basket'. It avoids agricultural, manufacturing and fashion monocultures and its sustainability benefits flow from sharing ideas, spreading risk and decentralizing production to maximize long-term environmental, economic and sociocultural effectiveness, resilience and stability of the sector as a whole.

Diversity of materials and ideas is hard to find in today's fashion and textile industry. It is dominated by a large volume of similar, ready-made products in a limited range of fibre types. Indeed in 2010 cotton and polyester together accounted for almost 85 per cent of world fibre production;[1] a percentage of the total that is increasing year-on-year.[2] The implications of the dominance of material choices by two fibres is to concentrate impacts in specific agricultural or manufacturing sectors, to increase ecological risk, to make the sector less resilient to changing global conditions in both business and the environment, and to reduce consumer choice. Yet a sustainability-driven strategy of materials diversity does not advocate zero production of the big two fibres – far from

it – but rather as a perspective it works to broaden our fibre-related outlook and make visible alternative, and often unseen, impacts of concentrating our fibre opportunities on so few source materials, ecosystems and supply chains. A strategy of materials diversity aims to temper these fibres' market dominance so that alternative, more resource-efficient and culturally responsive fibres can begin to flourish. Replacing some conventional cotton production, for example, with alternatives such as organic or low-chemical cotton, flax, hemp and lyocell could bring benefits by reducing pesticides and water use. Likewise a shift away from polyester to renewable and biodegradable fibres such as wool and those made from corn starch could also bring benefits, reducing our dependency on petrochemical products including oil. The result would be the cultivation, processing and promotion of a series of 'minority' fibres that, when taken together, amount to a majority. What is more, this majority has the potential to not only serve our material needs with reduced resource consumption, but it could also lead to more varied and locally sensitive agriculture, more regional fibres, more local jobs, and more healthy and socially robust environments. Ideas of diversity rightly reflect the complexity of the relationship between fashion, textiles and sustainability. They underscore the importance of recognizing that no one fibre, regardless of whether it is organic, fairly traded or recycled, can single-handedly transform the practices of a polluting and resource-intensive industry into a more sustainable one. Indeed a focus on materials alone is itself never likely to achieve this.

In sustainability, there is no such thing as a single-frame approach. Issues dealt with in single frames will, almost by definition, lead to unwanted and unforeseen effects elsewhere. To avoid these effects we have to be aware about the impacts of our fibre choices on the ecological, economic and social systems of which these materials are a part – and more tangibly on whole interrelated product lifecycles, which include cultivation, production, manufacturing, distribution, consumer laundering, reuse and final disposal. Broadening our field of vision to the whole helps us 'scope' those areas and lifecycle phases that are particularly high impact and identify key changes that need to be made. For some textile products, like frequently laundered clothes for example, these key changes are linked to improved laundry practices (see Chapter 3). For other textile products, like furnishings, where the production phase is the dominant source of impact, most benefit is brought by making products last longer by, for example, using design strategies that improve both physical and emotional durability (see Chapter 7). This does not mean that choice of fibre is unimportant – on the contrary it is central to what a textile or garment is – only that it is one amid many interconnected factors influencing overall product sustainability.

With one eye firmly fixed on the bigger picture, on lifecycle impacts and a goal of increasing materials diversity through our fibre choices, this chapter reviews the environmental and social impacts of fibre cultivation and extraction. The background to understanding the many and varied impacts of this first phase of the lifecycle is introduced, as well as a short description of the current market for textiles. The review describes some of the more 'promising' fibres that are being produced. To contextualize why some are more promising than others requires us to also review the conventional ones, which is where the fibre-by-fibre analysis begins. The information contained in this chapter is by its very nature detailed and in some cases technical. It can be read from start to finish or dipped in and out of, but its purpose is the same regardless of how it is engaged with – to provide a knowledge base about fibres from which we can begin to explore the whole system potential and direction of sustainability in the fashion and textile sector.

The market in textiles

The demand for textile fibre worldwide is increasing. Two fibres dominate this expanding market: cotton and polyester (see Table 1.1). Demand for polyester has doubled over the last 15 years – and has now overtaken cotton as the most produced textile material. While volumes of natural fibre production have remained fairly constant for several years, cotton fibre production has recently been on the increase along with volumes of cellulosic fibre. Also

Table 1.1 *World fibre production in 2010 (Million tons)*[3]

	World fibre production
Natural fibres	
Cotton	25.10
Wool	1.12
Silk	0.14
Total	26.36
Manufactured fibres	
Cellulosics	3.24
Synthetics	
Polyester	36.46
Nylon	3.86
Acrylic	1.98
Others	0.71
Total synthetics	*43.01*
Total	46.25
TOTAL	72.61

increasing is clothing's share of the total trade in fibre: figures from a recent European Commission study[4] reveal that individuals in Europe consume almost twice as many clothing products by weight as household textiles and combined these add up to 19.1 kg per citizen per year. Across both clothing and household textiles cotton and polyester are the most common fibres; making up 59 per cent by weight of clothing purchases (43 per cent cotton, 16 per cent polyester) and 56 per cent by weight of household textile products (28 per cent each cotton and polyester).

Background to sustainability impacts

Surveys repeatedly show that there has been – and indeed continues to be – tremendous confusion over the sustainability impacts of cultivating and extracting textile materials. Synthetic fibres are commonly seen as 'bad' and natural fibres as 'good'. This preconception is influenced by a complex set of factors including raw material renewability, biodegradability and stereotyped associations made with chemicals, factories and pollution. Certainly while there is no dispute that producing synthetic fibres impacts on people and the environment, natural fibre cultivation and processing also causes substantial impact. Cultivating 1 kg of cotton for example, draws on as much as 3800 litres of water.[5] In comparison, producing 1 kg of polyester uses little water, approximately 17 litres per kg of fibre.[6] Polyester manufacture does, however, consume almost twice the energy needed to make the same amount of cotton. Thus, the key sustainability challenges in fibre production are different for different materials. The process of recording and assessing impacts involves looking at resources consumed (energy, water, chemicals and land) and waste and emissions produced (to air, water and land). The areas of greatest impact in this one lifecycle phase are:

- Large quantities of water and pesticides required for growing cotton;
- Emissions to air and water arising from producing synthetic and cellulosic fibres;
- Adverse impacts on water linked to natural fibre production; and
- Significant use of energy and nonrenewable resources for synthetics.

The relative importance of these impacts also have to be assessed against a constantly evolving base of scientific research and set of social and ethical concerns. For example, around five years ago carbon emissions held a prominent place in the sustainability debate in the UK and this led to a rise in interest in carbon-neutral fibres (i.e. plant-based fibres which absorb the same amount of

carbon dioxide from the atmosphere during their natural growth cycle as they release on harvesting) like lyocell. Today, however, this has been supplemented with other concerns such as rapidly reducing oil reserves and overflowing landfill sites have meant that biodegradable fibres made from renewable resources (and particularly rapidly renewable resources (where the crop takes a maximum of three years to regrow)) are increasing in popularity. This means a shift away from oil-based synthetic fibres such as polyester and nylon that are nonrenewable and non-biodegradable to a range of natural and cellulosic fibres like cotton and lyocell and new breeds of biodegradable synthetics made from plants, like polylactic acid (PLA) from corn starch and soya bean fibre.

Fibre review

The next part of this chapter is dedicated to a review of the environmental and social impact of a range of fibres. There are two main categories of textile fibre: natural and manufactured. Natural fibres are almost exclusively made from plant or animal sources. Manufactured fibres are made from raw materials that come from a variety of sources, including plant, animal and also synthetic polymers (see Table 1.2). The following section describes some of the significant environmental impacts associated with the most popular natural and manufactured fibres. It describes resource use and impacts or emissions to air, water and land where they exist. It also provides a list of possible alternative cultivation or processing routes and material substitutes

Table 1.2 *Textile fibre types*

Natural fibres		Manufactured fibres	
Plant	Animal	From natural polymers (vegetable and animal)	From synthetic polymers
Cotton Flax Hemp Jute Ramie Sisal Banana Pineapple	Wool Silk Cashmere Mohair	Regenerated cellulosic fibres *Viscose* *Modal* *Lyocell* Alginate fibres *Acetate* *Triacetate* Elastodiene (rubber) Regenerated protein fibre *Casein* *Soya bean* Biodegradable polyester fibre *Poly (lactic acid) (PLA)*	Polycondensate fibre *Polyester* *Nylon* Polymer fibre *Acrylic* *Polypropylene* *PVC* Triexta fibre *PTT (hybrid of synthetic and natural polymers)*

for each fibre. After the discussion of conventional fibres, a number of studies are reviewed that compare and assess fibres. This is then followed by an assessment of a wide range of more resource efficient, 'alternative' fibres.

Natural fibres

Cotton

The total area of land dedicated to cotton growing has not changed significantly for around 80 years, but in that time output has tripled. This hike in productivity is widely attributed to the application of large quantities of fertilizers and pesticides to the cotton crop, the application of which is strongly correlated with a range of well-documented environmental impacts including: reduced soil fertility; loss of biodiversity; water pollution; pesticide-related problems including resistance; and severe health problems relating to exposure to acutely toxic pesticides.[7] The pesticides applied to cotton (a generic term incorporating insecticides, herbicides and fungicides) are estimated to make up 11 per cent of global pesticide use. In cotton production, the use of insecticides dominates, making up 25 per cent of world consumption rates, with pyrethoids and organophosphates most widely used. The World Health Organization has classified these as 'moderately hazardous'. However, some organophosphates, the use of which still persists in some of the poorest countries, are classified as 'highly hazardous', are generally acutely toxic nerve poisons and can contaminate groundwater.[8] Large amounts of synthetic fertilizers, often based on nitrogen compounds, are also applied to the crop and can result in nitrate contamination to water, with the effect of accelerating the growth of aquatic plants and algae with subsequent deoxygenation of water into a state in which it cannot support animal life.

The cotton crop is sometimes highly irrigated and cotton agriculture has been associated with adverse changes in water balance, the most infamous case being the 'drying up' of the Aral Sea after water was diverted from two feeding rivers to irrigate cotton plants.[9] The quantities of water drawn down in the irrigation of the cotton crop vary according to agricultural practices and climate and can be up to 3800 litres per kg of cotton[10] although it should be noted that approximately 50 per cent of land under cotton cultivation is not irrigated but rain fed and because water cannot be 'used up' (it is circulated in a natural cycle), problems associated with high levels of water use are linked more to changing access to water (through wells and infrastructure) and water contamination (by fertilizers and pesticides) which makes it unfit for use for other purposes. In Central Asia, perhaps the area of most inefficiently

irrigated cotton, it is estimated that 60 per cent of the water is lost before reaching the fields because of poor infrastructure. Furthermore, irrigation techniques in these areas are extremely inefficient, resulting in huge additional waste of water.

Other inputs in cotton cultivation include between 0.3 and 1 kg of oil per kg of cotton fibre (depending on the extent to which cotton growing is mechanized) to run the farm machinery and to fuel the planes for aerial spraying.[11] If cotton is machine picked it is routinely sprayed with defoliants prior to harvesting to speed up the process and it tends to contain considerably more impurities (seeds, dirt and plant residues) than hand-picked cotton.

Alternatives: organically grown cotton; low-chemical cotton; hand-picked cotton; rain-fed cotton; drip-irrigated cotton; substitute fibres like hemp or flax.

Wool

Just as in cotton, pesticides are used in the cultivation of wool fibre, although the quantities applied per kilo of wool fibre are considerably smaller than for cotton. Sheep are treated either with injectable insecticides, a pour-on preparation or dipped in a pesticide bath to control parasite infection, which if left untreated can have serious welfare implications for the flock. It is known that good husbandry can significantly limit negative environmental impact of using pesticides in wool cultivation. Poor practice can see the use of pesticides impacting on human health and ecosystems both on the farm and in subsequent downstream processing. Organophosphates for example, widely used in the UK until recently to treat sheep scab, are linked to severe nerve damage in humans. Their replacement, dips based on cypermethrim (a pyrethoid), while safer for farmers, have been linked to a significant growth in incidences of water pollution, as they are 1,000 times more toxic to aquatic life than organophosphates. These dips have now been suspended from sale in the UK because they are linked to a high number of water pollution incidences.[12]

For almost all countries, wool is a secondary product of sheep farming – the primary product being meat. As a consequence sheep are rarely bred for the fineness and quality of their wool and as a result the fibre, which tends to be fairly coarse, has low market value and is generally a wasted resource. An exception to this is wool from the Merino sheep – the most important type of wool for apparel production. A single Merino fleece can produce around 5 kg of fine, good-quality wool.

As the raw wool from all sheep breeds is cleaned (scoured) significant environmental impacts arise. Raw wool like all other natural fibres contains

many impurities, but wool is both dirty and greasy, resulting in it being the only fibre type to require wet cleaning before yarn manufacture; although in some techniques like Wooltech's wool cleaning system, the solvent trichloroethylene replaces the use of water. Where wool is scoured with water this is at hot temperatures to emulsify the grease. Scouring produces an effluent (wool grease sludge) with high suspended-solids content and a high pollution index.[13] It is also worth noting that there is a large loss of material during this phase, on average estimated at around 45 per cent by weight.[14] Wool grease is traditionally reclaimed from the scouring process for use as lanolin, however, pesticides applied to sheep have been found to be persistent even in refined grease. Although the switch away from organophosphates sheep dips as well as maximizing the 'withdrawal period', the duration of time between the last application of insecticide and scouring, is helping to reduce this. Wool scouring accounts for a significant part of the energy input in wool production, though the fibre's overall energy use tends to be relatively low, even when compared to other natural fibres. Wool fibre production typically requires almost three times less energy than polyester, and four to five times less energy than synthetic fibres such as nylon or acrylic.[15]

Alternatives: choose wool scoured in factories with strict effluent treatment protocols; or if solvent scoured, where reclamation and recycling of the solvent is ensured; specify organically grown wool.

Silk

Silk is produced from the chrysalis of silkworms. Most commercially produced silk is of the cultivated variety and involves feeding the worms a carefully controlled diet of mulberry leaves grown under special conditions. Selected mulberry trees are grown to act as homes for the silkworms and their leaves are carefully picked by hand as silk quality is highly related to a worm's diet. The trees require fertilizer and pesticides applications, although far less than cotton plants, as the worms are extremely sensitive to poisoning by agrochemicals.[16] Other inputs such as a supply of clean air and careful climate control (heating or cooling) are needed to ensure maximum yields and make it an 'extremely intensive user of resources'[17] although, despite its long-established cultivation, very little information about the environmental effects of silk cultivation is available. The fibres are extracted by steaming to kill the silk moth chrysalis, as if the moth is left to emerge as part of its natural life-cycle the silk filament is damaged, and then washed in hot water frequently with detergents to degum the silk. The wastewater is usually discharged to ground water acting as a low-level pollutant.

Alternatives: choose silk that is degummed in factories with effluent treatment protocols; specify wild silk, organic silk.

Flax

The production of flax (or linen) commonly uses agricultural chemicals, particularly fertilizers to promote strong growth and herbicides to control weeds. However, flax can grow with little attention or fertilizers, as long as water is available. For top-quality fine fibres, the climate must be very moist but mild and, as extensive irrigation is not normally required, the environmental impacts associated with water consumption, pollution and soil salinization are avoided. It is also suggested that bast fibres like linen (and also hemp, jute and kenaf) grow well on land unsuitable for food production and may help re-cultivate soils polluted with contaminants such as heavy metals.[18]

The selection of optimum-quality flax fibre has traditionally been done by hand in many countries – something that makes the process more financially costly though it creates jobs and minimizes fuel use for machinery. The customary process of degumming flax fibres from the stalk (retting) involves placing small bundles of stalks in water tanks, open retting ponds or running river water while the stalk rots and the fibres are separated from the woody core.[19] The nutrients from the decaying stalks mean that water retting is highly polluting to water. Best practice involves alternative techniques such as: dew retting, where plants are left to decompose on the ground with the right conditions of heat and moisture; and enzyme retting, in which enzymes are applied to the flax either in the field or in tanks, and which avoids pollution problems associated with the traditional method. Indeed as part of the push to reduce the environmental impact of retting and increase mechanization, there is a trend towards the development of a number of mechanical treatments for processing flax and other bast fibres like steam explosion and enzyme treatments such as CRAiLAR technology developed by Naturally Advanced Technologies in Canada.

Alternatives: dew-retted flax; substitute fibres such as hemp.

Manufactured fibres

Polyester

The agents used in the manufacture of polyester are petrochemicals and arguably its chief impacts stem from the political, social and pollution effects of the petrochemical industry. Chief among them is a heightened sense of

risk associated with an acute reliance of industries, nations, communities and lifestyles on oil – an increasingly expensive, and difficult to access, resource. Also impactful is the high ecological and social cost of oil exploration and extraction and the infrastructure necessary to transport the oil to the big oil-consuming nations. In the production of polyester, the main chemicals used are terephthalic acid (TA) or dimethyl terephthalate, which are reacted with ethylene glycol. The dominant route for polyester fibre manufacture involves a process of purifying TA and is based on bromide-controlled oxidation. Petroleum products are not only used as feedstock, but other fossil fuels are used to generate the energy required to convert the fibre. The amount of energy consumed in producing 1 kg of polyester is 109 MJ, the product of 46 MJ, the fuel value of the crude oil and natural gas used for making the raw materials, and 63 MJ of energy needed to process this raw material into fibre.[20]

In general terms, water consumption in the production of manufactured fibres is lower than for natural fibres. Polyester, for example, can be processed by several routes; the most common one, described above, consumes 'small amounts' of water although in other routes, no water is consumed.[21] In terms of emissions (to air and water) arising from the production of polyester, these are seen to have a medium to high potential of causing environmental damage if discharged untreated including: heavy metal cobalt; manganese salts; sodium bromide; antimony oxide (which is licensed by law despite it being a known carcinogen) and titanium dioxide.

Alternatives: choose fabrics not made with catalytic agents containing cobalt or manganese salts and those which avoid antimony-based catalysts; specify recycled polyester; choose fibre substitutes such as PLA.

Nylon

Similarly to polyester, nylon (or polyamide) fibres are based on a petrochemical feedstock and are affected by the same issues as polyester, namely the political, ecological and pollution effects associated with carbon chemistry. There are several forms of nylon. In the production of nylon 6.6 for example, raw materials hexamethylendiamine and adipic acid are combined to form a polyamide salt. The molecules of the two chemicals react under high pressure and heat. The polymer is then extracted and cooled with water. The process is known to be energy intensive, however, and producing 1 kg of fabric consumes 150 MJ of energy (as compared with 109 MJ per kg for polyester and 50 MJ per kg for cotton).[22] Producing nylon also produces emissions of nitrous oxide, a potent greenhouse gas. Nitrous oxide emissions

from a single UK nylon plant in the 1990s were thought to have a global warming impact equivalent to more than 3 per cent of the UK's entire carbon dioxide emissions at the time.[23]

Alternatives: substitute alternative fibres such as wool (for example in carpets).

Acrylic

Like other synthetic fibres, acrylic fibres are made from mineral oil or other hydrocarbons. Acrylic polymer is produced by forcing acrylonitrile to react with various combinations of process chemicals including styrene, vinyl acetate, ammonium persulphate and iron among others. It is then solvent spun, washed in hot water to remove residual solvents and salts, drawn in tanks of water that are kept near boiling point (to give the fibre strength), finished by immersion in an acid bath to give the fibre an anti-static treatment and then dried. Acrylic is roughly 30 per cent more energy intensive in its production than polyester and consumes substantially more water.[24] The environmental implications of its production are not well understood despite its significant presence in the textiles market[25] though it is thought that a significant number of production chemicals (including its base ingredient acrylonitrile) have a high potential for creating environmental problems if discharged untreated.

Alternatives: avoid acrylic fibres and fabrics processed with vinyl acetate and those spun with the solvent dimethyl foramamide; substitute alternatives such as wool.

Viscose

Cellulosic fibres like viscose are formed from natural polymers that are chemically dissolved and then extruded as a continuous filament. A common source of cellulose for viscose is fast growing soft woods such as beech, although other sources such as bamboo have gained in popularity more recently. The raw material for cellulosic fibres is frequently described as carbon neutral (where the growing cycle of the plant absorbs the same amount of carbon dioxide from the atmosphere as it gives out on harvesting). However, the rest of the viscose fibre production process has significant environmental implications. The cellulose is firstly purified and bleached and then soaked in sodium hydroxide. It is then treated with carbon disulphide and then finally spun in a solution of sulphuric acid, sodium sulphate, zinc sulphate and glucose.[26] The production of viscose generates emissions to air in the form of sulphur,

nitrous oxides, carbon disulphide and hydrogen sulphide. Emissions from the process to water result in high pollution indexes. These emissions are all considered to have major potential for creating environmental problems if discharged untreated. One study of the toxicity of viscose water effluents concluded: 'It had high levels of bio-chemically degradable substances, organic matter, nitrates, phosphates, iron, zinc, oil and grease. The effluent was completely devoid of dissolved oxygen and micro organisms.'[27]

Bamboo viscose is processed using the same route as conventional viscose, substituting woody bamboo grass as the generic, anonymous input into a cellulosic fibre production process. Certainly deriving cellulose from such a rapidly regenerating raw material like bamboo confers some benefit, however, the sustainability credentials of viscose made from cellulose sourced from bamboo are overwhelmingly influenced by those of the poor resource and emissions profile of the viscose production process itself. Bamboo viscose also has other claims made about it, not least assertions about its anti-bacterial properties, special UV protection and an ability to shed dirt, among others.[28] There is no evidence for any of these claims. In the case of the assertion about antibacterial qualities, cellulose (the building block of bamboo) has no inherent antibacterial action and there is nothing in the viscose production process that confers this on to fibre. As to protection from UV radiation, viscose fibre manufactured from cellulose with origins in bamboo grass would protect as much as other cellulosics – with no special status for bamboo. As to the claim about shedding dirt, the same argument applies. It is as self-cleaning as other cellulose-based products, none of which are noted for their self-cleaning qualities, unlike fibres such as wool for example.

Alternatives: viscose made from wood from sustainably managed forests; viscose produced without chlorine-containing bleach and zinc sulphate and which avoids catalytic agents containing cobalt or manganese; choose viscose from factories with strict effluent treatment protocols including biological purification before discharge; substitute lyocell for viscose.

Fibre comparisons and assessments

As the previous part of this chapter has highlighted, sustainability issues associated with fibres are nuanced and involve many trade-offs, often making findings difficult to interpret. To aid assessment and interpretation, there are a range of different tools, software models and methods available. Some models and methods are based on qualitative assessments aimed at gathering detailed, nuanced though non-generalizable information about specific issues; while others quantify and balance a product's environmental

impacts, frequently using a technique called lifecycle assessment (LCA). Both approaches have benefits and limitations. For example, qualitative studies tend to generate equivocal findings. And LCAs, even though there are well-established internationally recognized methodologies, have a history of partisan results and methodological inconsistencies arising from different ways of defining boundaries around the problem being investigated. Thus, the same rules apply to interpreting findings about fibre impacts as to analysing all information: use multiple sources and foster a mindset of critical enquiry that asks ever deeper questions about the story we're being told. For all this, fibre assessments and comparisons are valuable and are perhaps at their most powerful when they are used to drive new ideas and innovation forward. They can do this by highlighting particularly polluting or resource-intensive practices and so act as a spur to drive change towards low-impact methods; and when used as part of a creative process to assess the sustainability potential of alternative scenarios and future strategies.

Fibre assessments and comparisons have been – and also continue to be – used in other ways, including to defend an organization's products, frequently by shifting the spotlight of environmental impact onto other fibres (usually cotton) or lifecycle phases (most commonly the use phase) to give the sponsoring body's products, practices and processes more positive spin. In the early 1990s for example, the synthetic fibre producer DuPont published a rank of a range of fibres,[29] it claimed, across the whole lifecycle – although the report said little about assessment criteria, methodology or assumptions. It concluded – perhaps unsurprisingly given DuPont's product range – that synthetics were superior and listed polypropylene as the preferred fibre; followed by nylon; joint third position is held by wool, polyester and acrylic; cotton is in sixth place and viscose is given the worst environmental loading. Also in the 1990s, cellulosics fibre producer Lenzing also published comparisons, contrasting viscose and cotton, concluding that its product, viscose, causes slightly less impact;[30] and comparing cotton and lyocell, determining that cotton uses more agrochemicals, land and water than lyocell and only slightly less energy.[31] Cynically, these studies can be seen as an attempt to deflect scrutiny from these manufacturers' interests and own products at a time when manufactured fibres were widely perceived as 'bad' for the environment. Yet these studies also hint at the beginnings of an awareness of a more complex and relational understanding of sustainability issues associated with textile fibres, an understanding that has since been promoted by a wide range of other studies.

More recent comparative studies reveal the extent of variations in resource consumption between fibre types for the cultivation/extraction

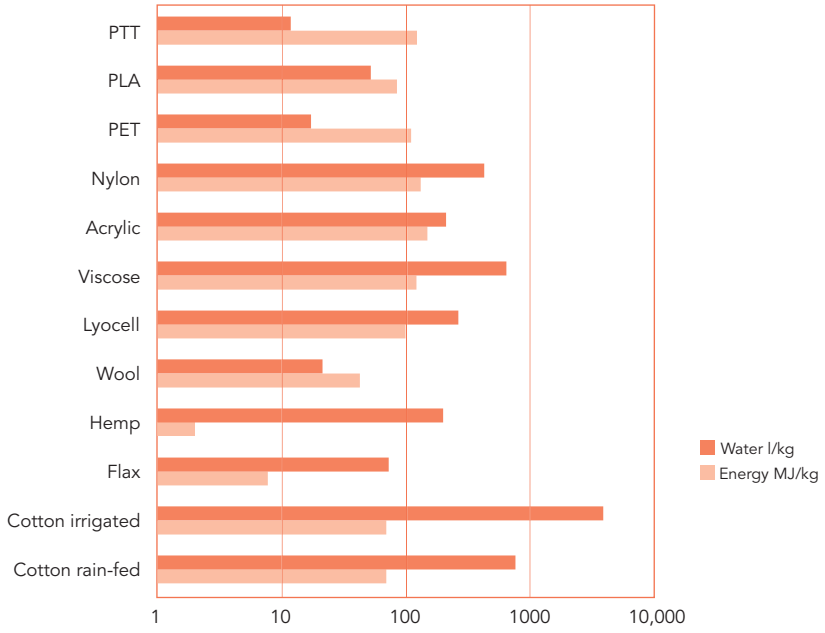


Figure 1.1 *Energy and water consumption in the production of selected fibre types*[32] *Note the log scale.*

phase of the lifecycle. A report for the UK Department of Environment[33] enumerates levels of energy and water use for the production of 1 kg of a variety of textile fibres (Figure 1.1) and offers a qualitative assessment of other impacts. For viscose, acrylic and polyester there are also significant emissions to air; for viscose and wool, significant emissions to water; and for cotton, very high levels of pesticide use. Other phases of the lifecycle including manufacturing, use and disposal also consume resources and produce wastes and in many cases these environmental impacts dwarf those associated with fibre cultivation and production.

A report commissioned by the European Union[34] into the environmental impact of textile fibres offers different insights, choosing to apportion a percentage value of impact to four lifecycle phases: production, transportation, use and end of life across a range of indicators. For three of these indicators – human health, ecosystem diversity and resource availability – the results paint an interesting picture (Figure 1.2). The major sources of impact on human health and resource availability are shared fairly equally between producers and users of textile products, serving to underscore the essential reality within sustainability that the issues faced are the responsibility of all actors, not an opportunity to deflect blame elsewhere. On the measure of ecosystem diversity, almost three-quarters of total impact is attributed to the

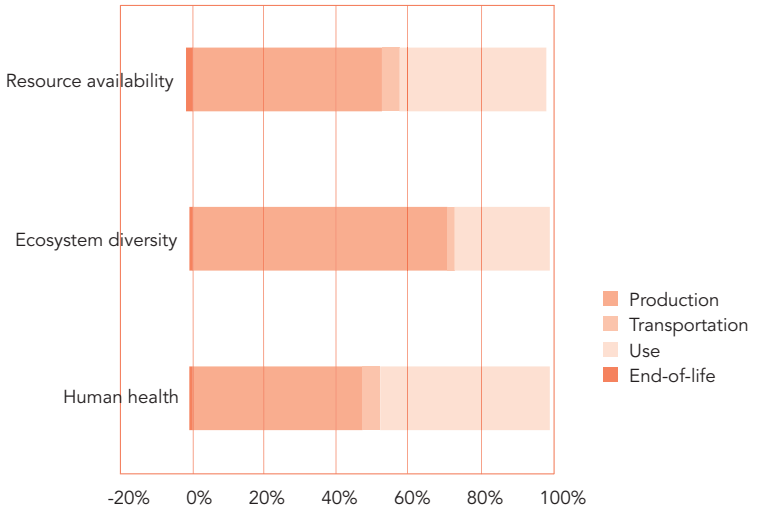


Figure 1.2 *Environmental impact of textile consumption in Europe on three indicators*[35]

activities of fibre producers: an impact value connected as much with the choices of designers and consumers as with fibre manufacturers, but which suggests at the value and importance of a strategy of working with a diverse range of fibre types alongside selecting lower-impact alternatives.[36]

A different approach again to comparing fibres' environmental credentials is taken by the supply chain transparency non-profit organization MADE-BY.[37] Following the commissioning of a piece of research compiling existing impact data on six parameters – greenhouse gas emissions, human toxicity, eco-toxicity, energy input, water input and land use – and weighting them differently, MADE-BY published a fibre index classification which categorized 25 textile materials from A (most environmentally friendly) to E (least friendly). The outcome, created as a quick reference tool for production managers and designers to increase the take-up of lower-impact fibre alternatives, reflects current thinking for the most part, though with some unexpected placement of entries – most notably the placing of wool in the worst category E. Wool's dubious ranking reflects the assumptions made in the research about the various weightings of different parameters and its lack of sensitivity to different types and qualities of land use – land grazed by sheep is often poor quality, sustaining only a small herd and resulting in a low yield per hectare. Perhaps most critically, the classification risks promoting an out-of-context view of fibre choices; stripped of information about the effect of other lifecycle phases or the underpinning goals and purpose of why certain fibre choices are made, the classification risks trading accuracy for simplicity.

Other authors have used the process of comparing fibres to predict future fibre trends and market success. One such study by Drury and Slater[38] published in 1996, which has proved somewhat prescient, contrasted the environmental costs of producing three 'alternative' fibres: hemp, lyocell and recycled polyester. Its conclusion states that in the short term, waste products (like recycled polyester) will be popular; and in the medium term lyocell will be successful. Hemp is the only fibre of the three seen to have 'true environment friendliness' and if its association with marijuana production is controlled it is considered the most successful of the three in both environmental and market terms 'once raw material scarcity has reduced our ability to produce the other two fibres'.[39] Almost two decades on from the publication of this study, 'raw material scarcity' is beginning to figure more heavily in conversations, particularly in the context of ideas such as Peak Oil, although has yet to radically transform fibre consumption practices. This being said, interest in renewable-resource-based fibres (including lyocell, PLA and soya bean) continues to grow and these are frequently promoted as replacements for petrochemical-derived synthetic fibres like polyester. Regardless, all of these fibres continue to remain niche products, none of them having won a substantial market share. Instead, perhaps the most familiar 'alternative' fibre is organic cotton.

Organic cotton is the focus of another comparative study,[40] this time with an affiliation to the company Patagonia, which has a strong interest in the fibre. Here the environmental costs for growing cotton conventionally are contrasted with growing it organically. This study converts the costs into a monetary value that is priced per stage in the lifecycle (see Table 1.3).

Table 1.3 *Environmental cost of each stage in the lifecycle of a cotton T-shirt (US dollars per T-shirt)*[41]

	Conventional cotton	Organic cotton
Growing	0.67	0.33
Ginning	0.02	0.02
Processing	0.02	0.02
Distribution	0.08	0.08
Transportation	0.32	0.32
Consumer care	2.69	2.69
Total	$3.79	$3.45

It attempts to put a direct monetary value on nature's 'services' which are drawn upon in cotton cultivation – such as fresh water, clean air, healthy biodiversity and productive land – and concludes that these costs of growing conventional cotton are roughly twice those of organic cotton. The variation reflects differences between the two techniques' effects on soil erosion, their pesticide use and water consumption. It is worth noting, however, that most impact is attributed to the consumer-care phase of the lifecycle (discussed further below).

The practice of attributing a monetary value to environmental cost has recently been taken to another level by the sportswear brand Puma in its pioneering initiative to construct an 'Environmental Profit and Loss Account' for its business by putting a cost on the impact a business has on the environment, across its entire supply chain. Inspired by a study on the economic benefits of biodiversity by The Economics of Ecosystems and Biodiversity (TEEB),[42] Puma is attempting to put a transparent cost on its impact on nature. Although these costs have no impact on the company's actual net earnings, the goal is to make clear the magnitude of the costs and to identify high impact points in the supply chain with a view to acting to reduce this impact. Puma started with greenhouse gas emissions and water usage, later adding land use, air pollution and waste, and costed these as services that must be paid for – in this case, with the planet as a service provider. Analysis of where these costs were being incurred showed that £6.4m or 6 per cent of the costs lay with the company's own direct operations, such as offices, warehouses and stores. A further 9 per cent lay with its Tier 1 suppliers, the companies responsible for manufacturing Puma shoes and clothing. The remaining 85 per cent of the impacts were distributed through its Tier 2, 3 and 4 suppliers going right back to the actual sourcing of raw materials, such as leather, cotton and rubber.[43]

Switching the emphasis away from brands and producers, the significant role played by the behaviour of consumers in a textile product's overall lifecycle performance was first highlighted by an LCA of a polyester blouse[44] conducted in the early 1990s for a report commissioned by the American Fiber Manufacturers Association: a conclusion that continues to be corroborated by the findings of numerous other LCAs since.[45] The Franklin Associates' report concludes that as much as 82 per cent of energy use, 66 per cent of solid waste, 'over half' of the emissions to air and 'large quantities' of waterborne effluents produced throughout the product lifecycle are amassed during use phase of the lifecycle (i.e. consumer care or laundering) (see Chapter 3 – Use Matters). Rather than comparing different fibres, this study compared the impact of different phases in a product's life. The conclusions,

whether by accident or design (given the particular interests of the study's sponsors), have the effect of training the laser of scrutiny of environmental harm on to the inconspicuous, widely dispersed laundering actions of every domestic setting and away from producers and industry. Its effect usefully instructs us about the lifecycle phases of most harm, but can also be seen to undermine a sense of shared and holistic responsibility for impact reduction in the sector. The report, for example, wasted no time in putting the onus of impact reduction on consumers.[46] More recently Cotton Incorporated, the trade body promoting American cotton growers and businesses, used an LCA to subtly bolster its constituency stating that: 'the agricultural production phase had the lowest relative impact of the three lifecycle phases in all categories except water consumed'[47] and setting out four areas for critical improvement only one of which falls in its territory:[48]

– Continue to conduct research to improve cotton's water and nitrogen use efficiencies;
– Work with mills to measure energy demand and water use of alternative spinning and wet processing technologies, which will identify opportunities for further reductions in the burdens associated with textile manufacturing;
– Continue to support wastewater reduction research;
– Educate and engage with consumers to significantly reduce the impacts at the use phase level.

LCA-driven data also plays a prominent role in the University of Cambridge report *Well Dressed?*[49] In the report, impacts arising from different scenarios for three textile products are compared. For each scenario, the product's impact is compared against the impact of the 'base case', so as to identify increases or reductions in impact. The report focuses on a cotton T-shirt, viscose blouse and nylon carpet and compares environmental, economic and social data for various scenarios, including:

– Changing the location of textile and clothing operations with and without new production technology and recycling schemes;
– Changing consumer behaviour including extending the life of clothing and improving the efficiency of laundering practices;
– Introducing alternative fibres, green manufacturing and 'smart' technologies.

The results show that shifting production of the T-shirt and viscose blouse to the UK brings modest savings across the board. The savings are modest only

because the use of energy for transportation is relatively small (compared to the washing of clothes) so shifting the location of production has little effect. In contrast, changing consumer behaviour and particularly omitting tumble-drying can have a large positive effect on environmental impact. A positive effect on social impact is also possible if consumers change behaviour and embrace a raft of reuse, repair and recycling activities to enhance the lifespan of their clothes. The introduction of alternative fibres and innovative technologies such as organic cotton and stain-repellent coatings in the case of the T-shirt brings savings across all measures. For carpets, however, switching from man-made to natural fibres has mixed effects, generating more carbon dioxide and waste but fewer other environmental impacts such as ozone depletion, acidification, nutrient enrichment and smog formation. Not only is the detail provided by this report very useful, its whole approach – based on lifecycles, industrial systems and recommendations that stretch beyond traditional company boundaries to also include consumers – is progressive. Usefully from a design perspective it also shows how scenario building can be used creatively to imagine a different future for our sector.

Fibre 'alternatives'

The process of reviewing and comparing fibres makes opportunities to reduce impact more visible. These include, for example, the development of better practices in the production of conventional fibres as well as the introduction of a group of different and inherently lower-impact fibres. Some of these changes could be brought about by a move to alternative systems of agriculture that are already well established (such as integrated pest management or organic cultivation methods for example), while others are more challenging and need technical development. The following section reviews a wide range of these alternatives.

Organic cotton

The greatest sustainability challenges for cotton cultivation lie in reducing pesticide, fertilizer and water use, and promoting better information and conditions for farmers. Cultivating cotton organically, that is in a system that does not use synthetic pesticides, fertilizers, growth regulators or defoliants, addresses many of these issues. In the organic system the use of synthetic pesticides and fertilizers is avoided as natural methods are used to control pests, weeds and disease. Particular attention is paid to the use of locally adapted varieties, the reduction of nutrient losses through wide crop

Table 1.4 *Toxicity profile of a conventionally grown cotton T-shirt*[50]

Lifecycle phase	Percentage of total impact
Material	93.0
Production	3.5
Transportation	1.0
Use	2.5
Disposal	0.0

rotation, and mechanical and manual weed control.[51] Switching to organic production brings a major reduction in the toxicity profile for cotton (as minimal chemicals are used). Table 1.4 shows the lifecycle toxicity profile for a conventionally grown cotton T-shirt. Organic production results in a dramatic change in the profile – the toxicity of materials drops to zero and overall product toxicity is reduced by 93 per cent.[52]

Organic production also has a strong social element and includes many Fair Trade and ethical production principles; as such it can be seen as more than a set of agricultural practices, but also as a tool for social change. One of the original undertakings of the organic movement was to create speciality products for family farmers struggling to stay on the land and who, through receiving a premium for their products, could compete with large commercial farms. Further promoting social change, organic standards also make recommendations to industry about production. The view is that it is not enough for cotton to be grown organically and then processed in a conventional, polluting system; and organic textile standards and accreditation schemes, such as the Global Organic Textile Standard,[53] include lists of permitted process chemicals and recommendations for dyeing and finishing techniques. Accreditation is growing across different scales of industry – from small companies producing fully accredited organic cotton ranges to global brands like Levi's using organic cotton in its products.

Unlike more politically contentious and technically challenging 'alternative' fibres like hemp, organic cotton fibre is a fairly straightforward like-for-like substitute for conventionally grown cotton and as such it has been fairly quickly incorporated into existing product lines. The mainstreaming of the organic sector has also seen the reproduction of speculative and unfair behaviours from the conventional market, behaviours which are counter-intuitive to the organic principle of ensuring long-term livelihoods.[54] The main factor limiting the increased use of organic cotton is its limited supply.

◀ Eco jeans in 100 per cent organic cotton with sustainable product components and production processes by Levi's

Figures from the growing season 2010–2011 reveal that organic cotton makes up a tiny percentage, 0.7 per cent, of the total cotton market, a figure down almost 40 per cent on the previous year: a reduction explained as an inevitable rebalancing of an overheated market.[55] Over two-thirds of organic cotton is produced in India where almost 325,000 hectares of land are certified for organic cotton cultivation. The quality of cotton grown in organic systems is equal to that grown in conventional ones, however, uniformity over large volumes can be an issue due to the limited supply of organic fibre for blending. Productivity of organic production is usually less than for conventional production, by up to 50 per cent and this has given rise to scepticism in the fibre industry of organic cotton's viability as a true replacement for conventionally grown fibre, as lower yields require more land (of which there is a finite amount) in order to meet demand.

Low-chemical cotton

Organic methods of cultivation offer one way to reduce the use of chemicals in cotton production, although other methods exist such as integrated pest management (IPM) and the introduction of genetically modified (GM) varieties. In California, USA, it has been found that biological IPM techniques have the potential to reduce more chemical use than organic cultivation practices. They do this by bringing more farmers and more hectares into chemically reduced programmes and so reducing chemical use across a large numbers of farms rather than just eliminating it in a few.[56] In California, organic cultivation of cotton has been slow to take off because of the method's increased demand for manual labour, which makes Californian-grown organic fibre expensive. The Sustainable Cotton Project has championed IPM techniques in California through its BASIC (biological agricultural systems in cotton) programme, and claims that over the last seven years BASIC growers have consistently achieved reduction of fungicides, insecticides and miticides by around 70 per cent.[57] BASIC cotton is also non-GM and is recommended by the Sustainable Cotton Project as a complement to organic programmes.

A philosophically contrasting low-chemical approach to BASIC is offered by the introduction of GM varieties of cotton. Whereas organic and non-GM agricultural programmes like BASIC engage farmers in biological solutions to pest management and natural agricultural controls, GM is a technological or industrial 'fix' to chemical reduction. Recent figures suggest that GM cotton crops now cover 60 per cent of the global cotton area.[58] The main varieties of GM cotton grown assist with pest management (and include the bacterial toxin *Bacillus thuringiensis* (Bt)) or are tolerant to herbicides (HT), although

varieties with multiple traits are now available. For farmers the benefits of GM varieties include: reduced pesticide use (because the crop is toxic to pests, comes under attack less often and so requires fewer sprays); equal or higher yields; no impact on fibre quality; and increased income because of less outlay on pesticides.[59] For the environment, chief benefits arise through reduced pesticide use; it is claimed, for example, that significant reductions in pesticide use have occurred in every country where Bt cotton has been grown.[60] Moreover, it leads to low tillage of the soil which results in less particulate matter in the air and greater water retention due to less compacted soil.[61] There are, however, a number of concerns about GM agriculture. One report by the biotech industry itself revealed that while pesticide use did decline in the first three years after herbicide-tolerant GM crops were commercialized, it is now significantly higher than on conventional crops,[62] a fact explained by weed communities changing to species that are more tolerant of high doses of herbicide, which has resulted in farmers spraying more. Other concerns are linked to the privatization of seed research – ten companies now control over half the seed industry[63] – and this is negatively affecting diversity and choice of conventional and organic seeds which in turn are being threatened by contamination from GM varieties. However, perhaps the greatest concern over GM technology is that its rapid rise (GM crops were introduced for the first time in 1996) is driven by commercial gain and the goal of making marketable products rather than long-term ecological or social improvements. Interestingly, neither the Better Cotton Initiative (BCI),[64] a body made up of representatives of the cotton supply chain from farmers to retailers, whose aim is to establish a value chain for cotton produced in a sustainable manner at scale, nor the Cotton Made in Africa (CmiA)[65] scheme which has similar goals, have rejected GM cotton in their standards, instead choosing to review the efficacy of a range of approaches on a region-by-region and case-by-case basis. In the first harvest of BCI cotton there was reported to be a 50 per cent reduction of both pesticides and water use and a 30 per cent reduction of the use of chemical fertilizers.[66]

▶ White 100 per cent African cotton dress by Noir

Low-water-use cotton

In addition to reducing the chemical use of cotton, minimizing water usage of cotton also brings benefits. Around 50 per cent of cotton is irrigated; the remainder is partially irrigated or depends entirely on rainwater. Currently 99 per cent of West African cotton is rain fed, as is a large proportion of Indian cotton. Rain-fed cotton offers obvious benefits including healthier soils and less demand on the water infrastructure, although there are trade-offs.

Though it uses less water, rain-fed cotton also tends to be of poorer quality because of the sporadic supply of water to the plant. Efficient irrigation techniques are also available, such as drip irrigation that reportedly saves up to 30 per cent water consumption compared to conventional irrigation.[67] This technique, however, is labour intensive and only suitable to areas where hand-picking is the harvesting method as the drip-irrigation lines have to be laid down by hand, and in any country that harvests mechanically these have to be ripped up at the end of the growing season.

▶ Organic wool tweed by Isle of Mull Weavers

Fair trade cotton

There are many social and health issues associated with cotton cultivation, including poor workers' rights (low pay, lack of job security, etc.) and hazardous working conditions mainly associated with application of pesticides. While most organic or low-chemical schemes tend to concentrate on environmental standards, other initiatives work to improve the sustainability of cotton agriculture by focusing on social goals. One such example is the fair trade movement which aims to ensure that producers receive a fair price for their product, benefit from acceptable working conditions and have access to education and health care. In 2005, a Fairtrade mark was introduced for seed cotton (the raw cotton, before ginning) that guarantees that cotton growers earn a minimum price for their product and a further premium to be used for community development projects. It also includes some environmental criteria and seeks to minimize the use of agrochemicals and prohibit the use of the most hazardous pesticides. Fairtrade mark cotton farmers are also required to use individual protective equipment when spraying pesticides, to help reduce the risk of pesticide poisoning.[68] Notably, Marks and Spencer has a very substantial commitment to Fairtrade mark cotton as part of its 'Plan A' sustainability initiative, pledging to: convert '20 million clothing garments to "Fairtrade" cotton – equal to 10 per cent of all M&S cotton use'.[69] Other projects, such as Illuminati II,[70] produce high-quality fairly traded African cotton based on the United Nation's Global Compact Principles[71] that include labour, human rights, environmental and anti-corruption issues.

Organic wool

Organic wool comes from sheep reared on organically grown feed, that graze on land not treated with pesticides and that are not dipped in synthetic pyrethoids or organophosphates. Sheep scab can be controlled only with certain injectable or pour-on preparations that minimize use of chemicals, impacts

on fresh water ecology, and downstream processing. While the market for organic wool is very small, it is growing, given impetus by companies like Marks and Spencer, who as part of its 'Plan A' sustainability initiative is sourcing a range of more sustainable fibres, including organic wool. Organically grown wool fibre can now be processed in the UK into a fully licensed organic product (which requires each manufacturing stage to have separate organic accreditation) and was developed into the UK's first organic tweed by Isle of Mull Weavers.[72]

Hemp and other bast fibres

Hemp (sometimes called cannabis hemp) grows very rapidly, naturally smothering weeds and controlling pests, and so is thought to be suited to low-impact systems of agriculture. Growing hemp also helps clear land for other crops; it improves the structure of the soil, its strong roots controlling erosion; it has a high yield and can be grown in cool climates. It grows to between one and four metres tall and yields around six tonnes per hectare. Between 20 per cent and 30 per cent of the plant is fibre and its yield is far superior to other natural fibres (see Table 1.5), leading to claims that hemp gives a 'double dividend'; a reduction in the ecological footprint of production by about half for an equivalent volume, if grown to replace cotton for use in textiles and wood for use in the pulp and paper industries.[73]

The narcotic properties of the plant from which hemp is extracted, cannabis sativa, have meant that its cultivation has been banned in many countries irrespective of the fact that varieties with a low psychoactive compound Tetrahydocannabinol (THC) are available. Fibre extraction (i.e. by retting) and associated environmental problems for hemp are similar to that for flax. Optimum-quality fibre is achieved by using traditional hand methods of harvesting and processing and is still done in some parts of China, however, high labour costs make this uneconomic in many countries. As a result other fibre

Table 1.5 *Average natural fibre production per hectare*

	Average fibre production (kg) per hectare
Cotton	300–1100
Flax	800–1150
Hemp	1200– 2000
Wool	62

extraction techniques have been developed and include enzyme retting and steam explosion. In steam explosion the fibre and the hemp plant's woody core are broken apart by the blast of steam and this shortens the fibre's staple length. While this makes hemp easier to process, it reduces its strength.

Other developments in processing have led to improved fibre qualities and resource profiles. The CRAiLAR enzyme-based process, for example, can turn natural bast fibres — such as hemp, flax, jute and kenaf — into finished textiles with a softer hand than traditional bast fibre processes which can then be integrated into existing spinning, weaving and fabric forming technology. While the CRAiLAR process was originally applied to hemp, more recently it has concentrated on flax and involves taking dew-retted raw fibre and treating it with the proprietary CRAiLAR process to remove the plant's stiffening lignins. The result, according to CRAiLAR's manufacturer, is a fabric indistinguishable from cotton and which requires 17 litres of water to produce a kilogram of finished fibre,[74] compared to around 760 litres for the same weight of rain-fed cotton.

▼ Bette hemp dress by Enamore

▲ Woven fabric in 100 per cent peace silk by Denise Bird Woven Textiles

Wild (or peace) silk

Wild silk production cultivates silkworms in open forest where there is an easy source of food and uses no hazardous chemicals. As such the production can encourage forest preservation (as an integral part of the forest ecosystem) and provide a major year-round income for millions of tribal people in India.[75] The silkworm chrysalis is collected after the moth has emerged naturally, as compared with cultivated silk where the silkworm grub is killed while in situ, hence the term 'peace' or sometimes 'vegetarian' silk. It is then degummed in the same way as cultivated silk by washing with mild detergent. Wild silk is perceived as being of lower quality than cultivated silk as the moth damages the silk cocoon as it exits the chrysalis breaking the single continuous filament. Thus, wild silk yarn and fabric, unlike that from cultivated silk, is made from short lengths of fibre (or staples) and is spun in a similar way to other staple fibres such as cotton.[76]

Polylactic acid and other biopolymers

Polylactic acid (PLA) is a thermoplastic polyester (also known as biopolymers) derived from 100 per cent renewable sources, presently corn. Unlike conventional synthetics like polyester, which is made from fossil fuels and

is non-biodegradable, PLA fibre is derived from annually renewable crops and is compostable, although only in industrial composting facilities which provide the right combination of temperature and humidity to trigger the fibre to break down.[77] While claims about the sustainability benefits of biopolymers over petrochemical fibres include energy savings, fewer emissions and use of renewable resources, they are also associated with significant environmental impacts. These include the negative effects associated with large-scale, intensive agriculture of the feedstock, often corn, a food stuff which is diverted away from mouths to fulfil demand for fibre; and the problems associated with landfilled biopolymers including the generation of methane, a powerful greenhouse gas, an increased level of eutrophication, eco-toxicity and production of human carcinogens.[78] As a result there have been some calls for a full assessment of the impact of biopolymers on sustainability indicators of land use, soil conservation and nutrient cycles as well as the more established indicators such as greenhouse gas emissions and energy flows in order to better understand their potential and direct their use.[79]

Initial uses of PLA were limited to biomedical applications such as suture material because of the high cost of manufacture and limited availability,

▼ T-shirt in 100 per cent Ingeo produced as part of the 'Genetic Modification' collection by Moral Fervor, inspired by the quandary surrounding GM technology

however, more recently, economic large-scale operations have developed, although it is still over three times more expensive than polyester.[80] PLA is created by extracting starch from the corn, converting it to sugar by enzymatic hydrolysis and then to lactic acid through fermentation. This is then turned into fibre using traditional melt spinning equipment and processes. A number of manufacturers now offer PLA products and while corn is currently the cheapest and most readily available source of sugar, there are other alternatives to corn for the starch or sugar supply including waste biomass and marginal crops such as grass.[81]

The fibre properties of PLA can be considered broadly similar to PET, however, it has a lower melting point which can restrict its use in certain applications, making it unsuitable for certain processing routes (such as transfer printing); although a new fibre type with higher melting temperature characteristics has now been introduced.[82] Another restriction arises in dyeing and finishing; where water can enter the fibre and weaken the molecular bonds and reduce fibre strength if appropriate processing (most notably cool temperature and acid) conditions are not observed. This is problematic in bleaching and dyeing, as these tend to use alkaline processes. Further, when dyeing PLA, more dye is wasted than when dyeing polyester. Dark shades are difficult to obtain because of these lower dye exhaustion levels – although these technical difficulties are predicted to be resolved over time. Research indicates that PLA is more sustainable than comparable polymers on the market today.[83]

The development and commercialization of PLA as a low-impact fibre alterative has been repeated in other polyester fibres which combine up to 37 per cent biopolymer feedstock with virgin petroleum polyester polymers to create hybrid fibres such as DuPont's *Sorona* and Teijin's *PlantFiber* and are often marketed as an immediate replacement for the traditional hydrocarbon-based feedstocks used to make polyester. Other biopolymers are also becoming available including a nylon fibre derived from castor beans[84] and a bio-based elastane.[85]

Lyocell

Lyocell is a cellulosic fibre made from wood pulp, normally eucalyptus, and was developed in the 1980s, as it is claimed 'an environmentally responsible fibre utilizing renewable resources as its raw materials'.[86] The wood pulp is dissolved in a solution of amine oxide (a solvent) that is then spun into fibres and the solvent extracted as the fibres pass through a washing process. Other than evaporation of water, the manufacturing process recovers 99.5

▶ Suit in lyocell by Linda Loudermilk

per cent of the solvent, which is purified and then recycled back into the main process. The solvent itself is non-toxic, non-corrosive and all the effluent produced is non-hazardous. Lyocell has other environmental benefits including its full biodegradability (taking six weeks in an aerated compost heap), its renewable raw material (eucalyptus has a fast growing cycle and reaches maturity in seven years) and careful attention paid to sourcing wood pulp from fully accredited, sustainably managed forests. Further environmental advantages include: no bleaching prior to processing as the fibre is already 'very clean'; reduced chemical, water and energy consumption in dyeing; and effective low-temperature laundering.

While the process of lyocell production consumes few other resources, it is energy intensive. One manufacturer, Lenzing, cites tackling energy use as one of its future tests.[87] An ongoing challenge is to contain the tendency of lyocell fibres to crease and 'fibrillate' in the wet state (i.e. for small fibre-like structures to peel away from the main body of the fibre but remain attached). Early versions of lyocell were typified by a creased and fuzzy or 'peach skin' fabric aesthetic with white lines and damage marks on the finished goods which limited its market appeal. Developments such as an enzyme treatment to remove the fibrils (which are first deliberately induced by a mechanical or peroxide bleach treatment) or the application of a resin to prevent fibrillation being generated in domestic washing have begun to address this. As with all similar processes, these consume a combination of energy and chemical inputs and produce waste and emissions.

Soybean fibre

Soybean fibre is part of a class of regenerated materials made from protein, either from a vegetable (like soybeans) or animal (like milk, fibre name casein) source.[88] These fibres were initially developed in the 1950s and recently have undergone a renaissance as ecological pressure to develop fully biodegradable fibres from renewable sources has intensified. In the 1950s the fibres were viewed as substitutes for more traditional ones in a time of shortages after World War II, but were shelved due to technical difficulties and intense competition from other fibres (both natural and synthetic). Recent research and development, conducted mainly in the US and China, has overcome some of these difficulties and has produced a fibre with a soft handle and attractive lustre, similar to that of silk. Soybean fibre is seen as a potential replacement for petrochemical-based synthetics generally and also for cashmere. China, a world leader in cashmere production, hopes that soya fibres, sometimes called 'vegetable cashmere', can help

reduce the negative impact caused by cashmere goats grazing on fragile grassland.

The developments that have led to the commercial production of soybean fibres involve bioengineering techniques to modify the soybean protein's structure using enzymes and incorporating polyvinyl alcohol either into the spinning solution or as a central core surrounded by an outer coating of soya protein to add strength and acceptable wearability characteristics to the fibre. The agents used in the processing of soybean fibre are said to be non-toxic and waste can be used as animal feed once the protein has been extracted. Like bamboo, soybean fibres are promoted as health giving with natural antibacterial properties, although also like with bamboo there is no evidence available to support this claim. Perhaps the biggest concern relating to soybean fibres is related to the environmental impact of soybean agriculture. Commercial, large-scale soybean farming is water-, fertilizer- and pesticide-intensive, and is commonly reliant on GM technology and widespread herbicide use supported by biotechnology companies. Some soybean fibres are marketed with organic certification and these are currently around 30 per cent more expensive than organic cotton.

Naturally coloured fibre

Naturally coloured fibre takes advantage of colour variations in natural fibre types (notably cotton and wool), growing a coloured fibre that is not bleached or dyed, so avoiding the impacts associated with colouration. Naturally pigmented or 'native' cottons were conserved by traditional peoples and have a colour range of eight to twelve shades of beige, red, earth brown, chocolate brown and green.[89] There are a number of problems associated with these cotton varieties, such as short staple and fineness, that has limited their appeal. Yet these fibres have continued to be developed in a number of projects such as in Peru with Naturtex Partners,[90] which involves many small indigenous producers using organic methods.

Recycled fibre

Recycled fibre offers a low-impact alternative to other fibre sources, with reduced levels of energy material and chemical consumption possible (see Chapter 4 for a fuller discussion of recycling). The traditional process of recycling involved the use of adapted carding machines to tear the old fabric made from any fibre type apart. The effect of mechanically 'opening' a fabric in this way is not just to unravel the fabric structure but also to break

▲ Yarn made from 50 per cent recycled London textiles and 50 per cent pure new wool, by EcoAnnie

the individual fibres into shorter lengths, which when re-spun into new yarn produce bulky, low-quality yarn counts and fabrics. The general trend towards deteriorating material quality in recycling (sometimes called downcycling) is compounded by the lack of research and development in mechanical recycling methods, which has used unchanged technology for 250 years, and the market dominance of cheap virgin fibres which makes recycling financially unattractive. In resource terms, mechanical recycling provides significant savings over virgin material production. It uses less energy and can also save on use of dye chemicals and water if waste raw materials are sorted on colour and then processed in colour-specific batches, which prevents the need for re-dyeing. Innovation to extract longer fibres, particularly in natural fibres, and develop quality products could work to change this. Small-scale ventures such as Annie Sherburne's recycled London textile yarn are part of this change.

While natural fibres can only be recycled by mechanical means, synthetic fibres like polyester can also be recycled via mechanical or chemical routes. A mechanical approach sees fibre manufactured from a mixture of post-

industrial fibre waste and post-consumer plastic, the most ubiquitous being the drinks bottle, involving a process of grinding, melting and extruding the fibre. In contrast, other polyester recycling routes are based on chemical breakdown of the polyester polymer which is then repolymerized to produce a recycled material that is purer and of a more consistent quality than produced by the mechanical method, although it is far more energy intensive. The significance of recycled polyester (of both forms) is growing rapidly. Recent figures suggest that over half of all staple polyester fibre in Europe is now made from recycled materials.[91]

Like polyester, nylon is recyclable using techniques which break down the polymer chemically. Recent developments have overcome a challenging repolymerization process and recycled nylon yarns are available made from post-industrial waste like substandard yarns rejected as part of manufacturing. The claims made for the energy-saving benefits of recycled polyester and nylon material over virgin material are fairly similar; both fibres demand around 80 per cent less energy to recycle than to make virgin intermediate chemicals from oil and convert them to fibre.[92]

Moving forward

The environmental and social impacts of producing textiles are many and varied and there are no easy answers. Instead, they expose a mosaic of interconnected resource flows that underpin even our simplest design choices. Our first task is to acknowledge this complexity in our work and to build expertise with a portfolio of more sustainable fibres chosen because of their appropriateness to product and user. Indeed, perhaps one of the greatest challenges of sustainability is to become skilled at this task; to be comfortable with complexity; to soak it up, yet not feel disempowered. Our holy grail is to be able to translate knowledge of 'big picture' issues (like diversity, ethics or consumption), and 'small picture' detail (such as a fibre's LCA profile) and still be able to make decisions that are simple, practical and insightful. This relies as much on traditional design skills, experience and intuition as well as 'science' and we must learn to combine our skills in new ways.

The fashion and textile industry's future success will depend on us reducing its environmental and social burden across the entire lifecycle. Part of this is reducing the impact associated with cultivating and producing all textile fibres and establishing a foundation of good practice across the board – a major ongoing challenge. Another part involves developing a new and more sustainable way of thinking about materials that helps us move away from a dependency on a few fibres, to developing a portfolio of fibres, some

with low resource intensity, others with rich cultural traditions and all which celebrate the range of skills, know-how and resources that are available to us. This strategy of materials diversity involves replacing some of the dominant or high-impact fibres with alternatives including low-chemical and organic cotton, hemp, lyocell, wool and PLA. This would help us pursue multiple strategies to tackle sustainability problems. There is, after all, no single one-size-fits-all solution but multiple design opportunities working at different scales, levels, time frames and with many different people. In nature, this sort of diversity leads to strong, resilient ecosystems, able to withstand a shock or period of crisis. In fashion and textiles, it similarly could lead to a healthier and more robust industry that would support and regenerate smaller-scale industry in Europe and India as well as reaping the rewards of efficient large-scale production in the big mills of the USA and China. Our task is to follow nature's lead and diversify while cooperating. Material diversity does, however, come at a financial price – producing small-scale fibres at multiple locations near to markets translates into more expensive fashion and textile products. As such its success would depend on reversing the general consumer trend of buying bigger volumes at lower prices from 'big box' budget retailers – in the EU the cost of garments fell by just over 26 per cent in the first decade of the twenty-first century and in the US by 17 per cent[93] – and convincing consumers to buy differently.

It is naïve to think that fibre alternatives as varied as wild silk, soybean and naturally coloured cotton can make inroads into established textile markets overnight. Their volumes are small, their cultivation and processing technologies in need of major research and development, and their long-term impacts untested. Novel fibres like these are exciting, they can play a part in more sustainable product development and also promote a debate about a shift in consumption away from quantity and towards quality (see Chapter 5 – Fashion, Needs and Aesthetics). However, in searching for novelty, we can sometimes disregard the familiar and lose sight of the major improvements being made to more conventional fibres. Change is best promoted by asking questions of fibres and by letting suppliers inform us about the sustainability profile of their products. We need to ask about raw materials, processing chemicals, emissions, recyclability and biodegradability. We need to ask about what is most appropriate for our product and what helps people the most. We need to be informed about fibre impacts and possibilities and we must design with a more pluralistic, decentralized and diverse view of what the industry can be.

Notes

1 Simpson, P. (2011), Global Trends in Fibre Prices, Production and Consumption, *Textiles Outlook International,* 150, p82.

2 Simpson, P. (2010), Global Trends in Fibre Prices, Production and Consumption, *Textiles Outlook International,* 147, p54.

3 Wolf, O., Cordella, M., Dodd, N., Kougoulis, J., Beton, A., Dias, D., Farrant, L., Gibon, T., Le Guern, Y., Desaxce, M., Perwueltz, A. and Boufateh, I. (2012), *Environmental Improvement Potential of Textiles*, Seville: European Commission, p10.

4 Simpson (2011), Op. Cit., p82.

5 Turley, D.B., Copeland, J.E., Horne, M., Blackburn, R.S., Stott, E., Laybourn, S.R., Harwood, J. and Hughes, J.K. (2009), *The Role and Business Case for Existing and Emerging Fibres in Sustainable Clothing*: *Final Report to the Department for Environment, Food and Rural Affairs (Defra)*, London: Defra, p50.

6 Ibid., p64.

7 Grose, L. (2009), Sustainable Cotton Production, in R. Blackburn (Ed.), *Sustainable Textiles*, Cambridge: Woodhead Publishing, p34.

8 Myers, D. (1999), The Problems with Conventional Cotton, in D. Myers and S. Stolton (Eds.), *Organic Cotton: From Field to Final Product*, London: Intermediate Technology Publications, p11.

9 Allwood, J.M., Laursen, S.E., Malvido de Rodriguez, C. and Bocken, N.M.P. (2006), *Well Dressed?*, Cambridge: University of Cambridge Institute of Manufacturing, p45.

10 Turley *et al.*, Op. Cit., p50.

11 Cupit, M.J. (1996), *Opportunities and Barriers to Textile Recycling*, Abingdon, Oxfordshire: AEA Technology, p14.

12 *ENDS Report* (2006), Directorate Suspends Cypermethrin Sheep Dips, 374, p15.

13 European Commission (2003), *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques for the Textiles Industry*, Brussels: European Commission, p30.

14 Barber, A. and Pellow, G. (2006), *Merino Wool Life Cycle Assessment: New Zealand Merino Industry. Total Energy Use and Carbon Dioxide Emissions*, Auckland NZ: The AgriBusiness Group.

15 Turley *et al.*, Op. Cit., p57.

16 Slater, K. (2003), *Environmental Impact of Textiles: Production, Processes and Protection*, Cambridge: Woodhead Publishing, p27.

17 Turley *et al.*, Op. Cit., p37.

18 Kozlowski, R., Mankowski, J. and Baraniecki, P. (1994), Bast Fibre Crops Cultivated on Polluted Soils, in The Textile Institute (1994), *World*

Conference Proceedings 1994, Manchester: The Textile Institute, pp167–174.

19 Riddlestone, S., Desai, P., Evans, M. and Skyring, A. (1994), *Bioregional Fibres: The Potential for a Sustainable Regional Paper and Textile Industry Based on Flax and Hemp*, Surrey: Bioregional Development Group, pp50–56.

20 Laursen, S.E. and Hansen, J. (1997), *Environmental Assessment of Textiles*, Copenhagen: Danish Environmental Protection Agency, p84.

21 Ibid., p85.

22 Allwood *et al*., Op. Cit., p29.

23 *ENDS Report* (1996), DuPont Outlines Plans to Curb Nylon N2O Emissions, 260, pp7–8.

24 Turley *et al*., Op. Cit.

25 Wolf *et al*., Op. Cit., p43.

26 Laursen and Hansen, Op. Cit., pp69–79.

27 Swaminathan, K. and Manonmani, K. (1997), Studies on Toxicity of Viscose Rayon Factory Effluents: Part 1 Effect on Water, *Journal of Environmental Biology,* 18(1), pp73–78.

28 Delano, R. (2007), The Lowdown on Bamboo, in *Future Fashion White Papers*, New York: Earth Pledge, pp160–167.

29 DuPont Environmental Excellence Team (undated), *Man Made Fibres and the Environment*, Gloucester: DuPont.

30 Raninger, F. (1996), Cellulosics and Environmental Protection, *Textile Asia*, September, pp62–64; 73.

31 Schmidtbauer, J. (1996), Clean Production of Rayon – An Eco-inventory, in *Imagine the Future of Viscose Technology Conference Proceedings*, Gmunden, Austria.

32 Turley *et al*., Op. Cit.

33 Adapted from Turley *et al*., Op. Cit., pp52–66.

34 Wolf *et al*., Op. Cit.

35 Ibid., p74.

36 Ibid.

37 MADE-BY, Online http://www.made-by.org/benchmarks/environmental (accessed 27 November 2012).

38 Drury, K. and Slater, K. (1996), Fibres and the Environment, *Textile Trends*, June, pp29–33.

39 Ibid., p33.

40 Walsh, J.A.H. and Brown, M.S. (1995), Pricing Environmental Impacts: A Tale of Two T-shirts, *Illahee*, 11(3&4), pp175–182.

41 Walsh and Brown, Op. Cit., p177.

42 TEEB, Online http://www.teebweb.org/ (accessed 27 November 2012).

43 Puma, Online http://about.puma.com/puma-completes-first-environmental-profit-and-loss-account-which-values-impacts-at-e-145-million/ (accessed 27 November 2012).

44 Franklin Associates (1993), *Resource and Environmental Profile Analysis of a Manufactured Apparel Product: Woman's Knit Polyester Blouse*, Washington DC: American Fiber Manufacturers Association.

45 See for example Wolf *et al.*, Op. Cit.

46 Franklin Associates, Op. Cit., pES–8.

47 Cotton Inc, *The Life Cycle Inventory and Life Cycle Assessment of Cotton Fiber and Fabric: Executive Summary*, Cotton Incorporated, p14.

48 Ibid., p23.

49 Allwood *et al.*, Op. Cit.

50 Ibid., p47.

51 van Elzakker, B. (1999), Organic Cotton Production, in D. Myers and S. Stolton (Eds), *Organic Cotton: From Field to Final Product*, London: Intermediate Technology Publications, p22.

52 Allwood *et al.*, Op. Cit., p47.

53 GOTS, Online http://www.global-standard.org/ (accessed 27 November 2012).

54 Ferrigno, S. (2010/11), Cotton Sector Needs Holistic Approach, *EcoTextile News*, 40: pp28–32.

55 Ferrigno, S. (2012), Organic Cotton Sector Upbeat Despite Fall, *EcoTextile News*, 49: pp52–57.

56 SCP, Online http://www.sustainablecotton.org (accessed 27 November 2012).

57 Grose, L. (2007), Back to Basics, *EcoTextile News*, No. 4, pp24–25.

58 Ferrigno, S. (2012), Clouds Gather Over Cotton Seed Security, *EcoTextile News*, 46: pp48–49.

59 International Cotton Advisory Committee (2004), *Report of the Second Expert Panel on Biotechnology of Cotton*, Washington DC: International Cotton Advisory Committee, p5.

60 Ibid., p28.

61 Ibid., p32.

62 *ENDS Report* (2003), GM Crops Have 'Increased Pesticide Use', No. 347, pp13–14.

63 Ferrigno, S. (2012), Clouds Gather Over Cotton Seed Security, *EcoTextile News*, 46: p48.

64 BCI, Online http://www.bettercotton.org/ (accessed 27 November 2012).

65 CmiA, Online http://www.cotton-made-in-africa.com/en/ (accessed 27 November 2012).

66 *EcoTextile News* (2011), IKEA Outlines BCI Growth Plans, 41, p33.

67 Heming, Z. (2007), Esquel Steps in the Right Direction, *EcoTextile News*, No.3, p14–15.

68 PAN UK (2007), *My Sustainable T-shirt*, London: PAN UK.

69 M&S, Online http://plana.marksandspencer.com/about/the-plan/fair-partner/2/ (accessed 27 November 2012).

70 Illuminati II, Online http://www.noir.dk/illuminati2.php (accessed 27 November 2012).

71 UN, Online http://www.unglobalcompact.org/ (accessed 27 November 2012).

72 Ardalanish, Online http://ardalanish.com/ (accessed 27 November 2012).

73 Alden, D.M, Proops, J.L.R. and Gay, P.W. (1996), *Industrial Hemp's Double Dividend: A Study for the USA*, The University of Melbourne, Department of Economics, Research Paper 528.

74 CRAiLAR, Online http://www.crailar.com/ (accessed 27 November 2012).

75 Mohan Rao, K. (2007), Tasar Culture and Forest Policy – Constraints and Guidelines, *Indian Silk,* 145(10), pp14–18.

76 Slater, Op. Cit., p27.

77 *EcoTextile News* (2007), PLA Composting Project Recognized, 3, p9.

78 Mowbray, J. (2011), Bioplastic: Really Fantastic? *EcoTextile News*, 41, pp24–28.

79 *EcoTextile News* (2012), Bio-based Textiles – Not Yet Green, 49, p38–39.

80 Blackburn, R.S. (2005), Introduction, in R.S. Blackburn (Ed.), *Biodegradable and Sustainable Fibres*, Cambridge: Woodhead Publishing, pxvii.

81 Mowbray, Op. Cit., p27.

82 *EcoTextile News* (2009), Teijin to Roll Out 'Biofront' in 2009, 21, p7.

83 Farrington, D.W., Lunt, J., Davies, S. and Blackburn, R.S. (2005), Poly(lactic acid) Fibres, in R.S. Blackburn (Ed.), *Biodegradable and Sustainable Fibres*, Cambridge: Woodhead Publishing, pp212–215.

84 Mowbray, Op. Cit., p26.

85 *EcoTextile News* (2011), Bio-based Stretch on the Horizon, 43, p25.

86 White, P., Hyhurst, M., Taylor, J. and Slater, A. (2005), Lyocell Fibres, in R.S. Blackburn (Ed.), *Biodegradable and Sustainable Fibres*, Cambridge: Woodhead Publishing, p157.

87 Ibid., p171.

88 Brooks, M.M. (2005), Soya Bean Protein Fibres – Past, Present and Future, in R.S. Blackburn (Ed.), *Biodegradable and Sustainable Fibres*, Cambridge: Woodhead Publishing, pp398–440.

89 Rainsford, F. (2007), Cotton with Altitude, *EcoTextile News*, 1, p22.

90 Naturtex, Online http://www.perunaturtex.com/ (accessed 27 November 2012).

91 *EcoTextile News* (2008), The Carbon Challenge for Textile Fibres, 16, p31.

92 Patagonia (undated), *Patagonia's Common Threads Garment Recycling Program: A Detailed Analysis*, California: Patagonia. And *EcoTextile News* (2007), Toray Offers Recycled Nylon, 4, p23.

93 Anson, R. (2010), Editorial: End of the Line for Cheap Clothing? *Textile Outlook International*, 147, pp4–10.

CHAPTER 2 Ethically Made

Producing fashion and textiles involves one of the longest and most complicated industrial chains in manufacturing industry. The conversion of raw textile fibre to finished fabric and final product draws on labour, energy, water and other resources and cumulatively makes for a high-impact sector. The textile and garment manufacturing industry in general is recognized as both a major user of water and a major polluter,[1] scoring worse than any other on the UK Environment Agency's pollution risk assessment.[2] It is linked to a litany of labour abuses including poverty wages, excessive working hours, forced overtime, lack of job security and denial of trade union rights.[3] Further, the sheer ubiquity and number of its products – for jeans alone, around 5 billion

globally, with each pair drawing upon 70 litres of water, 1.5 KWh of energy and 150 g of chemicals throughout its life[4] – makes for substantial and widely distributed impact. Yet it also brings positive benefits, not least because it creates products that are at the heart of our culture, and it generates wealth and employment, as many as 26 million jobs worldwide.

Designing fashion and textiles within a context of ecological responsibility and social justice requires that alongside a long and deep critique invoked by sustainability of the fundaments of our enterprise, we also know about and support best practice systems of production. The issues are complex and there is no silver bullet that resolves them and provides a simple checklist of production choices for the 'ecological' or 'ethical' garment. Instead, improvements are hard-won and come from a combination of creativity, mindfulness, information about the processes we are dealing with and an ability to adopt a holistic approach to affecting change. This chapter starts where the previous one left off – with raw fibre – and follows its conversion process to final product. It reviews the key environmental and social impacts of the production phase of the lifecycle and highlights opportunities to bring more sustainable improvements. This chapter explores two starting points for bringing more sustainable change in production. The first is concerned with improving individual production processes by, for example, minimizing energy and resource use and waste – the most common approach in the sector to date. The second by contrast is concerned with whole systems improvement and looks for opportunities to transform the sustainability of the underlying industrial system of which the individual processes are a part.

This chapter is organized into two parts to reflect these two starting points. The first part is focused on process improvement and is designed as a guide to sustainability issues and opportunities in key processing stages. It describes efficiency measures, toxic chemical substitution and best practice in terms of baseline labour and chemical standards. The information included is technical and specific and has especial relevance to those who are hands-on makers and producers. It can be used as the basis from which to design more responsible fashion and textiles and to guide the questions we ask of suppliers about their production processes. It also provides the building blocks of low-impact production on which many of the other design ideas covered in this book rely. The best practice techniques described offer valuable benefits especially in the short term and to the company whose process is being improved. They can lead to more efficient resource use, better relationships with workers, lower costs and valuable evidence of Corporate Social Responsibility (CSR) activity. The second part of this chapter is concerned with systems improvements. It looks for opportunities to reduce the impact

of the fashion and textile industrial system by working across the boundaries of individual processes or producers. It involves modelling the fashion and textile manufacturing industry as a whole system and searching for ways in which to improve the sustainability of the system at root. Some of these ways raise important and far-reaching questions about the relationship between business, industrial activity and long-term environmental and social quality, and have the potential to transform the goals and rules of our design and production practice so that they are more closely aligned with sustainability.

Background to sustainability innovation in the production chain

Before we delve into the detail of process improvements that make up the first part of this chapter, it is worth recognizing that these improvements are influenced by a number of economic, structural, legislative and cultural forces. The result is a nuanced and uneven spread of innovation across the sector that tends to reinforce the industrial status quo, while other types of improvements are little recognized. For example, while the value of whole systems improvement is widely recognized, it is little practised because organizations are heavily invested in the continuation of the current set up and often motivated to work on bringing change to processes that chiefly bring benefit to themselves. Other forces that have influenced sustainability innovation include the sector's cultural preference for technology-based improvements and legislation-driven change.

Technology-based innovation

One feature of production-related sustainability innovation is the prevalence of 'hard' technology-based improvements over 'soft' cultural change. For many manufacturers, being innovative means 'adding' technology to a problem, particularly when it is to try to ameliorate the negative impacts of existing technology. Favouring technological fixes over softer behavioural and cultural ones is perhaps inevitable in an industry like textiles that since the Industrial Revolution in the eighteenth century has been processing materials better, faster and cheaper by improving the efficiency and effectiveness of technology. However, the result is a tendency to neglect the very substantial effect that behaviour has on determining a product's overall environmental impact (see Chapter 3 – Use Matters). It also overlooks the (significant) role of softer change in bringing sustainability improvements and sidelines the contribution of non-technologists, like designers

and consumers. Relying on technology to 'fix' our problems can also have the more subtle and insidious effect of reinforcing our tendency to avoid accountability for our choices and behaviour. A technological- and science-led revision of existing ways of doing business leads to modified practices and minimized harm, and shapes a debate and research agenda that is focused around production aspects of an un-scrutinized industrial paradigm. Yet even though this production-focused approach is the most popular form of response to sustainability in the fashion sector, it is relatively ineffective at securing substantive change to the way in which societies and economies are structured; a point that has been recognized by design-for-sustainability scholars for many years.[5] For the existing model's values, perceptions and habits of mind are themselves the root cause of the problem of unsustainability.[6] Without changing how fashion is thought about, both as a sector and as a set of individual and social practices, the very issues that cause unsustainability will prove resilient.

There are, however, noteworthy exceptions to the dominance of technology-led innovation, such as the improvements that have been brought to working conditions in garment manufacturing through the introduction of non-technology-based codes of conduct. There are also signs, in the sector more generally, of a willingness to embrace softer types of change, although this has been slow to recognize the potential of design and is almost exclusively linked to the supply of information. CSR activities are examples of this as is work to influence the information flows which impact upon the sustainability of the sector, though these are often closely linked to technological innovation such as, for example, *String* which enables the gathering and sharing of supply chain information by global retailers, who now track and trace orders as they flow through the long and complicated textile manufacturing chain.[7] Perhaps the most notable example of softer change is the cross-brand initiative led by the *Sustainable Apparel Coalition* which has seen the development of a pre-competitive common approach for measuring and evaluating fibre and fabric efficiency and improving supply chain performance industry-wide, the Higg Index.[8]

Innovation driven by legislation

Legislation has had a formative influence on sustainability innovation in the fashion and textile sector to date. Legislation influences market forces because non-compliance is expensive and increases business risk. Businesses do 'what they can get away with', particularly when prices are low, rarely innovating beyond the minimum required in order to satisfy legal requirements.

The effect is to promote a reactive and compliance-driven agenda for innovation in which environmental and social standards are perceived as a cost and a business threat rather than an opportunity to create social and hence commercial value. The result is that legal boundaries and pressure from consumers, non-governmental organizations (NGOs) and the media act as important mechanisms for controlling production in a market-based economy. For example, NGO campaigns exposed labour abuses in the supply chains of major brands like Nike and Gap in the 1990s which eventually led to the introduction of codes of conduct setting out minimum levels of workers rights; and legislation-driven change – again in the 1990s – banned the use of 22 azo dyes in Europe which break down into carcinogenic amines,[9] which helped spur a more proactive approach to toxicological and pollution issues in the use of dyes.

The legislative framework itself is changing and continues to have a big effect on innovation. Until 2003, European industry's experience of pollution regulation was mainly limited to consent for discharges to sewer, but now the European Commission's Integrated Pollution Prevention and Control (IPPC) regime requires companies to also make significant improvements upstream, changing their processing to reduce and even prevent impact. These improvements or 'best available techniques' (BAT) for the production phase of the lifecycle have been set out in a mammoth 586-page reference document.[10] The BATs range from advice to seeking collaboration and information exchange on the type and load of chemicals used by upstream partners in order to create a chain of environmental responsibility for textiles, to measures for improving chemicals use and optimizing water consumption. Yet while the IPPC offers an important step forward in documenting improved processing opportunities it focuses almost exclusively on the sector's wet processes and its chemical use and therefore seems to emphasize a process improvement agenda, stopping short of introducing a fully integrated, whole lifecycle-based legal framework. The use of chemicals in textile production falls under the EC's ambitious programme REACH (on the statute book from 1 June 2007), which is designed to improve the current legislation on chemical substances and regulate their manufacture, import, marketing and end use.[11] REACH is a significant compliance challenge for the textile sector – as it requires safety data to be gathered about all chemicals – with major strategic business implications that could promote improved transparency of chemicals use and innovation of more environmentally benign alternatives.

Yet more recently, legislation has perhaps begun to be eclipsed as the key driving force for innovation in the sector. The power to affect change

has started to shift from governments to large corporations eager to protect the reputation of their brands and who are adopting Corporate Social Responsibility initiatives as a key top-level risk management function within corporations. This shift has been given momentum by consumer and shareholder pressure on companies, motivated by greater interest in socially responsible investment and catalysed by indices of ethical performance such as the Dow Jones Sustainability Index and FTSE4Good. Company initiatives, embraced under CSR programmes, are the voluntary actions that business can take, over and above compliance with minimum legal requirements, to address both its own competitive interests and the interests of wider society. Recent changes to UK law through the 2006 Companies Act now require listed companies to report on their environmental and social impacts and on employee and supplier issues, although it falls short of setting out a statutory standard for reporting. Throughout the fashion and textile industry, CSR practices are increasingly recognized and supported by governments, NGOs, retailers and manufacturers and have become a major part – and even a prerequisite – of being in business; although CSR is yet to be fully integrated into most businesses' core functions, despite assurances. In the early 1990s Levi Strauss was the first to develop 'terms of engagement' to raise labour standards in its supply chain, and more recently most high-street fashion brands have placed CSR activities at the core of their business. This can be seen to represent a major shift in the way corporations respond to sustainability-related issues: moving from a strategy of compliance and risk mitigation to one of opportunistic brand differentiation. CSR activities go some way to countering the charges of the No Logo debate[12] in which international companies – especially those enjoying high brand recognition – were linked to exploitation, environmental destruction, human rights abuses, disowning their domestic workforces and driving down wages.

Best practice in fibre and fabric processing

The improved processing techniques that have emerged from a mix of legislative and corporate drivers, and are influenced by industry's fragmented structure and preference for technological solutions, are as multistage and complex as the textile industry itself (see Figure 2.1) and are reviewed in the following section. Where possible, 'best practice', that is the processing choices that cause least impact, involves preventing impacts from arising in the first place. Yet not all processes or chemicals treatments can be avoided, indeed many are essential to producing useful and usable fashion and textile products. For essential processes, environmental impact can be reduced by

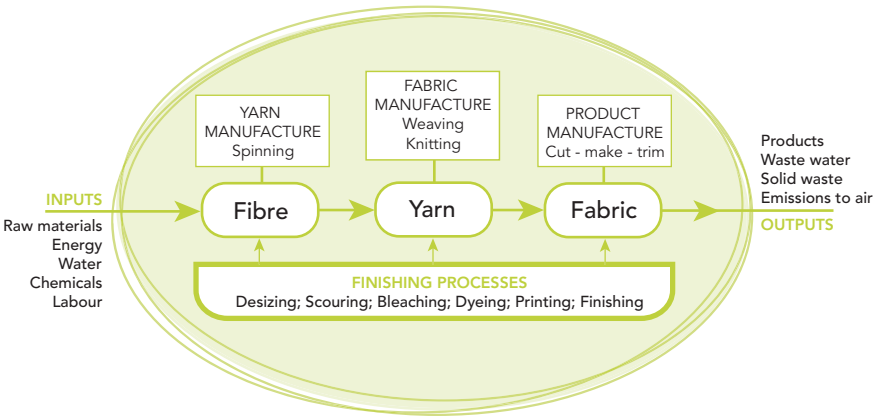


Figure 2.1 *Map of key processes, inputs and outputs in the textile production chain*

emphasizing principles of minimization and optimization and by following simple guides including:

- Minimize the number of processing steps (e.g. merge three processing stages – desizing, scouring and bleaching – into a single process);
- Choose 'clean' production techniques (e.g. reuse and exhaust dye baths);
- Minimize processing consumables (e.g. introduce automated dosing and dispensing systems for chemicals);
- Choose 'clean' processing chemicals (e.g. select chemicals based on minimizing overall lifecycle risk);
- Reduce energy and water consumption; and
- Reduce waste production and carefully manage waste streams.

The key environmental challenges for the production sector are well recognized and include: reducing energy, water and toxic chemical use and minimizing the release of chemicals in wastewater. Guidelines, such as those issued by independent textile industry standard Bluesign,[13] aid in the navigation of a safe and healthy supply chain and include efficient consumption of natural resources; as do the findings of extensive research commissioned into supply chain impacts and resource productivity, such as that conducted by the European Commission as part of its IPPC regulation. The EC[14] sees the following processes to be of key concern:

- Scouring processes prior to colouring and finishing where auxiliaries are removed which can be hard to biodegrade and contain hazardous compounds such as biocides;

- Desizing of cotton fabrics which produces an effluent with high pollution index;
- Sodium hypochlorite bleaching which gives rise to secondary reactions that form toxic organic halogen compounds;
- Hydrogen peroxide bleaching where strong complexing agents (stablizers) are used;
- Dyeing (in general) where water-polluting substances include toxic chemicals, heavy metals, alkali, salt, reducing agents, etc.;
- Batch dyeing which is inefficient and results in spent dye baths with high concentration levels; and
- Printing (in general) which includes emissions to water from print paste residues and cleaning operations, and emission to air (in the form of volatile organic compounds) from drying and fixing.

The key social challenges are to protect workers, provide more secure employment, pay living wages, and respect workers' rights to freedom of association. These challenges lie mainly in the cut-make-trim processing stage, where labour is employed most intensively. The following section reviews the production phase of the lifecycle; the processes, their impacts and the best practice techniques to reduce these impacts.

Spinning, weaving and knitting

Spinning, weaving and knitting are largely mechanical processes and the major environmental burdens are related to energy use, solid waste production and the generation of dust and noise. Latterly the manufacturers of textile machinery are increasingly putting an emphasis on the development of machines that use less energy and water, process fibre more efficiently and produce fewer emissions.[15] In addition to mechanically manipulating fibre, all three processes involve the application of lubricants (in spinning), oils (in knitting) or size (in weaving) to strengthen and protect the fibres from the stresses of processing. These coatings and lubricants become waste as they are washed out of the fabric prior to dyeing in the scouring process, and can be hard to treat as they are slow to biodegrade.

Overall the environmental impact of weaving is higher than that of knitting, because of the use of size. Sizing agents are applied to the warp to prevent thread breakage during weaving and need to be completely removed before further processing. This is done in the desizing step often with a large amount of water and the addition of process chemicals. The resulting effluent is highly polluting and while some sizing agents can be

reclaimed and reused from the desizing liquor, like polyvinyl alcohol (PVA), which has the potential to cut pollution load by a massive 94 per cent,[16] more often cheap, natural starches are used that are impossible to recover and have to be neutralized in the effluent treatment plant. Weaving and fabric finishing are normally separate activities, carried out by different companies, frequently in different countries, and there is little financial incentive for weavers to use more expensive synthetic sizes when it is a downstream producer who enjoys the benefits. In addition to sizing agents any biocides like pentachlorophenols (PCPs), a rot-proofing agent added to cotton fabric to protect it in storage and transport, are washed out in desizing. Emission of these substances is outlawed in the EU and the US for their negative effects on nervous, reproductive and renal systems and for their carcinogenic properties.

Best practice in yarn and fabric manufacture includes:[17]

- In spinning, ask suppliers to manufacture yarn with readily biodegradable lubricants;
- In knitting, ask suppliers to use water-soluble and biodegradable lubricants as substitutes for mineral oils;
- Avoid woven fabrics where PCPs have been added as a size preservative;
- Ask suppliers to substitute recyclable sizing agents for natural starches and use 'low add-on techniques' which minimize the amount of size used;
- If recyclable sizing agents are used, check with suppliers that size is recovered and reused;
- If unknown sizing agents are used, check with suppliers that size is removed with efficient techniques such as the oxidative route[18] and ensure adequate effluent treatment;
- Ask suppliers to combine scouring and desizing processes with bleaching to save chemicals, energy and water.

Environmental impact can also be reduced through the introduction of innovative production technology such as whole-garment or seamless knitting. Whole-garment knitwear is made in one entire piece, three-dimensionally directly on the knitting machine, and is reported to have significant energy-saving potential – it takes around 30 to 40 per cent less time than for conventional sew and manufacture.[19] In addition whole-garment technologies reduce labour costs (there are no post-production labour costs) and lead times (by allowing on-demand production), and eliminate fabric waste or cut-loss.[20]

Fabric finishing

The final stage in fabric processing is known as finishing and includes preparation of the fabric to be dyed and/or printed, dyeing and printing itself and the application of any specialist fabric finishes such as those giving water repellency and crease resistance. Finishing is the chief cause of environmental impacts in the production phase, using significant quantities of water, energy and chemicals and producing substantial amounts of effluent. Some of the chemicals used contain toxic elements such as heavy metals like copper, chromium and cobalt which are known carcinogens; dioxins that are also carcinogenic and are suspected hormone disrupters; and formaldehyde, a suspected carcinogen. Effluents from the textile processing chain are characterized by their grey colour, high polluting load, high solids content and high temperature.[21] To avoid breaching pollution regulations, effluents have to be treated prior to discharge. A standard sequence of effluent treatment for woven or knit fabric finishing includes: screening, to remove fibrous waste from the effluent; equalization, to mix waste in order to achieve a fairly standard effluent for downstream processing; and biological treatment, to lower the effluent's polluting load. In biological treatment, microorganisms are grown to feed on the substrates in the effluent and require a treatment time of between 24 and 48 hours. However, some pollutants are untreatable and for these prevention, not treatment, is the primary concern. Such a preventative approach can be seen in the GOTS organic textile standards,[22] for instance, which does not allow the use of certain process chemicals in its accredited products (such as aromatic or halogenated solvents, PCPs, formaldehyde, heavy metals except for iron and 5 per cent copper in blue-green dyestuffs, etc.) and allows others to be used only in closely monitored processes, such as ammonia pretreatments for wool in a closed circuit. Sustainability considerations have driven the development of green chemistry in which the focus is on minimizing hazard and maximizing the efficiency of any chemical choice; and have also achieved popular attention through campaigns such as Detox[23] by Greenpeace which highlighted the link between supply chain activities of major brands and toxic pollution in Chinese rivers, including the release of chemicals that break down into persistent, bioaccumulative and hormone-disrupting substances. Detox's aim, to challenge popular brands to eliminate all releases of hazardous chemicals to water in their supply chains, has seen a range of global fashion brands, including among others Nike, Adidas, Puma, H&M, M&S, Levi's and Uniqlo, commit to zero discharge of hazardous chemicals by 2020; widely admitted to be a significant test for an industry that has a global, multi-part supply chain across multiple tiers.[24]

Bleaching

Most natural fibres have an off-white colour, so bleaching is necessary to produce white fabrics and those that will be dyed or printed to pale colours. Manufactured fibres are also bleached as it enhances colour brilliance after dyeing, improves colour uniformity – even for dark shades – and removes the last traces of residual impurities. Bleaching does, however, undermine fibre strength and thus the durability of the textile product. The oldest known method of fabric bleaching is sun bleaching, requiring around 36 hours of direct sunlight to break down coloured molecules and lighten a fabric.

Today in Europe it is common practice to bleach with hydrogen peroxide in a wet process. Hydrogen peroxide is active only at temperatures above 60°C, resulting in a fairly energy-intensive bleaching process. Chemical additives are needed in the bleaching bath to stabilize the hydrogen peroxide and optimize the bleaching process, giving a fabric with uniform appearance. One of these additives (sequestering agents) counters the effect of reactive metal particles present in the bath which otherwise would act as a catalyst for the bleaching agent and cause it to attack and breakdown the fibre. Sequestering agents, if discharged untreated, are considered to be highly polluting.

Fibres can also be bleached with chlorine-based products like sodium hypochlorite and sodium chlorite, however, concerns about the negative effects of these products on the reproductive and immune system have meant that chlorine is no longer seen as an acceptable bleaching agent. Although for some fibres, like hemp, white fabrics can only be produced by bleaching with chlorine; and here a two-stage process, first using hydrogen peroxide and then sodium chlorite, is recommended to reduce impact. Indeed there are now strategies in place for the phase-out of chlorine in manufacturing more generally.

Best practice in bleaching:[25]

- Ask suppliers to combine bleaching with scouring (and desizing if appropriate) to save chemicals, energy and water;
- Use hydrogen peroxide as the preferred bleaching agent combined with techniques to minimize the use of stabilizers;
- Check that suppliers biologically treat wastewater prior to discharge.

Dyeing

Textiles can be dyed as fibres, yarn or fabric. Different fibres have an affinity for different dyes and different colours and shades of colours use different

dye classes. The dye bath contains processing (auxiliary) chemicals as well as dye. These chemicals vary by dye, dyer and machine as does liquor ratio (the ratio of water to chemicals), water temperature and dyeing time. As a result the actual consumption of dye varies between 2 g and 80 g per kilogram of textile, with an average of around 20 g/kg depending on depth of colour.[26] After dyeing, the yarn or fabric requires intensive washing to remove auxiliary chemicals in addition to any unfixed dye. The dyeing process is resource-intensive in terms of water, energy and chemicals and produces effluent that is often highly coloured, with dyes being the most likely source of major metal pollutants such as zinc, copper and chromium[27] (see Table 2.1). In countries with poor working conditions and few environmental protection measures, dyeing and printing can pose a serious threat to human and

Table 2.1 *Types of pollution associated with dyeing a range of fibres*
Note: *The categories of pollution are as follows: 1 = relatively harmless; 2 = readily biodegradable; 3 = difficult to biodegrade; 4 = difficult to biodegrade, moderate pollution load; 5 = unsuitable for conventional biological treatment.*[28]

Fibre	Dye class	Percentage of non-fixed dye that may be discharged	Type of pollution
Cotton	Directs	30%	1 salt 3 unfixed dye 5 copper salts, cationic fixing agents
	Reactives	50%	1 salt, alkali 3 unfixed dye
	Vats	25%	1 alkali, oxidizing agents 2 reducing agents
	Sulphurs	25%	1 alkali, oxidizing agents 2 reducing agents 3 unfixed dye
Wool	Chromes	1-2%	2 organic acids 5 heavy metal salts
	1:2 metal complexes	10%	2 organic acids
	Acids	10%	2 organic acids 3 unfixed dye
Polyester	Disperse	15%	2 reducing agents, organic acids 5 carriers

environmental health. Reducing this threat is a complex task as there is no one dyestuff provides the best answer to low-impact dyeing. Similarly, no one colour can be singled out as having the 'best' or 'worst' environmental load – although certain shades, most notably blue, green and turquoise, are difficult to achieve without the use of copper, a heavy metal. In general terms, the darker the shade, the greater the amount of dye lost to effluent. Therefore, some scope for improvement exists by avoiding dark, heavy shades such as navy and black. However, the environmental benefit of avoiding dyeing to dark shades may be cancelled out in laundering, as light shades tend to show the dirt more easily and so may be laundered more frequently, causing more impact in the use phase (see Chapter 3 – Use Matters). This highlights yet again one of the central challenges of sustainability for our sector: to simultaneously act for positive change at the large and small scales – a theme we come back to over and again in the course of this book.

Many steps have been taken to reduce the impacts of dye processes, particularly in response to legal restrictions on pollution, most notably contaminated effluent and the use of toxic chemicals. While there have been some advances in the chemical make-up of dyes and pigments themselves, the most effective action has come from technological developments in dyeing techniques. For instance, the Turkish weaver Akin Tekstil recently announced a new low-water dyeing technique using conventional wet processing equipment that eliminates pretreatment processes and washing-off after dyeing, claiming that water demand is reduced from around 140–200 litres per kg of fibre under normal dyeing conditions of cellulosics to 1.5–2 litres per kg.[29] Other examples see the development of techniques to recover, reuse and 'exhaust' dye baths that are proving effective in reducing both volumes of effluent and the use of chemicals. Dye bath reuse has already been applied while disperse dyeing polyester, reactive dyeing cotton, acid dyeing nylon and basic dyeing acrylic, on a wide variety of machines. The likelihood of dye liquor reuse is increased especially when dyeing is limited to a few shades – like in nylon hosiery – where given the right conditions a dye liquor could be reused up to ten times before the level of impurities limits further use.

Another example of improved dyeing techniques is pad-batch dyeing, suitable for cellulosic fibres like cotton, linen and viscose, and which saves energy, water, dyes, chemicals, labour and floor space.[30] The technique involves steeping the fabric in dye liquor, 'batching' it into rolls, covering it with plastic film and storing for up to 12 hours, after which it is washed. In a recent pilot trial by Marks and Spencer this technique showed a range of savings across a range of metrics.[31] In addition, other improved dyeing techniques include: electrochemical dyeing where an electric current enables a

spent dye bath to be regenerated and the dye recycled;[32] and the possibility of dyeing with non-aqueous systems either with super-critical carbon dioxide or ionic liquids in place of water in the dye bath. While originally these systems were only suitable for dyeing hydrophobic fibres like polyester and nylon, more recently combinations of dyes have been specifically designed to colour natural fibres.[33] Innovations in dye chemistry comprise work on the development of disperse dyes as 'universal dyes' suitable for dyeing all fibre types which would reduce both the complexity of the dyeing process and the waste streams,[34] and a range of improvements in most dye groups as summarized in Table 2.2.

Natural dyes, made from plants, animals and shells, provide important alternatives to petrochemical-based dyes and, if harvesting is carefully managed, offer environmental and social benefits including a low carbon

Table 2.2 *Summary of developments in dye chemistry*[35]

Dye	Key challenges to be overcome	Best Practice
Reactive dyes	Poor dye fixation, which in the worst case can lead to up to 50% of the dye unfixed and high salt concentrations to fix the dye to the fibre	Poly-functional and low-salt reactive dyes that can give greater than 95% fixation Follow dyeing by a hot rinsing process, which can avoid the use of detergents and complexing agents in the neutralization step
Sulphur dyes	Use of sodium sulphide to 'reduce' dye so that it penetrates the fibre	Stabilized non-pre-reduced sulphide-free dyes Replace sodium sulphide with sulphur-free reducing agent
Chrome dyes for wool	Use of chrome – a highly polluting heavy metal	Substitute chrome dyes for reactive dyes. Where not possible use ultra-low chroming methods
Metal complex dyes for wool	Discharge of heavy metals in the waste water	Use auxiliaries to enhance dye uptake and pH-control methods to exhaust dye bath
Acid and basic dyes for wool	Use of organic levelling agents	Use pH-controlled process to maximize dye exhaustion and minimize use of organic levelling agents
Disperse dyes for polyester	Use of hazardous carriers and non-biodegradable dispersing agents	Avoid the use of carriers by using a modified non-carrier dyeable polyester Dye in high temperature conditions without the use of carriers Use dispersing agents with a high degree of bioeliminability

footprint and valuable employment for rural communities. Moreover, they present conventional industry – and its colour standards – with an implicit challenge, by emphasizing wide-ranging colour variation, dye material diversity and a sense of place through 'local' colours as opposed to the industrial paradigm's priority of reproducibility and scale. The five classic dyestuffs are madder, cochineal, weld, cutch and indigo which give a good range of colours, although there are many other sources including nettles, rhubarb root and walnut hulls. Natural dyes are suitable for colouring natural fibres only and in the majority of cases have no built-in affiliation for the fibre and so fixing agents (mordants) are required. Mordants range from heavy metals, including chromium and tin, to oak galls, yeast and urine. In comparison to synthetic dyes, natural dyes have large variations in colour tone because of the quality differences of different provenances of the dye plant; they require longer, slower dyeing treatments to achieve good colour, particularly for vegetable fibres – a feature which makes the process more costly than dyeing with synthetics; and they also require large quantities of materials for small amounts of dye – as concentrations of dye found in nature tend to be extremely low. Yet natural dyes' subtle colour variation and greater demands on time means that natural dye technology – as it stands today – has caché and quality that works well at the small scale or for specialist production. Scaling natural dye processes up to become acceptable to industry will require sustained research and development to address such difficulties as the water-insoluble natural dye material (normally in a powdered or chopped form) which is much less easy to use than solid and water-soluble synthetic dyes. However, this difficulty has been overcome in part by providing dyers with watery extracts of dye instead of large dye bags full of natural material.

Best practice in dyeing:[36]

- Use automated systems for dosing and dispensing of chemicals and controlling machine variables, to maximize efficiency;
- Check suppliers have introduced water- and energy-efficiency measures;
- Ask suppliers to guarantee low-liquor dyeing and associated improved dye fixation;
- Avoid fabrics dyed with hazardous dyestuffs and auxiliaries, substituting alternatives that are biodegradable or bioeliminable;
- Ask suppliers to reuse and exhaust dye liquors on repeat shades and reuse rinse water for the next dyeing;
- Check that wastewater is treated prior to discharge.

Printing

Printing is one of the most chemically complex areas in textile processing. It is possible to print with almost all classes of dye needing a wide range of chemical auxiliaries. Textile printing involves the accurate application of a colour paste made up of dye or pigment, a thickening agent and other chemicals onto a fabric. Unlike in dyeing, colour is applied to specific, selected areas of fabric, which reduces resource consumption. There are many different methods of printing such as flat screen, roller, transfer and inkjet, each with different demands on resources. In screen printing for example, impact can be reduced by reducing print paste losses in machine pipes and squeegees; with careful cleaning of screens and belts with reused rinsing water; and by switching to water-based PVC- and phthalate-free printing formulations (now widely available) that do not contain aromatic solvents, which are harmful to watercourses on discharge. Digital printing, the most popular form of which uses inkjets, involves the propelling of tiny droplets of dye or pigment onto a fabric electrostatically. In inkjet printing, the selected dyes or pigments are dosed on demand and avoid print paste residues at the end of each run and if pigmented inks are used (rather than those based on dyes) no solvent, with associated volatile organic compound emissions, is required to dissolve the colourant. Further, pigment-based inks can be cured with novel ultraviolet curing technology, where UV radiation is used to rapidly fix the printing ink to the fabric without the emission of odour or toxic by-products, offering advantages over traditional methods of drying by heating and steaming.[37]

Of particular note is transfer printing, which has important advantages in comparison to other methods of printing. In transfer printing, paper is first printed with volatile disperse dyes and then heated, together with the fabric, in a thermapress. Under these conditions the dyestuff is transferred from the paper to the textile material by sublimation. In transfer printing only the dyestuff and no other chemical is deposited on the fabric so no washing-off is required and no effluent generated. For conventional printing, 250 kg of water per kilogram of printed fabric is required; for transfer printing, only 2 kg is needed.[38] In its present form transfer printing is only suitable for some synthetic fibres and is particularly successful with polyester.

Best practice in printing:[39]

- Choose suppliers who use water-based print formulations;
- Ask suppliers about measures to reduce print paste losses and water consumption in screen printing;

– Use digital inkjet printing for short production runs to reduce print paste waste;
– Choose suppliers who substitute the use of urea in reactive printing by introducing novel printing methods;
– In pigment printing ask suppliers to use thickeners which contain no volatile solvents to minimize emissions to air as print pastes are dried.

Specialist fabric finishing

Textiles can be given a range of additional treatments after dyeing and printing, to improve either fabric performance or aesthetics. Some treatments are mechanical such as calendering, where the fabric is pressed between rollers, giving it a glaze and increasing its density. Others are chemical, such as those providing water repellency and crease resistance (easy-care). Making cellulosic fabrics easy-care has traditionally involved a treatment of urea and formaldehyde which when baked onto the fabric forms a resinous polymer and makes the fabric less prone to creasing. The use of formaldehyde is now restricted; it is a skin irritant and is linked to the production of carcinogens – as a result formaldehyde-free or formaldehyde-poor techniques have been developed. Other treatments give water repellency. Traditional treatments made use of paraffin wax coatings that need regular reapplication to maintain watertightness. More durable finishes which withstand washing and repel oily stains as well as water are based on perfluorinated chemicals which have wide-ranging health impacts and are persistent in the environment. Recently the UK government has announced plans to phase out one widely used perfluorinated chemical (PFOS) and 3M, maker of Scotchguard the stain resistant coating for textiles, has withdrawn from 'perfluoroctanyl chemistry' because of risks to human health.[40] In Europe it seems likely to regulate against non-essential uses of perfluorocarbons, such as stain-repellent coatings on fabrics, which account for substantial use of the chemicals, yet deliver few benefits.

Other finishes still provide antimicrobial protection either with organochlorines such as triclosan, the primary ingredient of the registered biocide Microban, (suitable for polyester and nylon fibres and their blends with cotton and wool); or with coatings such as poly(hexamethylenebiguanide) (suitable for cellulosic fibres). While the side effects of these bacteria-killing coatings are still largely unknown, there is growing unease about the possibility that their widespread use might result in bacteria (so-called super bugs) developing resistance to drugs with the same mode of action.[41] All specialist finishes are applied to add value to the final product, where they can – for example, reduced impacts in washing or enhanced product durability. The

remaining largely untested question is whether these benefits outweigh the negative impacts in the processing stage and whether adding more and more complex treatments in production reduces the textile's overall lifecycle impact.

Best practice in specialist fabric finishing:[42]

- Ask for formaldehyde-free or formaldehyde-poor, easy-care finishing agents;
- Minimize energy consumption of drying machines (stenters);
- Use recipes optimized for low air emissions.

Cut-make-trim

Following fabric finishing, cloth is cut and sewn into garments or other textile products. The cut-make-trim (CMT) stage is a largely manual operation – with key sustainability impacts being social and worker-related rather than environmental, in contrast to the finishing stage. Converting pattern pieces to garments needs workers at sewing machines – an inexpensive, mechanically simple technology. This results in a 'mobile' industry that is relocated to whichever area of the globe has the cheapest labour costs. Manufacturers compete with each other for a place in the supply chain of retailers and big brands and this puts downward pressure on labour rights and working conditions, making these key impacts associated with garment manufacture.[43] This downward pressure has increased according to Fashioning an Ethical Industry – a project of the campaigning group Labour Behind the Label – with the removal of trade protection barriers in the textile and garment sector on 1 January 2005:

> In order to remain competitive, governments and employers feel the need to offer the cheapest, most flexible labour in the least regulated workplace. This translates into downgrading working conditions and wages and stepping up trade union repression. Lesotho, El Salvador and Sri Lanka for instance have excluded textile and garment workers from statutory wage increases; Bangladesh for a while legalised a 72 hour working week; in the Philippines, unpaid overtime is becoming the norm. Flexibilization translates into informalization, which means reduced legal production for workers.[44]

Evidence for labour abuses in the supply chains of high-street names is convincing. War on Want's report, *Fashion Victims*,[45] for example, revealed

that Bangladeshi workers making goods for UK retailers are working 80-hour weeks for 5p an hour despite pledges by these companies to protect basic human rights. Oxfam's report, *Offside!*,[46] published to coincide with the 2006 Football World Cup, revealed the serious labour abuses in the supply chains of many global sports brands including workers being dismissed or threatened with violence when they have organized unions to lobby for better pay and conditions. In another report, Labour Behind the Label shed light on the 'poverty wages' paid to many working in the garment sector. Here commitments of retailers and big brands to pay workers minimum wages are undermined because neither national legal standards nor industry benchmark standards come close to meeting basic needs. In Bangladesh, for example, the minimum wage is £7 per week whereas the living wage is calculated as £30 per week.[47] Low pay, lack of rights and unacceptable working conditions is the daily reality for millions of garment workers across the world – conditions that are tolerated because workers need an income, and working in poor conditions in the clothing supply chain is perhaps better than some of the alternatives available, particularly for low-skilled female workers. Stepping into this space, the campaign for an Asia Floor Wage[48] (AFW) is attempting to concretize a minimum living wage for workers in Asia, the largest hub for garment manufacturing. The industry in Asia employs around one hundred million workers, the majority of whom are female, and AFW is a regional strategy for fighting poverty, promoting more equitable economic development and for the betterment of a workforce that is composed largely of women.

Codes of conduct

Since violations of workers' rights were first brought to public attention in the 1990s, there has been growing pressure from the public, trade unions and campaigning groups to improve labour rights and working conditions in the textile and clothing sector. Ethical trade initiatives have succeeded most by helping retailers and brands acknowledge their responsibility to the workers in their supply chains, mainly through the development of codes of conduct. Codes of conduct outline basic workers rights and minimum standards pledged by a company, and can help raise awareness, put pressure on fashion companies and factories to meet basic standards, and provide guidance for law making. Codes are voluntary agreements and are frequently drawn up by the company themselves and passed on to contracted factories to sign. Consequently codes vary enormously and this has led NGOs and trade unions to develop 'model' codes that include details of proper monitoring and independent verification procedures. Monitoring and verification

is vital to ensure the code is more than just a list of good intentions and is implemented in an effective and systematic way.

The Clean Clothes Campaign[49] has developed one such model code, building on international standards. It states that:

- Employment is freely chosen;
- There is no discrimination in employment;
- Child labour is not used;
- Freedom of association and the right to collective bargaining are respected;
- Living wages are paid;
- Hours of work are not excessive;
- Working conditions are decent;
- The employment relationship is established.

The most progressive codes of conduct are developed in collaboration with workers, trade unions and NGOs in a bottom-up approach called a 'multi-stakeholder initiative' and the most stringent of these is that developed by Social Accountability International and its SA 8000 Standard. These initiatives emphasize worker education and training, the right to form a union and the active involvement of workers, local NGOs and independent auditors in the monitoring of standards. This helps prevent codes bringing only temporary change to the lives of workers – such as around the time a contract is signed for instance, or during occasional, pre-organized monitoring visits – as major violations of workers' rights, for example, have been recorded in factories that have passed social audits. Indeed even with extensive implementation, monitoring and verification procedures, such as those put in place by the most forward-looking multinational corporations, problems still exist; Nike, for example, has admitted that even with strict codes and independent monitoring, up to half of its workers do not even receive the legal minimum wage.[50] To make change happen will therefore take more than a code – a point recognized by forums such as the Ethical Trading Initiative – which provides corporate members with a safe space for discussion with other companies and for engagement with critical NGOs and trade unions. It conducts pilot projects and has set up a number of working groups to look into various aspects of code implementation.

Modelling the industry as a whole system

In the first part of this chapter we saw how more efficient processing techniques and codes of conduct can help reduce the negative impacts of the way business is done in the fashion and textile sector. These codes and techniques have evolved out of the economic and technological reality of production conditions in today's industry. They play a vital role in bringing tangible and sometimes instant environmental benefits and act as an important driving force in getting retailers to take more responsibility for the workers in their supply chains. The next part of this chapter changes emphasis and switches away from a close focus on process improvement to a systems view of sustainability improvements across the industry as a whole. It does this by interweaving culture, behaviour and industrial activity to help contextualize those standards- and process-driven improvements in a bigger picture of possible and sustainability-oriented actions. This 'bigger picture' involves us moving from a reductionist approach to tackling sustainability issues (i.e. looking at individual issues, materials, methods and companies), to a whole industry-as-system approach. When we consider the fashion and textile industry as a system, new and different opportunities for bringing more change towards sustainability are revealed. This change happens at many levels, some with more far-reaching influence than others.

Exploring these levels of change, Donella Meadows,[51] a visionary complex systems thinker, developed a list of intervention or leverage points for affecting change within systems, each with greater influence than the last. The next part of this chapter explores this list using case studies from the fashion and textile sector. It draws on a growing band of designer-makers, large companies and collaborative projects that are working towards change in different ways and can be described as 'intervening' at different points in the fashion and textile industrial system. They are producing products and championing approaches that support communities and respect workers; that promote information and supply chain transparency; and that offer us more effective, imaginative and conscientious models of production. These projects and companies are both high end and high street and comprise a wealth of different production configurations, ranging from one-off craft or bespoke production; to networks of small suppliers, normally organized into cooperatives; to vertically integrated manufacturing; to manufacturing on multiple sites with strict codes of conduct and supply chain standards. Donella Meadows' list helps explain why certain types of change bring short-term benefits and why others have deeper, broader and longer-lasting effects. It also builds confidence and shows us how our actions (including small actions) can affect the

bigger system. Meadows lists nine 'places to intervene in a system', which are a set of tactics, of varying effectiveness, for changing current practices. From least to the most effective, they are:

9 Numbers (subsidies, taxes, standards)
8 Material stocks and flows
7 Regulating negative feedback loops
6 Driving positive feedback loops
5 Information flows
4 The rules of the system (incentives, punishment, constraints)
3 The power of self-organization
2 The goals of the system
1 The mindset or paradigm out of which the goals, rules, feedback structure arise

9 Numbers and standards

For Donella Meadows, a focus on standards or efficiency targets tends to bring the most limited change because it involves only minor adjustments to a product or process. Adjusting numbers may change efficiency ratings, but because these improved ratings are being applied to the same fibres, processed with the same machinery, sold by the same retailers as before, the system does not change much. So for example, if wastewater is filtered, it cuts river pollution downstream from the dyehouse, but it does not make a dye process low impact. Likewise, if retailers introduce recyclable packaging, it positively reduces the amount of waste sent to landfill, but it does not tackle problems linked to over-design of packaging and overconsumption of resources more generally.

Yet, somewhat paradoxically, a focus on numbers and standards is where most change tends to start, and where the vast majority of sustainability actions of the fashion and textiles sector has been concentrated to date, because it tends to be in the direct influence of most companies. These manufacturers, retailers or designers can, for example, fine-tune an inefficient process far quicker and easier than they can redesign the overall system. Yet Meadows' point is that it is important not to focus on making changes only at this level and to guard against the fact that many of us seem to become 'stuck' here because, while the benefits tend to be felt quite quickly and are particularly important for the company whose process is being improved, they will not on their own completely transform the sector into a sustainability-oriented one. To engage with the process of sustainability, we

need to develop other tactics too and use the focus on numbers and standards as the start of a process of questioning, thinking and improving to drive fundamentally deeper and longer-term change.

8 Material stocks and flows

Substituting one material for another and introducing innovative products can have a substantial effect on how a system operates, particularly in a manufacturing-led industry like fashion and textiles. A key way to support less resource-intensive materials flows in the fashion and textile industry is to build large, stable material stocks of, say, low-impact fibres. This will help ensure that lower-impact alternatives are widely available and readily taken up. To increase the stocks of these fibres, suppliers first need to be drawn into the market. For this to happen, there needs to be strong, dependable demand. Guaranteed markets for fibres like organic cotton protect farmers from price fluctuations in commodity markets; and for recycled synthetic fibres like polyester or nylon, encourage research and development in the building of successful new markets for second-hand materials.

Retailer Marks and Spencer (M&S), which accounts for around 10 per cent of the UK's clothing market, is successfully influencing stock and flow structures. For over a decade, M&S has been working to reduce the impact of its own-brand products mainly through the introduction of strict production standards across the supply chain that, for example, banned suppliers from using certain dye chemicals and insisted on the removal of all other dyes before the effluent is released to the environment (these follow many of the best practice guidance set out in the first part of this chapter). More recently its focus on standards and material flows has been transformed; first in 2006 as it launched a major advertising campaign (Look Behind the Label) to differentiate its brand on the basis of its CSR policies, including care over the chemicals used in its products; and then in 2007 with the launch of its progressive 100 point sustainability initiative, 'Plan A'. Plan A commits M&S to becoming carbon-neutral, to send no waste to landfill and, most ambitiously, to extend sustainable sourcing and set new standards in ethical trading. In its sourcing policy, it has pledged to launch product lines in organic cotton, linen and wool, and using recycled polyester. It is also committed to Fairtrade cotton: today 20 million of its garments will carry the Fairtrade mark for cotton, an independent product certification label that guarantees sweat-free cotton farming and a minimum price for the crop. It is the sheer size of M&S's operation – its influence extends to over 2,000 factories, 10,000 farms, 250,000 workers and millions of customers – that makes acting to build a

◀ T-shirts in 100 per cent Fairtrade mark cotton by Marks and Spencer

strong market in lower-impact materials an important way to affect change of the bigger system, but one that will always be limited by appropriateness and efficiency of overarching business and industry goals.

7 Regulating negative feedback loops

Negative feedback loops help maintain systems within safe limits. They focus on keeping undesirable factors under control by looking at the output of the system and reducing it (hence the term 'negative') to keep the system in check (see Figure 2.2). In the case of the fashion and textile sector these impact-reducing loops are provided by legislation or pressure from consumers and NGOs. Rafts of new European legislation including IPPC, REACH and producer responsibility 'take back' legislation which requires companies to take their products back from consumers at the end of their lives (already informally implemented in-store at M&S in the UK under the banner of 'shwopping' and more recently, introduced at H&M globally), along with the Greenpeace Detox[52] campaign to challenge suppliers to eliminate all releases of hazardous chemicals to water, are all negative feedback loops and act, in varying degrees, to reduce the impact of industry. Other examples include codes of conduct, effectively lobbied for by a number of campaigning groups including Labour Behind the Label and Oxfam, which have acted to promote workers' rights by controlling the amount of overtime worked and by safeguarding pay, working conditions and the right to join a union.

Yet negative feedback loops are only effective if they are as strong as the impacts they are trying to keep in check. New business pressures such as the push to supply 'value' clothes, to increase volumes and reduce lead

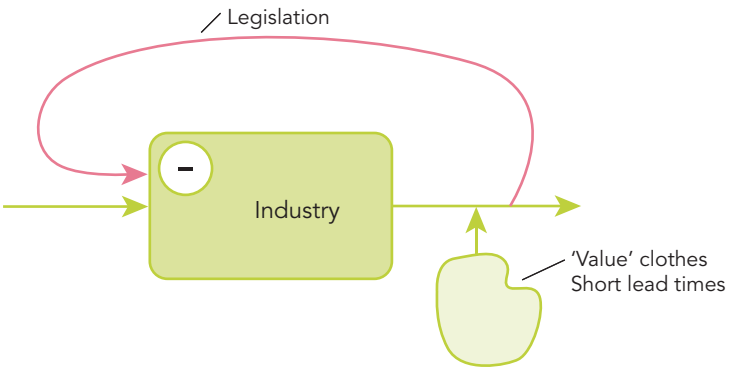


Figure 2.2 *Negative feedback loop*

times are ratcheting up the level of impact. In recent years, for example, the lead times from product development and concept to delivery expected by big retailers and global brands from their suppliers have been cut by 30 per cent,[53] with some brands reported to be able to develop and deliver collections and styles in as little as 15 days, though using fabric available from stock, as fabric development and delivery still takes a minimum of seven weeks.[54] This prevents long-term planning by supplier factories and fuels a cycle of lowering labour standards as workers are forced into unpaid overtime to meet deadlines, frequently on temporary contracts. This has resulted in a 'race to the bottom' in terms of labour standards and prices as countries compete for contracts from leading brands and retailers, and an increased level of 'throwaway' consumption. The average UK consumer today buys up to one-third more textiles and garments than four years ago[55] and spends one-quarter less per garment.[56] Thus, in order to continue to be effective and keep impacts in check, the strength of codes and regulations will have to increase, with ever more prescriptive legislation, unless we address issues to do with consumption and relationships between brands and suppliers in other ways. Otherwise laudable attempts to lessen the net impact of the fashion and textile sector will be completely eroded by the increase in the number of garments in circulation.

▶ ONE T-shirt made from 100 per cent Lesotho cotton by EDUN

6 Driving positive feedback loops

A number of fashion and textiles companies and projects are pushing for change using positive feedback loops. These loops are powerful, self-reinforcing and can drive growth with important effects on the bigger system (see Figure 2.3). There is, for example, a loop of positive feedback around encouraging the growth of knowledge in fashion and sustainability. The more awareness there is in environmental and social issues, the more opportunities

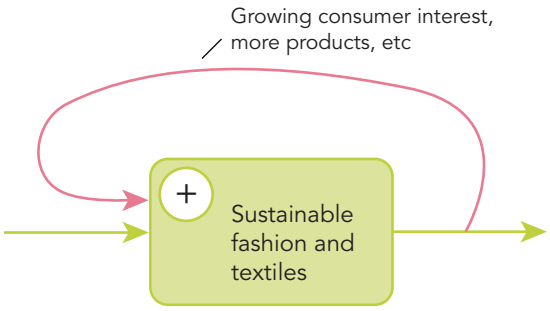


Figure 2.3 *Positive feedback loop*


ONE

there will be – both inside and outside of the market – to foster change in this area. This increased knowledge and raised profile leads to more interest in the issues and greater demand for development of alternatives to consumerist fashion. And so the loop goes on, positively reinforcing the potential of sustainability thinking and practice in fashion and textiles.

EDUN, the clothing brand set up by Ali Hewson, wife of U2 frontman Bono, employs positive feedback loops to affect change. EDUN focuses on poverty reduction through trade and sustainable employment especially in Africa. One of its past campaigns 'One' focused on supporting the precarious clothing industry in Lesotho through a combination of trade and aid. The removal of global import quotas in the textile sector in 2005 left a number of countries – such as Lesotho – which built great dependency on the textile and clothing industry in an era of quotas, at risk of widespread economic hardship. In Lesotho, for instance, the clothing sector accounts for around 40 per cent of national jobs. The positive feedback loop is established by providing factories in Lesotho with guaranteed work, which then creates more jobs and raises more people out of poverty, which in turn increases Lesotho's industry and capacity to work. Further, a quarter of the ticket price of EDUN's Lesotho-made One T-shirts is ploughed back into AIDS prevention and medicines for the factory workers – AIDS claiming the lives of around 2,300 of Lesotho's garment workers each year.

Another positive feedback loop is created by Aid to Artisans, an non-profit organization that provides 'a world community' of entrepreneur-

▼ Pillows produced by Armenian craftspeople supported by Aid to Artisans

craftspeople with access to programmes of product design, production and business skills to strengthen their businesses and ultimately to build self-reliance and support families, communities and livelihoods. Here the loop is initiated by information: the more knowledge of the market Aid to Artisans can provide an entrepreneur, the more products that are sold and the more self-reliance fostered in the community. This then leads to more knowledge and experience of the market and helps the entrepreneur grow their business. Aid to Artisans' work spans more than 140 artisan groups, helping them to create sustainable businesses. The Sharan Craft Centre in Armenia, for example, gained design assistance from Aid to Artisans as a fledgling enterprise and is now a fully independent and thriving children's knitwear business with an annual turnover of US$ 600,000, employing over 400 artisans, to whom it pays an average wage over 50 per cent higher than the national wage.

5 Information flows

Adding or changing the flows of information between companies in a supply chain or between retailers, designers and consumers can bring big change for relatively little effort and cost, as compared to capital expenditure linked to replacing a company's equipment or factory set-up. The power of information in bringing change towards sustainability is recognized for example by the European Commission in its IPPC recommendations, where exchanging information on the type and load of chemicals used by upstream partners in the supply chain can help create a chain of environmental responsibility for textiles.[57] Other examples include CSR programmes that use information strategically to bring change inside corporations and also with outside stakeholders, and the MADE-BY supply chain traceability initiative for fashion brands pushes this further by introducing a new flow of information about sustainability impacts into the fashion industry system. Using tracking technology and an Internet interface, the MADE-BY initiative links up with a fashion brand to show all the production processes behind a product, including where it was made, from what and by whom, and publishes the data on its website for consumers to access. Its goal is to ensure absolute transparency of the supply chain (both good and bad) with the hope that openness will lead to more responsible practices. Some garments produced under the MADE-BY label carry a small blue button near the care label and an identification tag that uniquely identifies a single batch of product. By entering the data on this label into the MADE-BY website and 'pushing the button' a full garment production history is revealed.

MADE-BY button indicating supply chain transparency

4 The rules of the system

The system rules define the scope and boundaries of the fashion and textile industry and set out who benefits. They can for example set out new relationships with workers or a different approach to resource use. A number of companies are working at the level of rules to influence the bigger system. The business model at the brand People Tree, for example, is designed around fair trade and ecological principles. People Tree produces its simple, pretty and natural fibre garments – some made with organic cotton – in collaboration with 70 fair trade groups in 20 developing countries, normally operating as cooperatives. It pays producer partners a fair price, offering advance payment, providing technical and design assistance and committing to regular, ongoing orders with achievable lead times. Its products rely on the specialist skills of over 1,400 artisans and include hand woven cotton from Bangladesh, delicately beaded Zardosi embroidery from India and Japanese Hanga woodblock printing. Particularly in labour-intensive manufacturing stages like garment production, fair trade initiatives bring important benefits for workers.

Purple hooded sweatshirt by American Apparel

The business model of American Apparel – now the biggest T-shirt manufacturer in the US – also has different rules. Its multicoloured knitted jersey

sweatshirts and T-shirts are celebrated as 'Made in Downtown LA, Sweatshop Free', where it has developed a strong brand image around credibility within its organization by dedication to its workers. American Apparel has sidestepped criticism often levied at clothing labels about their ignorance of labour and working conditions in factories in low-cost countries (out of sight, out of mind) by making all its clothes in a vertically integrated mill in its own backyard. Advertising and marketing are also in-house – with factory workers modelling in its ad campaigns. American Apparel pays above the US minimum wage and provides staff with benefits that include company-subsidized lunches, bus passes, free English language classes, on-site masseurs and free bicycles.

▶ Slip dress in 100 per cent silk by Dosa

Christina Kim's high-end label Dosa also intervenes at the level of rules, combining a sense of a personal responsibility for workers with environmental awareness. Kim uses traditional hand-loomed khadi fabrics, organic wool, undyed hand-spun wild silk, natural dyes such as cochineal, fustic and indigo and avoids chemical bleaches. Dosa's products frequently use hand techniques to infuse the product with a sense of the energy and touch of the maker, and support rural communities – the label's demand for hand-spun silk, for example, provides livelihoods for 500 women in the Assam region of India. Rewriting the rules about sales and consumption, Kim also avoids the practice of designing new collections for multiple seasons, instead producing a new collection once a year.

3 The power of self-organization

Self-organization is a process in which a system's internal organization increases in effectiveness without being guided or managed by an outside source. It happens without any controlling 'brain' and instead involves cooperative working between each part of the system, adapting as needed to help with the functioning of the whole. Providing the people in the system are armed with information, knowledge and choice, then it can lead to positive and substantial change. Setting up the right conditions for self-organization to happen in the fashion and textiles sector means generating the biggest stock possible of sustainability-related ideas, materials, behaviours and culture from which to seed the building of new, or more effective versions of existing, systems. To promote self-organization we have to promote diversity and build as broad a range of potential solutions and ideas as possible. This pluralistic vision, of building a multitude of diverse and engaging approaches, is at the heart of this book.

2 The goals of the system

The goals of the system profoundly influence its purpose, dynamics, impacts and products. Today, the fashion and textile industry's whole-system goal is to make profit through selling fibres, fabrics and garments. These profits help businesses grow and control more of the market, which then reduces their exposure to financial risk. Overhauling a growth-oriented goal in favour of one that promotes sustainability, i.e. one that fosters social and environmental quality and value as its primary aim and which then finds business opportunity within this redefined space, would lead to big change (impacting on all of the other leverage points on this list). Yet such a change in direction and goal requires broad and deep discussion and courageous leadership from both within and without the industry. It poses challenging questions about the industry's current set-up and about who benefits from this status quo. Furthermore it invokes a moral enquiry about whether this state of affairs is 'good' and desirable. Such a redefinition of industry goals could ask about how the fashion and textile industry would operate if its purpose was to benefit citizens; or about its formulation if its aim were to foster convivial communities; or even what would fashion and textiles provision and consumption be like if the sector's goal was to practise material restraint.

The practice of reformulating an organization or enterprise's system goals and aligning them with social and environmental value is underway in the case of outdoor sportswear producer Patagonia and carpet giant Interface. Interestingly, both companies' business goals are closely aligned with personal convictions of their founder (Yvon Chouinard in the case of Patagonia) or CEO (Ray Anderson at Interface). The influence of these goals has flowed far beyond the reaches of their individual product lines – in Patagonia's case directly challenging consumption: 'don't buy unless you really need it'[58] – and has begun to influence the bigger system, challenging notions of business practice, objective and orientation.

1 The mindset or paradigm out of which system arises

Paradigms or the accepted models of how ideas relate to one another are the sources of systems. They are the frames of reference, stories and exemplars that enable us to think about a complex subject, work with it and achieve results that we can apply in useful ways. A paradigm gives us a foundation for what we do, but is far from perfect, containing anomalies that often distort our experience and understanding of the world as it is squeezed into 'the preformed and relatively inflexible box that the paradigm

supplies'.[59] Thus, we must be alert to a paradigm's influence, and how it affects our ideas and thoughts; to its usefulness, as we navigate and frame complex subjects; and to its shortcomings, which can perpetuate certain perspectives or partial information. Yet if we influence things at the level of a paradigm, then a system can be totally transformed and if this power were harnessed to foster sustainability values, then substantial cultural and ecological shifts would likely follow. Generally speaking, we resist changes to our paradigms more than any other type of change, although as Meadows states: 'there's nothing physical or expensive or even slow about paradigm change. In a single individual it can happen in a millisecond. All it takes is a click in the mind, a new way of seeing'.[60] For fashion and textiles – and the manufacturing of fashion and textiles in particular – it is this shift in mindset that is essential to bring change beyond operational improvements to process or supply chain. For it is a new way of seeing, of perceiving the world and our role in it, that will affect the industry most.

Notes

1 See for example: *ENDS Report* (2007), Textile Firm Fined for Pollution and IPPC Failures, 385, p10; *ENDS Report* (2002), Rochdale Dyeing Firm Fined for Bleach Pollution, 328, p58; *ENDS Report* (2000), Textiles Business Fined Under Council's Nuisance Powers, 304, p55.

2 *ENDS Report* (2004), IPPC Makes 'Poorly Managed' Textile Firms Pull Their Socks Up, 356, pp8–9.

3 Fashioning an Ethical Industry (undated), *Working Conditions in the Global Fashion Industry*, Factsheet 6, Online http://www.fashioninganethicalindustry.org/ (accessed 12 December 2012), p1.

4 *EcoTextile News* (2012), Planet Denim, 48, p37.

5 See for example: Manzini, E. (1994), Design, Environment and Social Quality: From 'Existenzminimum' to 'Quality Maximum', *Design Issues*, 10(1), pp37–43; Margolin, V. (1998), Design for a Sustainable World, *Design Issues*, 14(2), pp83–92; Walker, S. and Nielsen, R. (1998), Systemic Shift: Sustainable Development and Industrial Design Methodology, *Journal of Sustainable Product Design*, 4, pp7–17.

6 Ehrenfeld, J.A. (2008), *Sustainability by Design*, New Haven: Yale University Press.

7 Historic Futures (2012), Online http://www.historicfutures.com/ (accessed 12 December 2012).

8 Sustainable Apparel Coalition (2012), Online http://www.apparelcoalition.org/ (accessed 12 December 2012).

9 *ENDS Report* (2004), Tests Mandated for Azo Dyes, 359, p55.

10 EC (2003), *Integrated Pollution Prevention and Control Reference Document on Best Available Techniques for the Textiles Industry*, Brussels: European Commission.

11 REACH (2012), Online http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm (accessed 12 December 2012).

12 Klein, N. (2000), *No Logo*, London: HarperCollins.

13 Bluesign, Online http://www.bluesign.com/ (accessed 27 November 2012).

14 EC, Op. Cit., ppii–iii.

15 *EcoTextile News* (2011), Greener Machinery Strives to Reduce Carbon Footprint, 44, pp57–61.

16 UNEP (1993), *The Textile Industry and the Environment*, *Industry and the Environment Technical Report No. 16*, Paris: United Nations Publications, p48.

17 EC, Op. Cit., p450.

18 EC, Op. Cit., p288.

19 Allwood, J.M., Laursen, S.E., Malvido de Rodriguez, C. and Bocken, N.M.P. (2006), *Well Dressed?*, Cambridge: University of Cambridge Institute of Manufacturing, p33.

20 *Textile Horizons* (2003), The Future of Knitting Available Today, November–December, pp21–22.

21 UNEP, Op. Cit., p38.

22 GOTS (2012), Online http://www.global-standard.org/ (accessed 27 November 2012).

23 Greenpeace Detox, Online http://www.greenpeace.org/international/en/campaigns/toxics/water/detox/?accept=695c561620b43f31c8d44b015f0d1f34 (accessed 27 November 2012).

24 *EcoTextile News* (2011/2012), Toxic-free Road Ahead?, 46, p47.

25 EC, Op. Cit., pp293–296.

26 Laursen, S.E. and Hansen, J. (1997), *Environmental Assessment of Textiles*, Copenhagen: Danish Environmental Protection Agency, p124.

27 UNEP, Op. Cit., p40.

28 Cooper, P. (1992), The Consequences of New Environmental Legislation on the UK Textile Industry, *Textiles Horizons International*, 12(10), pp30–38.

29 *EcoTextile News*, (2011), Akin Tekstil Claims Waterless Dyeing, 42, p4.

30 UNEP, Op. Cit., pp54–55.

31 *EcoTextile News*, (2012), Cool Running, 46, p26.

32 Milmo, S. (2007), Developments in Textile Colorants, *Textile Outlook International*, January–February, p28.

33 Ibid., pp26–28.

34 Lewis, D.M. (1997), Colouration 2000, *Journal of Society of Dyers and Colourists,* 113, July/August, p196.

35 EC, Op. Cit., pp304–357.

36 EC, Op. Cit., pp451–453.

37 Milmo, Op. Cit., p38.

38 UNEP, Op. Cit., p.56.

39 EC, Op. Cit., pp453–454

40 *ENDS Report* (2004), Perfluorinated Chemicals: Jumping from Frying Pan into Fire? 354, pp28–31.

41 *ENDS Report* (2007), Tackling a Grubby Reputation, 386, pp30–33.

42 EC, Op. Cit., pp373–393.

43 Fashioning an Ethical Industry (undated), *The Structure of the Fashion Industry*, Factsheet 2, Online http://www.fashioninganethicalindustry.org/ (accessed 12 December 2012).

44 Fashioning an Ethical Industry (undated), *Life after the MFA*, Factsheet 4, Online http://www.fashioninganethicalindustry.org/ (accessed 12 December 2012), p4.

45 War on Want (2006), *Fashion Victims: The True Cost of Cheap Clothes at Primark, Asda and Tesco*, Online http://www.waronwant.org/Fashion+Victims+13593.twl (accessed 12 December 2012).

46 Oxfam (2006), Online http://www.oxfam.org/en/policy/briefingnotes/offside_labor_report (accessed 12 December 2012).

47 Labour Behind the Label (2006), *Clean Up Fashion*, Online http://www.cleanclothes.org/ftp/06-09-cleanupfashion.pdf (accessed 12 December 2012).

48 Asia Floor Wage, Online http://www.asiafloorwage.org/ (accessed 12 December 2012).

49 Clean Clothes Campaign (2012), Online http://www.cleanclothes.org/ (accessed 12 December 2012).

50 Fashioning an Ethical Industry (undated), *A Brief History of Company Engagement*, Factsheet 9, Online www.fashioninganethicalindustry.org (accessed 12 December 2012).

51 Meadows, D.H. (1997), Places to Intervene in a System, *Whole Earth*, Winter, Online http://www.sustainer.org/pubs/Leverage_Points.pdf (accessed 12 December 2012); Meadows, D.H. (2008), *Thinking in Systems*, London: Earthscan.

52 Greenpeace Detox, Online http://www.greenpeace.org/international/en/campaigns/toxics/water/detox/?accept=695c561620b43f31c8d44b015f0d1f34 (accessed 12 December 2012).

53 Fashioning an Ethical Industry (undated), *The Fashion Industry and Poverty Reduction*, Factsheet 3a, Online www.fashioninganethicalindustry.org (accessed 12 December 2012), p3.

54 Dalziel, A. (2010), Evolving Business Models in the Textile and Apparel Industry, *Textile Outlook International,* 146, p70.

55 Allwood *et al*., Op. Cit., p12.

56 Anson, R. (2010), Editorial: The End of the Line for Cheap Clothing?, *Textile Outlook International,* 147, p5.

57 EC, Op. Cit.

58 *EcoTextile News* (2011), Patagonia Launches Green Partnership Program, 45, p11.

59 Kuhn, T. (1962), *The Structure of Scientific Revolutions*, Chicago: Chicago University Press, p24.

60 Meadows, Op. Cit., p18

CHAPTER 3 Use Matters

Research from the Netherlands shows that the average piece of clothing stays in a Dutch person's wardrobe for three years five months, is on the body for 44 days during this time and is worn for between 2.4 and 3.1 days between washings.[1] Yet even though the typical garment is only washed and dried around 20 times in its life, most of its environmental impact arises from the process of laundering and not from the growing of the fibre, the production of fabric or the disposal of the piece at the end of its life. The washing and drying of a pair of a classic Levi's 501 jeans, for example, is responsible for almost two-thirds of the energy consumed throughout the whole of the jeans' life;[2] for men's underwear, cleaning is 80 per cent of the total energy

demand;[3] and the laundering of a polyester blouse uses around six times as much energy as that needed to make it in the first place.[4] Just by washing the blouse half as often, the product's overall energy consumption can be cut by almost 50 per cent with similar savings for air pollution and production of solid waste. The message here is stark: some of the biggest gains in environmental performance for many fashion and textile pieces can be made by tackling the impact arising from their laundering. Material choices, production-efficiency issues and waste also matter, but for frequently washed items, reducing impact of materials and production does not deliver resource savings on the same scale as influencing laundry practices.

Yet while use is very important to questions of ecological and social value, it is an under-explored, though growing, area of investigation and innovation towards sustainability in fashion and textiles. Moreover, there is relatively little knowledge about the scope and potential of designing to reduce the impact of the use phase of fashion and textiles' life. This chapter aims in part to address this imbalance and to explore multiple and emerging sustainability issues associated with the use phase of fabrics and garments. It touches on washing machines and detergents, opportunities to design fabrics and garments with lower impact in use, community laundries and the socially and culturally determined need to keep clean. It also highlights an emerging body of work exploring use practices as an opportunity for fostering change towards sustainability. While these themes go far beyond the traditional remit of fashion and textile design – venturing into the territory of white goods manufacturers as well as home economists, ethnographers and sociologists, among others – they are part of a trans-disciplinary approach essential to most sustainability work and one in which disciplinary specialisms dissolve in favour of subject-specific expertise, which draws from a wide span of approaches and knowledge bases and which emphasizes whole systems improvement over piecemeal gains. The upshot of such sustainability-specific expertise is an overhaul in the way designers, companies and indeed whole industries view their contribution to a fashion and textile product's lifecycle. In systems thinking the success of the whole entails joint responsibility for all players (weavers, finishers, retailers, detergent manufacturers, consumers, etc.) to foster resourceful outcomes. This makes things like laundering and use habits, for example, as much a concern for designers as for those who wear and maintain clothes. It promotes a sense of shared responsibility for material upkeep and associated environmental impact reduction between those who make the fabric, those who use it and those who design and produce the machines and detergents that help us keep clothes clean.

Different products, different resource profiles

At the heart of a sustainability-oriented fashion and textiles sector is a broad, flexible approach to change that supports a wealth of differentiated activity (as described in Chapter 1 – Material Diversity). In the case of the use phase, this flexibility is perhaps even more important because of its overwhelming dependency on individuals and their practices – the unique, complex, habitual, idiosyncratic actions taken by people with clothing in the course of their lives. Here, universal statements and generic assumptions about fibres or consumers can bring only limited insight, as it is in the detail and subtleties of the human-garment relationship and empathy with actual washing and drying habits that areas of high impact and opportunities for big change are revealed. In the case of laundering-related impacts for example, there are substantial differences between types of textile and clothing products, let alone between users. Demonstrating this variance between products, Table 3.1 sets out a rough approximation of the distribution of environmental impact across the life of various textile products and helps scope lifecycle phases that have most impact and where change could bring most benefit. For example, in the case of a frequently laundered garment like a cotton T-shirt, the use phase has the highest impact and the effect of reducing the energy used in washing, drying and ironing the T-shirt dwarfs the possible effects of changing production methods.[5] But for carpets, the energy and environmental impact profile is weighted very differently. Here the materials production phase is very important – approximately 71 per cent of the total energy[6] – and disposal is similarly high impact meaning that innovation is best directed at phases other than use.

There is a growing body of evidence that confirms the high relative impact of the use phase for frequently laundered clothing.[7] The first lifecycle

Table 3.1 *A rough guide to relative impact of textile products throughout life*
Key: *+ small relative impact; ++ medium relative impact; +++ large relative impact.*[8]

	Products	Use	Disposal
Clothing	+	+++	+
Workwear	+	+++	+
Household textiles	+	+++	+
Furnishings	+++	+	++
Carpets	+++	+	++

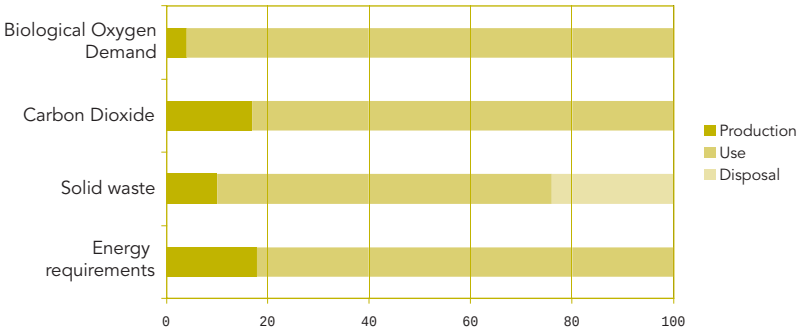


Figure 3.1 *Lifecycle impacts for a women's polyester blouse (percentage of total impact)*[9]

assessment (LCA) study to set out this finding was of a polyester blouse performed in the early 1990s by consultants Franklin Associates[10] for the American Fiber Manufacturers Association (AFMA), the trade association for US companies that manufacture synthetic and cellulosic fibres. The Franklin Associates' report uses an established LCA methodology and its results show unequivocally that the majority of environmental impact in the lifecycle of a blouse arises from the consumer use phase (see Figure 3.1). It concludes that as much as 82 per cent of energy use, 66 per cent of solid waste, 'over half' of the emissions to air (for carbon dioxide specifically the figure is 83 per cent) and 'large quantities' of waterborne effluents (96 per cent if measured by Biological Oxygen Demand alone) are amassed during washing and drying.

In the years since its publication, the findings of the Franklin Associates' study – and others like it – have had a major influence on the dynamics of the fashion, textiles and sustainability debate, chiefly by drawing attention to the role played by user practices in overall lifecycle performance. However, it is important to recognize the political capital of such studies and the ways in which business interests can influence how they are presented. LCAs have a long history of being used by companies to defend themselves against environmental requirements by demonstrating that problems are more complex than initially believed[11] and in the early 1990s (the period in which the Franklin Associates' report was being prepared) synthetic fibre manufacturers were keen to deflect rising levels of environmental scrutiny away from their business practices. The headline results of the polyester blouse LCA can be seen to do just this, by turning the spotlight away from manufacturers (although making polyester is far from impact free) and on to consumers, their homes and washing practices. The report's executive summary states:

> it was demonstrated that the manufacture of a particular reusable product was not the most significant consequence for an energy and environmental analysis; instead improvement measures should be aimed at the efficiency of home laundering devices. It may also be possible to develop 'easy care' fabrics requiring lower consumer maintenance. These improvements would have much greater potential benefit than improving the product manufacturing process.[12]

Public relations spin and politics aside, LCA studies, like this one, are useful and important. They provide much-needed, data-driven information that helps identify lifecycle stages in which environmental measures may be most effective. More than that, as practices they gain their purpose and meaningfulness from the view that environmental issues are systems extending beyond the boundaries of individual companies. In the case of the polyester blouse for example, if this information is used to galvanize action and whole system improvement, then textile producers and white goods manufactures together with electricity providers and consumers would be encouraged to work together to bring change. Were this to translate into 'better' laundry practices for example, where a garment is washed on cold temperatures and dried on a line instead of in a tumble dryer, then total lifecycle energy consumption could be reduced by a factor of four according to data for polyester[13] and a factor of two for cotton;[14] a substantial improvement.

Modifying laundry practices is not a guarantee of big sustainability gains across the board. If the environmental impact of cotton is measured in terms of toxicity rather than energy use, then changing garment washing and drying practices brings almost no improvement.[15] Similarly modifying laundering behaviour brings little benefit for products that are rarely or never washed. This includes furnishings, carpets and a range of garments, typically outer garments, suits, heavier knitwear and those made from wool. Even if we launder woollen items relatively often, they tend to be hand washed with care in cool water and dried on a line (as they are largely unsuitable for tumble-drying), and so for these types of products the biggest efficiency gains can be made by improving design and production, not by concentrating efforts on affecting behaviour in the laundry. Such complexities underscore the dynamic effect of diverse patterns of behaviour on the use of fashion and textiles. They also reiterate the value of deep understanding of use practices, habits, behaviour, skills and knowledge as a powerful source of design innovation.

Innovating to reduce the impact of clothes and textiles cleaning

While it is the case that for those garments and textiles that are washed infrequently, there are few sustainability benefits from influencing laundering practices; for other products, like cotton and polyester clothing and household textiles, the gains are potentially substantial. There are many ways to act to reduce the impact of cleaning and caring for fashion and textiles and because the issues associated with these practices are systems that stretch beyond the boundaries of individual companies or industries, many of these innovations occupy brand new territory for the sector. They push into the world of detergents, consumer laundering habits and innovation around a product's functional and cultural meaning and represent a novel and emerging design and business opportunity, catalysed by the bringing together of knowledge and experience of previously separate parts of the industrial system.

In this new territory of innovation in laundering practices to foster whole system improvement, there are at least three broad clusters of opportunity, each with a different focus. The first of these has a *process focus* and includes improved efficiency and better control of the washing process. The second treads more familiar ground to fashion and textiles and has a *product focus*, concentrating on designing fabrics and garments to cause less impact as they are laundered. The third takes a *system focus* and centres on designing a product's function or results and influencing the habits and values associated with cleaning our clothes. These different clusters tally with well-recognized types of design for sustainability innovation[16] (see Figure 3.2) and

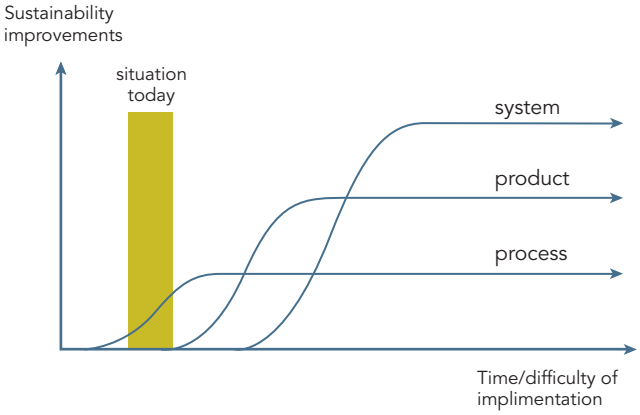


Figure 3.2 *Types of sustainable design innovation*

bring a range of different degrees of environmental benefit. The more radical innovations focus on consumption patterns and bring the biggest benefits because they are based on cultural change and shifts in consumer consciousness, although they are both difficult and time consuming to introduce. In contrast, changes to products or processes can be introduced more quickly as they generally involve familiar technologies and require little change to established behaviour, but they bring smaller-scale improvements.

Process focus – more efficient laundering practices

Improving the efficiency of washing machines and drying techniques has obvious benefits for the use phase of fashion and textiles. White goods manufacturers and detergent companies have been aware of the sustainability impacts of their products for several decades and many have taken steps to reduce these impacts. The key issues include energy, water and detergent use in washing and energy use in drying and ironing. Washing at a lower temperature reduces energy consumption by about 10 per cent for every 10°C reduction,[17] and it is projected that if all UK citizens currently laundering at a temperature of 40°C chose instead to wash at 30°C, the UK would save 12 per cent of the energy that is currently consumed on clothes washing annually.[18] Eliminating tumble-drying (which accounts for 60 per cent of the use phase energy) and ironing in combination with a lower washing temperature has been calculated to lead to around 50 per cent reduction in total energy consumption of the product.[19] Indeed figures collated for the UK suggest that increased line drying during summer months could result in an estimated energy saving of 0.9 TWh (equivalent to 0.4 Mt CO_2 emissions) per annum.[20]

It is certainly possible to create washing machines that use water and energy more efficiently. The incentives and effect of the EU-wide mandatory energy labelling scheme for white goods bears this out and now 90 per cent of all new washing machines sold fall into the most energy-efficient category,[21] although not all existing machines in people's homes are as efficient. Yet although manufacturers have improved the energy efficiency of appliances, increased usage driven by convenience and a growing number of individual households has resulted in more loads of washing being done – completely overshadowing efficiency gains. Consumers' preferences for products with enhanced features, functionality and controls also limit improvements. One of the UK's white goods manufacturers, for example, designed a washing machine that was able to mechanically wash clothes in cold water with comparable results to warm-water washing. As well as saving energy, it removed the need for complex water heating and the sophisticated

controls required to provide the range of wash programmes found in many machines, yet its simplicity meant that prospective customers saw it as backward and low status and it was never introduced to market.[22]

There are other simple solutions that help reduce the quantity of detergents used. Concentrated detergents, for example, use fewer chemicals and less packaging. Yet even though concentrated detergents are widely available, there is a move back to standard detergents (where the compact version is 'bulked up' with fillers such as sodium sulphate by up to four times volume) because of consumers' difficulties in accurate dosing and perceptions of poor value for money due to overdosing.[23] Other key issues centre on the biodegradability of detergents and whether they give rise to harmful breakdown products – which can negatively affect water quality and waterborne organisms. If stringent regulations on ultimate biodegradability were enforced it is thought that around 80 per cent of petrochemical surfactants (a key ingredient of detergents) would be banned. However, one detergent industry trade body has claimed that restricting the use of surfactants because of their poor biodegradability would block the introduction of sophisticated detergents that would enable households to wash clothes with less water.[24] There are other innovations that avoid the use of detergent completely. Washing balls (reusable plastic balls placed in the drum of a machine) wash clothes by the action of the machine agitating the ceramic granules in the balls that then ionize oxygen molecules in the water. The effect, it is claimed, is to lift dirt from clothes just as a detergent would, but without any chemical additives.

Dry-cleaning causes a different range of environmental impacts compared to wet cleaning. Dry-cleaning uses liquid solvents and detergents placed with the garment in large machines, which are then agitated to remove dirt, oil and stains. Once clean, the clothes are dried in the same machine or transferred to a separate dryer, then pressed and shaped. The used solvent is distilled so it can be purified and reused. Perchloroethylene (perc), the most commonly used dry-cleaning fluid, is a petrochemical-based solvent and a hazardous air pollutant that is heavily regulated by pollution control bodies. Decades of research has shown that at high doses (higher than those used to dry-clean clothes today) it affects the central nervous system and causes damage to the kidneys, liver and reproductive system after long periods of exposure. Recently a solvent and cleaning process (Green Earth Cleaning) has been developed based on liquid silicone, although the long-term health implications of this are not yet clear. Other systems are also being developed such as a detergent-free dry-cleaning system using perc with comparable cleaning to conventional systems that reduces environmental impacts and operational costs.[25]

The laundering process can also be made more efficient by switching away from home ownership of machines to use of community or commercial laundries. Community laundries, perhaps in the basement of a shared building, act to share washing machines between households and so reduce the number of machines in use. This cuts washing machine manufacturing and disposal costs although it does little to address the impacts arising from the use phase of the machines. For commercial laundries, savings are not just linked to sharing machines but also to the efficiencies that come from washing continuously (including reuse of warmth and water) rather than in batches and also from better laundry practices. Yet a number of structural barriers mean that good economic and environmental performance of commercial laundry services is difficult to guarantee. For example, the increased energy demand linked to higher washing temperatures (to maintain hygiene standards), machine drying of clothes, and transportation, mean that commercial laundry services can consume more energy than private laundering.[26] In the case of babies' nappies, an LCA conducted by the UK's Environment Agency[27] comparing three competing nappy systems (disposable nappies; home-laundered cloth nappies; and commercially laundered cloth nappies delivered to the home) concluded that, 'no system clearly had a better or worse environmental performance, although the lifecycle stages that are the main source for these impacts are different for each system'.[28]

Product focus – designing fabrics and garments that cause less impact as they are laundered

Making changes to fabrics and garments as well as to washing machines can bring efficiency improvements. Such simple ideas work to influence laundry behaviour by altering the structure and composition of garments and other textile products to promote low-impact laundering. There are a number of factors that affect how much impact the use phase of a fabric or garment causes, including: washing temperature, washing frequency, size of load and method of drying. Making changes to any or all of these factors has potential to reduce impact.

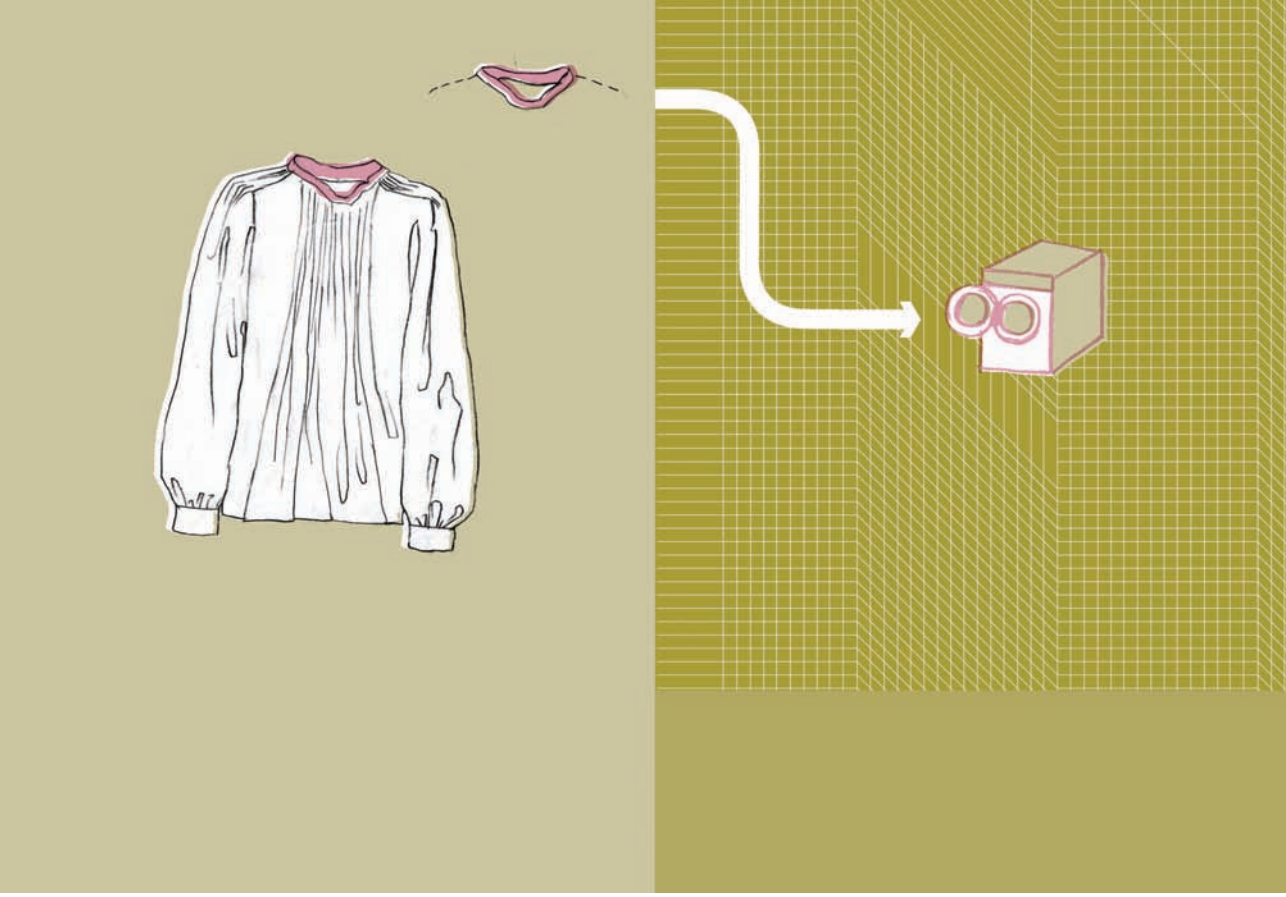
In the case of wash temperature, studies reveal that different fibre types are laundered on different temperatures. Cotton items are commonly washed at warmer temperatures than synthetics. This means that by designing with 'synthetic' fibres instead of 'cotton', impact associated with the use phase of the lifecycle could be reduced, although this has complex resource implications in other areas of the lifecycle (see Chapters 1, 2 and 4) and takes little account of widely held cultural preferences for natural fibres. The more

general point, however, is that selecting 'easy-care' fibres that wash well on cool temperatures and dry quickly (without tumble-drying) could bring benefits. This gives a tentative green light to fibres like polyester and nylon on the basis of their low-temperature laundering profile. Further, when diverse fibre types are combined with different fabric construction methods (i.e. knitted, woven, non-woven), performance characteristics such as resistance to soiling, resistance to creasing, and water absorption vary with potential impact on laundering behaviour.

▶ Modular garments designed for low laundering

Yet the benefits of substituting one fibre for another to reduce the impact of laundering are dependent on users correctly differentiating between fibre types and washing them accordingly. Evidence indicates, however, that this is not the case and most people struggle to tell the difference between fibres resulting in most textiles being laundered on cotton cycles regardless of their actual fibre content. Further complicating matters, when studies of how people *sort* their laundry are taken into account, it is clear that in the majority of cases, clothes are sorted by colour and not fibre type. These loads are then laundered at warmer temperatures if they are white or light coloured than if they are made up of dark shades. The implication here is that careful specification of colour (i.e. choosing dark shades) is an effective means of reducing the impact of consumer care. The key UK retailer Marks and Spencer has tried to circumvent laundering behaviour complexity by introducing a standard 'think climate – wash at 30°C' care label in 70 per cent of its machine washable clothes.[29] In recent years M&S has responded to increased knowledge about energy consumption in laundering by revising its clothes' recommended washing temperature from 50°C pre-2000 to 40°C in 2001[30] and to 30°C in 2007.

Another way to influence the environmental impact of consumer care is to reduce the volume of laundry created. Modular design can lead to less laundry, perhaps by making the parts of garments that get soiled most quickly detachable from the main body of the garment for separate washing. Certainly this is not a new idea, men's dress shirts with detachable collars were commonplace in Victorian and Edwardian times until mass production led to their phasing out in the 1920s. While there are many contemporary takes on the modular design theme, few have exploited its potential for sustainability. Yet there is a major caveat that limits how effective modular design can be in reducing the amount of laundry we do – our laundry practices. Not only does modular design require consumers to develop into the habit of detaching dirty parts of a garment for separate cleaning, it also has to influence the behaviour in the laundry – otherwise there are few benefits. Modularity slows the frequency of washing if people wait for a full load to



accumulate before doing their laundry. However, if it is done in part loads, say when dirty items are needed, then the impact is less positive, for frequency is not reduced – in the UK, the average number of washing loads per household is between 274 and 343 per annum[31] – and load sizes become ever smaller.

Different options for reducing the frequency of laundering may include choosing fabrics that resist soil and odour, such as with stain-blocking coatings that form a barrier around the fibre. Durable stain-resistant coatings, like the Scotchguard made by 3M, have been widely applied, particularly to dry-clean-only products like silk ties and suits to provide resistance against oily stains and prevent the need for frequent cleaning. However, these coatings, based on perfluorinated chemicals, are known to have wide-ranging human health impacts and are persistent in the environment – and face increasingly tight regulation in the future.[32] Other coatings impart antimicrobial properties to fibres with the aim of keeping fibres 'fresher' for longer. The antimicrobial agent in longest use is silver, first used in Roman times, and this has gained traction in the medical textiles market, used in antimicrobial dressings by incorporating silver ions into highly absorbent alginate fibres.

However, questions over silver coating's fastness, together with evidence of silver particles' deleterious effect on plant life and soil microbes[33] and persistent public health concerns over nanotechnology coatings (of which silver is one) have raised concerns about the value and safety of its application.[34] Yet within supply chain standards such as Bluesign, which rigorously test such textiles processes and treatments for harmful effects, silver is approved. What is more, pioneering outdoor brand Patagonia recently introduced the use of silver-based, antimicrobial treatment for odour control in its clothing, where the silver is derived mostly from recycled electronics to aid reduction of the need for frequent laundering, saving water and energy over the lifecycle of apparel.[35] Antimicrobial protection can also be provided with organochlorines such as triclosan, the primary ingredient of the registered biocide Microban, suitable for polyester and nylon fibres and their blends with cotton and wool and quartenized silicones. While the side effects of these bacteria-killing coatings are still largely unknown, there is growing unease about the possibility that their widespread use might result in bacteria (so-called super bugs) developing resistance to drugs with the same mode of action.[36] This has resulted in the quiet removal of many of these products from retailers' shelves because of a perceived increase in product liability risks.[37] One abridged LCA study of cotton towels suggests, however, that these coatings may indeed slow down the frequency of washing by making towels stay fresher (i.e. smell fresher) for longer.[38] Yet just as for modular clothes above, coatings only directly influence physical factors of laundering, not cultural or behavioural ones. And evidence suggests that it is the cultural or behavioural reasons that account for most of our laundry (as only 7.5 per cent of laundry is thought to be 'heavily soiled'[39]). More dependable gains come from altering the expectations people have about how often they need to change their clothes and from influencing inefficient laundering habits, like our tendency to wash everything that is not in the wardrobe, regardless of how dirty it is.

Systems focus – designing clean clothes

The strong interconnections between product, process, culture and individual during the use of a textile or garment's life make it imperative that when working with sustainability processes, we consider habits, norms, values, utility, knowledge and skills associated with laundering, as much as, say, a fabric's composition or washing machine's efficiency. Such wide-ranging influences open up the design space and enable those working in this way to move beyond conceptual limitations linked to traditional views of what must be delivered to the customer; and are thought to promise substantial

resource savings – predicted to deliver up to a factor 4 (or 75 per cent) or even 10 (90 per cent) reduction in impact.[40] In the context of laundering, an increase in the design opportunities are created when a shift is made from thinking about products to the results that those products are mobilized for; and whether those same results can be delivered but with less of a draw on resources. A shift from thinking about products (e.g. clothes, washing machines, detergents) to thinking about results (e.g. clean clothes) is a major ideational and innovative leap for designers and businesses alike and involves a high level of interaction with users over time, far beyond the point of sale.

One possible way to innovate around the result of clean clothes is to design products never to be washed. While it is perhaps hygienically and culturally unsuitable to keep wearing some items (like underwear) without laundering them, there are other items that are more naturally suited to 'no wash' or at the very least 'low wash' design approaches. It has been shown, for example, that wearing unwashed clothes does not threaten health: 'Canadian student, Josh Le, wore the same pair of jeans for over a year without washing them and found that "bacteria growth was virtually the same from the jeans after 15 months of no washing, compared to two weeks after being washed"'.[41] In the No Wash top developed as part of the 5 Ways project[42] a fine knit woollen jumper was transformed into a garment designed never to be laundered. The No Wash top was designed partly to resist or repel dirt but mainly to wear it like a badge. It was developed in response to a six-month laundry diary, which documented majority smell under the arms and majority dirt on cuffs, elbows and front panels. The garment featured wipe-clean surfaces and extra underarm ventilation. With its bold 'decoration' of coffee spills and soap smells, it acts as a reminder of our garment's history as well as our responsibility to reducing the impact of use.

In another 'low wash' project, this time by Lauren Montgomery Devenney, a linen/silk dress was pre-stained with red wine in a semi-random splatter pattern. In this way any future stains add to the garment's design rather than cause it to be regularly laundered or even discarded. As the stains dry, their hue changes and the tonality of the stained colour gains depth.

The ideas represented in these pieces and projects are perhaps typical of much design-for-sustainability work in that they are prototypes and not in commercial production. Ann Thorpe suggests this is because these are, 'slow, engaging and connective; sometimes they're relevant only to a small local population – not suitable for "commerce as we know it"'.[43] Yet recent developments such as a nanotechnology-based self-cleaning coating for textiles[44] – an idea reminiscent of the 1950s film The Man in the White Suit – has

▼ No Wash top from the 5 Ways Project

◀ Stain dress by Lauren Montgomery Devenney

potential to mainstream no wash clothes and textiles. Ideas like designing no wash clothes fall between industries and involve forming relationships and connections where none existed before. It requires us to look in new places for inspiration, to ad hoc projects, alternative lifestyles and different people. It is very likely, for example, that we all have durable unwashed items in our wardrobes, but probably have never recognized them as such. One starting point – and one developed in the work of UK designer Emma Rigby – is to identify these garment's features and design to enhance these characteristics. This design process must, however, happen in parallel with a broader social and cultural project geared towards the developing (or remembering) of skills and knowledge of garment-use practices, such as ways to freshen up items without washing them and, say, about how stains and smells diminish, or become more stubborn to remove, over time. Married with carefully considered product development, such knowledge could change practices and usher in alternative models of how to live.

A counterpart solution to durable no wash products is disposable no wash ones (also described in Chapter 7 – Speed). Less culturally contentious and more familiar to us, disposable textiles and clothing offers a means to reduce to zero environmental impact arising out of washing. Just as with durable no wash items, some garment types are likely to be particularly suited to overall lifecycle impact reduction by designing them to be discarded before laundering (such as underwear or items bought for a one-off occasion). Yet they provide no immediate panacea, as while disposability sidesteps environmental impacts linked to laundering, other impacts like the cost of production and disposal have to be included instead. To make it past the drawing board, environmentally responsible, disposable, no wash garments would have to be produced super efficiently, from low-impact materials, involving a non-polluting transportation system and an effective and economic cycle of materials reclamation and reuse. The capability of our current system of fashion and textile production and reclamation to do this is untested, but major improvements across the supply chain are essential if disposable, no wash products are to offer a more resource-efficient alternative across the lifecycle.

Barriers to the introduction of no wash garments are mainly organizational, technical and to a certain extent conceptual, yet the environmental compatibility of the system is still dependent on an individual's behaviour. It is patently obvious that the issues faced within the use phase of fashion and textiles cannot be solved simply with technological or organizational fixes. Sociocultural and political aspects are at the core of deep and lasting change. And no issue is more central to the complex relationships between people, textiles and laundering than our societal perceptions of cleanliness.

In a recent piece of work exploring reducing the impact of laundering, researcher Tullia Jack investigated a group of Australian consumers' attitudes, behaviour and responses to wearing a pair of denim jeans five times a week for three months without laundering. Her conclusions state that it is working with the cultural expectations of cleanliness that are most key to influencing laundering behaviour.[45]

Cleanliness, originally motivated by disease prevention and fear inspired by putrid infection, quickly became established as a key domestic activity, even though it was realized that cleaning did little to alter the transmission and destruction of pathogens that gave rise to many deadly diseases like tuberculosis and typhoid. Keeping clean also became associated with religious piety, civilization and cultural enlightenment, largely because its opposite, dirtiness, was linked to suspect behaviour including immorality, laziness and ignorance and with poverty and manual labour.[46] With the introduction of washing machines, standards of cleanliness rose further. The distinction between those who could afford washing machines and those unable to do so became accentuated by having 'perfect' clothes. This established the link – still evident today – between cleanliness and social and cultural values such as success, acceptance and happiness. Cleanliness today bears little relation to science but is important in signifying respectability, rather than any explicit association between health and hygiene.[47] Keeping clean has now become an imposed need, supported and legitimized by a multimillion-pound industry and a marketing and product world built up around an unattainable ideal of 'whiter than white'.[48] Any changes to our laundering practices therefore impact as much on cultural and symbolic needs as material ones. This makes cleanliness' dominant social status and complex cultural significance the key, though difficult, point to influence. Yet cultural norms change constantly and any change, however small, to cultural perceptions of cleanliness is likely to bring far-reaching sustainability benefits to the resource profile of fashion and textiles.

The 'craft of use'

The use phase of fashion and textiles, while dominated by laundering from a resource flow perspective, is also made up of sets of interconnected practices, of 'doings and sayings',[49] that lead to the carrying out of social and practical life. These practices, influenced by body, mind, knowledge, skills, stories, things and individuals,[50] extend far beyond laundering behaviours and work with the creative, refined and ingenious ideas and actions that lead to satisfying use of garments. They are described as the 'craft of use'[51]

and help foster intensive, ongoing use of fashion and textiles products that tie in with sustainability goals of paced consumption, material restraint and increased self-reliance. Building on the understanding that skills and stories of use are a craft to be cultivated over time and that garments are lived as a process, even though they are created and sold as products, brings scrutiny to the repeated, iterative tending and use of textiles and fashion. It also updates and expands innovation opportunities to include a framework of action that is not just influenced by resource use or environmental impact, but also directed by social and moral factors. It builds on recognition that the 'processes' of use link resource consumption, social practice and personal satisfaction and bring people and lives into the world of design and production. As such they signal the development of a relational, complex and valuable sustainability contribution.

Notes

1 Uitdenbogerd, D.E., Brouwer, N.M. and Groot-Marcus, J.P. (1998), *Domestic Energy Saving Potentials for Food and Textiles: An Empirical Study*, Wageningen, NL: Wageningen Agricultural University.

2 Kobori, M. (2010), *Traceability, Cotton, and Collaboration: Levi Strauss & Co.'s Drive for More Sustainable Agriculture,* Socially and Environmentally Responsible Supply Chain Conference, Stanford GSB, April 29, 2010.

3 Marks and Spencer (2002), *Streamlined Life Cycle Assessment of Two Marks & Spencer plc Apparel Products*, London: M&S.

4 Franklin Associates (1993), *Resource and Environmental Profile Analysis of a Manufactured Apparel Product: Woman's Knit Polyester Blouse*, Washington DC: American Fiber Manufacturers Association, pp3–4.

5 Allwood, J.M., Laursen, S.E., Malvido de Rodriguez, C. and Bocken, N.M.P. (2006), *Well Dressed?*, Cambridge: University of Cambridge Institute of Manufacturing, p43.

6 Ibid, p29.

7 See for example: Cotton Incorporated (2012), *The Life Cycle Inventory and Life Cycle Assessment of Cotton Fiber and Fabric: Executive Summary*, Cotton Incorporated; Wolf, O., Cordella, M., Dodd, N., Kougoulis, J., Beton, A., Dias, D., Farrant, L., Gibon, T., Le Guern, Y., Desaxce, M., Perwueltz, A. and Boufateh, I. (2012), *Environmental Improvement Potential of Textiles*, Seville: European Commission.

8 Table adapted from Paakkunainen, R. (1995), *Textiles and the Environment*, Eindhoven: European Design Centre.

9 Franklin Associates, Op. Cit.

10 Franklin Associates, Op. Cit.

11 Heiskanen, E. (2002), The Institutional Logic of Life Cycle Thinking, *Journal of Cleaner Production*, 10(5), pp427–437.

12 Franklin Associates, Op. Cit., ppES–8.

13 Franklin Associates, Op. Cit., pp3–4.

14 Allwood *et al*., Op. Cit., p40.

15 Allwood *et al*., Op. Cit., p47.

16 Brezet, H. (1997), Dynamics in Ecodesign Practice, *UNEP Industry and Environment*, 20(1–2), January–June, pp21–24.

17 *ENDS Report* (2001), M&S Recommends Cooler Clothes Wash to Save Energy, 319, p32.

18 Bain, J., Beton, A., Schultze, A., Mudgal S., Dowling, M., Holdway, R. and Owens, J. (2009), *Reducing the Environmental Impact of Clothes Cleaning*, London: Defra, p9.

19 Allwood *et al*., Op. Cit., p 40.

20 Bain *et al*., Op. Cit., p8.

21 *ENDS Report* (2007), Calls for Energy Labelling Overhaul as Sales of Efficient White Goods Stall, 329, p32.

22 Fletcher, K. and Goggin, P. (2001), The Dominant Stances on Ecodesign: A Critique, *Design Issues,* 17(3), pp15–25.

23 *ENDS Report* (2002), Consumption Cutbacks 'On Track', Say Laundry Detergent Producers, 329, p32.

24 *ENDS Report* (2003), Surfactant Producers Claim that Water Consumption is the Real Issue, 337, p33.

25 Sawa, K., Rodriguez, C., Aramaki, K. and Kunieda, H. (2003), A New Detergent-free Dry-cleaning System, *International Journal of Clothing Science and Technology*, 16(30), pp324–334.

26 van den Hoed, R. (1997), *Sustainable Washing of Clothes, Towards Sustainable Product Design Conference Proceedings*, Farnham, UK: The Centre for Sustainable Design, unpaginated.

27 Aumônier, S. and Collins, M. (2005), *Life Cycle Assessment of Disposable and Reusable Nappies in the UK*, Bristol: Environment Agency.

28 Ibid., p7.

29 M&S (2012), Online http://www.marksandspencer.com/gp/node/n/50713031?ie=UTF8&mnSBrand=core (accessed 6 February 2013).

30 *ENDS Report* (2001), M&S Recommends Cooler Clothes Wash to Save Energy, 319, p32.

31 Bain *et al*., Op. Cit., p17.

32 *ENDS Report* (2004), Perfluorinated Chemicals: Jumping from Frying Pan into Fire?, 354, pp28–31.

33 Zeliadt, N. (2010), Silver Beware: Antimicrobial Nanoparticles in Soil May Harm Plant Life, *Scientific American*, Online http://www.scientificamerican.com/article.cfm?id=silver-beware-antimicrobial-nanoparticles-in-soil-may-harm-plant-life (accessed 8 February, 2013).

34 *EcoTextile News* (2012), US Legal Tussle over Nanosilver Textiles, 48, pp54–55.

35 *EcoTextile News* (2013), Patagonia Opts for Recycled Silver Treatment, 53, p11.

36 *ENDS Report* (2007), Tackling a Grubby Reputation, 386, pp30–33.

37 *ENDS Report* (2003), Retailers Step Back from Triclosan, 345, p35.

38 Blackburn, R. and Payne, J. (2004), Life Cycle Analysis of Cotton Towels: Impact of Domestic Laundering and Recommendations for Extending Periods Between Washing, *Green Chemistry,* 6, ppG59–G61.

39 Catton, G. (2007), *Sustainable Cleaning, Fast, Affordable and Sustainable Fashion ASBCI Conference Proceedings,* 17 May 2007.

40 See for example Charter, M. and Tischner, U. (Eds.) (2001), *Sustainable Solutions: Developing Products and Services for the Future*, Sheffield: Greenleaf.

41 Jack. T. (2012), *Nobody was Dirty*, MPhil thesis, Melbourne: University of Melbourne, p18.

42 5 Ways (2012), Online http://www.5ways.info (accessed 6 February 2013).

43 Thorpe, A. (2007), *The Designers Atlas of Sustainability*, Washington: Island Press, p193.

44 *Textile Outlook International* (2006), Innovations in Fibres, Textiles, Apparel and Machinery, 126, November–December, p90.

45 Jack, Op. Cit.

46 Tomes, N. (1997), Spreading the Germ Theory: Sanitary Science and Home Economics 1880–1930, in S. Stage and V.B. Vincenti (Eds), *Rethinking Home Economics*, New York: Cornell University Press.

47 Shove, E. (2003), *Comfort, Cleanliness and Convenience,* London: Berg, p99.

48 Hoy, S. (1995), *Chasing Dirt: The American Pursuit of Cleanliness,* New York: Oxford University Press, p171.

49 Schatzki, T. (1996), *Social Practices: A Wittgensteinian Approach to Human Activity and the Social,* Cambridge: Cambridge University Press.

50 Reckwitz, A. (2002), Toward a Theory of Social Practices: A Development in Culturalist Theorizing, *European Journal of Social Theory,* 5(2), pp243–263.

51 Craft of Use, Online http://www.craftofuse.org/ (accessed 8 February, 2013)

CHAPTER 4 Reuse, Recycling and Resource Exchange

In New York City, Jill Danyelle's[1] tiny, personal fashion project 'fiftyRX3' records the wearing of at least 50 per cent reused or recycled garments every day for a year. Documented daily with photographs and a blog, her style diary works and reworks her image and details her ongoing search for sustainability in fashion, art and the environment. Her principles are simple: to reuse – not buy new; to reduce – by choosing products made with environmentally friendly production practices; to recycle – making garments from a previously existing item. The results show a lavish, creative, sociable and very human exploration of cyclical living.

Different in scale and mission, outdoor sportswear producer and long-time environmental pioneer Patagonia, which championed the idea of making high-quality recycled garments from post-consumer waste well over a decade ago, continues to innovate around the theme of recycling. Its polyester fleeces made from discarded plastic drinks bottles are a product staple and it has begun offering shelled jackets using a recycled polyester woven fibre, reusing polyester from car dashboards and classroom chairs. More recently Patagonia has gone one step further and has started making new clothes from old through its Common Threads programme. It collects unwanted polyester clothing and rather than downcycling them into lower-quality end uses, processes the fibre into genuine new garments using the EcoCircle fibre-to-fibre recycling system developed by Teijin of Japan. It is predicted that this fibre will save 76 per cent of the energy and 71 per cent of the carbon dioxide emissions of using virgin polyester.

▶ Windows blanket by LoooLo

Different again is LoooLo Textiles,[2] a Canadian furnishings company whose products are designed to biodegrade fully at the end of their lives. Indeed within a year of being composted the textured blankets and cushions are reabsorbed by the earth. Ensuring complete and safe biodegradability is hard won and involves painstaking care over choice of materials and the processes by which the fabrics are made. LoooLo's products use only certified organic materials and carefully selected dyes, free of all toxic chemicals and hazardous bio-products. The yarn used in LoooLo products is processed in a 'closed loop' facility where the spent dye baths are reclaimed and reused. LoooLo Textiles' mission is to encourage Canadian farmers towards more sustainable production as well as educating consumers about the impact their choices make.

All of these projects – and many more like them – emerge around a space of fashion as both social and material practice connected with redirecting streams of textile waste. They give form to the possibilities of working with material flows and cycles and build experience of strategies like reuse and recycling. They articulate the individual identities and social structures of waste issues in fashion and textiles, infusing them with social acceptability, creativity, status and even luxury. Further, they make use of technological development, cutting-edge recovery strategies and new media to assist and communicate their ideas. And in so doing, they offer an easy access point to sustainability issues and can aid a transition to a new type of society where people intuitively think in terms of loops and cascades; where waste is elevated to a thing of use and beauty; where resources can be saved; and where the hearts and minds of consumers and industry alike are prepared for bigger sustainability messages. Yet reuse and recycling also have downsides;

limitations that are not connected with the practicalities of reworking fibre, fabric and garment, but with the industrial system that they are despatched to 'clean up' after, and the habits of mind endemic therein.

This chapter explores the design opportunities and sustainability challenges associated with the end-of-life phase of the lifecycle of textile and fashion products, touching upon practical handling of waste as well as more philosophical concerns and associated structures that have normalized business models based on obsolescence. Certainly waste is an important issue and acting to reduce it has an easy-won popularity that stretches far beyond the boundaries of the fashion and textile industry. The sector itself has a long history of working with waste. Rag collectors and shoddy manufacturers have been recovering and recycling fibre for many hundreds of years. Individuals too have been reusing, repairing and reconditioning their own household textiles and garments for generations. Unsurprisingly therefore, there are a large number of designer- and producer-led initiatives focusing on textile waste and its management, mainly through reuse and recycling. These initiatives bring important benefits particularly in the short term and are explored in the pages that follow. Yet longer-term, waste-based initiatives hold a profoundly different challenge for the fashion and textile sector. This chapter goes on to describe a shift in emphasis from the present-day status quo that unquestioningly accepts the presence of waste as a by-product of designing, producing and consuming textiles to a future sector in which the provision and consumption of fashion and textiles is integrated.

Volumes of textile waste

The total amount of textiles and clothing discarded into household and municipal waste varies considerably between countries. In the USA, the annual figure is approximately 9.3 million tonnes (equivalent to around 31 kg per head a year) and in Germany 1.9 million tonnes (around 23 kg per person per annum).[3] In the UK the annual volume of clothing and textile products discarded into waste streams is about 1.1 million tonnes – around 18 kg per person per year. A further 523,000 tonnes (8.5 kg per citizen per year) is collected for reclamation in the UK[4] via a 'bring system' comprising 18,500 charity shops and textile banks and household collection schemes.[5] Data shows that the collection of textiles for reuse and recycling has grown substantially in the UK in the last five years;[6] that over two-thirds of the UK population is willing to buy and wear pre-owned clothing;[7] and at the same time the volume of textiles discarded to municipal solid waste has decreased. Of the textiles discarded in the household waste bin, over 40 per cent are deemed reusable.[8]

Lower socio-economic groups discard greater quantities of textiles as residual waste, perhaps indicating that it is cheap, rather than outdated clothing that is discarded.[9] Where textiles and clothing are sent to landfill, these products contribute to the overall environmental impact of these sites, including production of methane emissions to air and pollution of groundwater through toxic leachate.[10] Synthetic textile materials with long decay times prolong these impacts, while the decomposition of fibres such as wool gives rise to especially high emissions of ammonia, a toxic pollutant to both air and water.

Around half of the textiles and clothing collected in the UK is exported for sale overseas, particularly to sub-Saharan Africa and Eastern Europe where brokers sell it to traders who then sell it on at local markets.[11] Statistics show that just over 105,000 tonnes of second-hand garments are resold in the UK each year, around 20 per cent of what is collected, where a small proportion are reworked into customized pieces (like at TRAID Remade, see below) and it is thought a similar amount is sorted in the UK before subsequent reuse as wiping cloths, shredded for use as filling materials such as in mattresses, or recycled (either mechanically or chemically) and re-spun into a new yarn. Furthermore a small volume (16,000 tonnes per annum) is incinerated for energy recovery.[12]

Waste management strategies

The most common approach to tackling waste arising from the textile lifecycle is to implement waste management strategies (widely known as the 3Rs; reduce, reuse, recycle). Their aim is to extract the maximum benefits from products by extending their life either as whole products, fabrics or fibres, before throwing them away. Waste management strategies intervene at the end of the industrial chain and contain or help remediate the negative environmental effects of waste generation. They work to disrupt some of the linear flow of materials through the industrial system, that is a flow where materials are extracted from the environment at one end, are processed, used and then flow out of the system and back into the environment as emissions and waste at the other.[13]

There are different types of waste management strategies. This chapter explores three of them, organized in a hierarchy based on the relative amounts of energy and materials that are needed to carry them through. From most to least resource efficient, the strategies are:

1 *Reuse* of products, normally for the same purpose, sometimes with redistribution and resale

2 *Repairing and reconditioning* of either whole products or parts of products to keep them useful as long as possible

3 *Recycling* of raw materials to provide inputs to the manufacture of other goods.

Strategies that promote the *reuse* of goods require fewest resources to enact, generally only involving collection and resale. *Repair and reconditioning* strategies require more resources and can involve a manufacturing infrastructure to provide parts and labour for maintenance work. *Recycling* strategies, where the products go back to fibre, or even polymer, require more resources still and are the least efficient of the strategies from a materials perspective, although in most cases they are still less resource intensive than the production of virgin materials. This hierarchy is built around maximizing embodied energy or the total energy that can be attributed to bringing that item to its existing state. Embodied energy includes the energy consumed in winning raw materials, processing them as well as transporting materials between and within these processes. The embodied energy of a garment is greater than that of a fabric (because of its more complex form) that in turn is greater than that of a fibre. The overall aim of waste management strategies is to preserve the products/materials in their highest value state (i.e. with greatest embodied energy) for as long as possible. So a hierarchy of strategies emerges: reuse of goods; repair and reconditioning of goods; recycling of raw materials.

All three strategies described above are found in the fashion and textile sector and are described in more detail below. They are all influenced by a larger trend of *downcycling* of used material in industrial systems. This involves downgrading the quality of reclaimed materials immediately into cheap, low-value end uses rather than maintaining them as a high-value product or resource. This happens, for example, when various fibres are mixed together to produce a blend of lower quality that then goes into amorphous products such as insulation panels or mattress stuffing, rather than being reused as high-value products such as clothing. Countermanding the trend towards deteriorating quality are the activities of *upcycling*, where the processes and practices of reclamation and reuse enhance a piece's perceived value, quality and design capital, drawing upon a mix of factors including uniqueness of bespoke production, scarcity and preciousness of material, emotional engagement with past experiences and memories and craft skills of making.

Reuse of goods

Reuse of textile products 'as is' brings significant environmental savings. In the case of clothing for example, the energy used to collect, sort and resell second-hand garments is between 10 and 20 times less than that needed to make a new item.[14] In the UK, relatively little – around one-fifth[15] – of the second-hand clothing collected is resold domestically; most of it is shipped overseas to be sold on a global commodities market before being resold to local traders, a scenario likely to be similar in other Western economies. While reuse brings resource savings, there are some concerns that the influx of cheap, second-hand clothing, particularly in Africa, has undermined indigenous textile industries, with the result that clothing collected in the West under the guise of 'charitable donations' could actually create more poverty. However, it appears that the pressure on local African producers' markets is not solely from the West's exported second-hand garments, but also from cheap imports of virgin fibre products from China.[16]

Indeed the dominance of textile markets by low-cost virgin fibres, and our increased consumption of them, also threatens the continued economic viability of the collecting, sorting, distributing and reselling of second-hand garments and textiles in the West. While the price for used textiles in countries like the UK is buoyant, this is because sufficient volumes are difficult to source locally. And these difficulties arise in turn because the high volume of unwanted clothing discarded – an inevitable by-product of growing consumption stimulated by the availability of cheaper new clothes (in Europe, clothes today are up to 25 per cent less expensive than in the year 2000)[17] – is too costly for recyclers to sort at home, hence it is sent overseas for processing to low-labour-cost countries. This has led to a situation where the economics of the market of both recycled and virgin product inhibits resourceful approaches to materials use in the sector.

Other routes of reuse include donation of garments for reuse within networks of family and friends which, while significant, is believed to be declining;[18] and Internet-facilitated trade and exchange in used textiles and clothing which is growing from a very small base. Here, online auction houses like eBay connect users to an international source of second-hand clothes, and fashion-swap websites[19] allow the market in high-quality, second-hand garments and vintage pieces to flourish, although this trade is only in the top-quality branded goods that have a high resale value.

Repair and reconditioning of goods

▶ back2Back dress by Junky Styling

Similarly to reuse, repair and reconditioning of textiles and garments also saves resources compared with manufacturing new items, although resource savings are less than for reuse because some labour and materials are usually needed to retrieve, fix and upgrade the products. Repair and reconditioning of textiles has been practised for generations, both in an industry context and in the home. Originally the incentive to repair was economic; labour was cheap compared to the cost of textile materials and garments, so fabrics were carefully maintained and repaired. At home, techniques like replacing worn collars and cuffs, patching trousers and jackets, unravelling old knitwear to reuse the yarn, cutting worn bed sheets into dusters and darning holes were widely practised. Yet within two generations, the financial incentive to repair has largely disappeared mainly because the price of new garments and textiles has fallen dramatically relative to the cost of labour. Repairing garments at home – if it takes place at all – is now motivated less by economics and more by ethical factors or lifestyle choices like downshifting or voluntary simplicity. Mending and repair has also been given added momentum by a revival of interest in craft skills that were once associated with the restrictive work of women, but are now reclaimed as important creative practices in their own right and which recognize the value of material culture in shaping and making sense of people's lives. Further groups like MEND*RS[20] are exploring tending and repair as a practice, as a critique of consumerism and as a route to improved self-reliance.

Indeed many of these same skills have become the key tools of a small but significant group of designers and producers. They use a raft of techniques such as restyling, reshaping, embellishing and overprinting to give discarded, torn and stained fabrics added value, a new life, and to divert (or delay) waste from landfill. For example, charitable organization TRAID, under the label TRAID Remade,[21] employs a team of innovative young designers to rework and reconstruct second-hand garments by transforming them into one-off fashionable pieces that are resold. TRAID who markets itself as a 'fashion retailer and a charity shop' has also sold its customized second-hand clothing in Top Man, the fashion retailer. And London-based outfit Junky Styling[22] has made its name by deconstructing second-hand, traditional men's suits found in jumble sales and charity shops into twisted, tailored garments. Restyled and reworked clothes tend to be hand-finished and unique. They also frequently use vintage fabrics and garments, pieces that are themselves survivors, old things which have kept their value over time, and as such are easily associated with sustainability values.


A BUTCHER OF DIST

Recycling of goods

▶ Reused yarn vest by Muji

As with other waste-management strategies, recycling saves resources. Even the most technologically sophisticated and energy-intensive processes of shredding fabric, reclaiming fibres and re-spinning them into a yarn uses less energy than the production of new items. There is a great deal of interest in recycled yarns and fabrics and the number of recycled products available is increasing, though from a very low base; indeed in the outdoor clothing market, technical innovation is focused mainly on recycled and recyclable products.[23] Further reflecting this interest, there is now a 'Global Recycle Standard'[24] for textile products which works to certify claims of recycled content and addresses traceability, environmental principles, social requirements and labelling across the whole supply chain.

The method of extracting fibre from fabric has stayed the same for the last 200 years and involves mechanically tearing the fabric apart using carding machines. The process breaks the fibres, producing much shortened lengths, which when spun tend to produce a bulky, low-quality yarn. One way to increase the quality of this fibre is to use waste from pre-consumer sources, where quality can be more tightly controlled, or to blend it with longer, virgin fibres. Other techniques, such as that used to manufacture the yarn for Muji's reused yarn T-shirts,[25] maintain quality by avoiding mechanically pulling the fabric apart. Here, cotton yarn left over on roll ends of fabric is first unravelled and then knotted into a continuous filament ready for re-knitting. Recycled yarns and fabrics made with mechanical recycling methods remain a niche market and it is worth noting that until recycled materials are regularly specified in mainstream products, they will continue to be difficult to source, for without demand, supply is restricted. It is not enough to specify materials that can be recycled, for without a market for the recyclate, a high-value second life is unlikely.

A largely mechanical approach is also used to recycle some polyester fibre, usually from a source of plastic soft drinks bottles. The recyclate is chopped, ground and melted to reform polyester chip, which is then extruded, processed and textured just like virgin polyester. In contrast, other polyester recycling routes are based on chemical breakdown of the polyester polymer into monomers, the building blocks of polyester. The polymer feedstock is then repolymerized to produce a recycled material that is purer and of a more consistent quality than produced by the mechanical method, although more energy intensive to produce. The significance of recycled polyester (of both forms) is growing rapidly. Statistics suggest that over half of all staple polyester fibre in Europe is now made from recycled materials;[26] this

demands around 80 per cent less energy to recycle than to make virgin intermediate chemicals from oil and convert them to fibre;[27] and innovation such as Tejin's EcoCircle technology that enables material quality to be maintained through the polyester recycling process may signal the end of the inevitable downgrading of material quality in recycling.

While recycled polyester gives waste from the food and drinks industry a valuable second life, there are some concerns that the material composition of plastic bottles is unsuitable for use in fabrics and garments, an example of what is sometimes called 'danger-cycling'. Plastic bottles commonly contain antimony, a known carcinogen unsuitable for prolonged contact with human skin, and there have been calls for it to be replaced with readily available, more benign alternatives so that in future polyester recyclate is more suitable for textile applications.[28] Recycled polyesters from sources other than plastic bottles are available, including old polyester garments produced by Teijin's EcoCircle fibre-to-fibre recycling system, although volumes are still small.

Recent developments have also seen the introduction of a recycled nylon fibre, Recyclon,[29] which involves a far more challenging repolymerization process than for polyester. The fibre is made from post-industrial waste (rather than recovered post-consumer textiles), mainly substandard yarns rejected as part of manufacturing, which are then chemically reconstituted into the recycled fibre. It is claimed that producing the recycled nylon uses 80 per cent less energy than producing virgin fibre.[30]

Design for recycling and disassembly

Design for recycling (DFR) and design for disassembly (DFD) are two related approaches, developed largely in product and industrial design sectors with the explicit aim of facilitating recycling of products and their components and materials at the end of their life.[31] DFR and DFD initiatives have mainly resulted in the production of checklists and design recommendations that attempt to promote reuse by developing products that are easy to take apart (by avoiding permanent fastenings, for example) and recycling by promoting pure (non-composite) materials which have a high resale value.

One technical factor limiting the success of textile recovery operations today is the numerous types of materials used and extensive use of fibre blends. This slows down sorting operations and forces a situation of deteriorating material quality (i.e. downcycling) that inhibits marketability of recycled material. Markets for recycled textiles are influenced by the colour, fibre type, fibre quality and the purity of the old textiles/garments themselves.[32] Thus,

a DFR checklist to promote optimum markets for recycled textiles would prioritize:

- White textiles which allow easy re-dyeing;
- Natural fibres which are easier to 'pull' and more versatile;
- Quality (long staple) fibres which can be processed on faster machines; and
- Pure (not blended) fibres that require less processing than fibre mixes and which are less problematic in subsequent processing stages.

When taken as a whole, such a list represents a significant challenge to current industrial practice on a number of levels and subverts the current design agenda by emphasizing value in resources that have finished being used over value in consumption and novelty. Yet there are trade-offs here, as while limiting the number of different textile materials in circulation may provide more lucrative markets for recycled fibres, it could promote inappropriate (and wasteful) use of fibres and encourage the increased dominance of monoculture plantations of fibre crops like cotton, with a significant environmental burden.[33] Easier disassembly of complex textile products, like garments, may be possible with developments in laser and water-jet technologies for example, where cutting, etching and bonding techniques may make it possible to 'sew' or weld fabric together without thread and so facilitate rapid disassembly at end of life.

A decade ago, Vaude,[34] the respected German outdoor gear company, developed the Ecolog system – an example of DFR principles in action. Working hard with many component and fabric suppliers Vaude put together a palette of materials that allowed their designers to develop garments that were 100 per cent polyester. This included the fabric, zips, snap fasteners, labels, thread, cords, cord grips, etc. This totally homogenous product could then be recycled (just like a PET bottle) to make polyester resin for new products and involves no sorting for metals or other recycling contaminates. Vaude's retailers return Ecolog products to Germany where they are recycled with specifically developed technology.

Critique of waste management strategies

Waste management strategies bring substantial benefits. Moreover, with further research and development, such as around techniques to extract long fibres, and certain tax breaks, say to reduce the cost of labour for reuse and repair, these benefits could increase. Yet while waste management strategies

help treat waste, containing and limiting its negative effects, they fail to prevent it from being produced in the first place. This has led techniques like reuse and recycling (sometimes called eco-efficiency) to be roundly criticized as superficial and unlikely to lead to sustainability: 'Eco-efficiency is an outwardly admirable, even noble concept, but it is not a strategy for success over the long term, because it does not reach deep enough. It works within the same system that caused the problems in the first place, merely slowing it down with moral proscriptions and punitive measures. It presents little more than an illusion of change'.[35]

The key charge here is that strategies like reuse and recycling fail to mitigate against fundamentally inefficient industrial systems, because they focus on optimizing one small part of the system, rather than the whole. Perversely it is almost exactly for this reason that recycling is so popular. It demands only easy to achieve, small change from producers and consumers alike and no radical shift in behaviour. Recycling initiatives can, for example, be bolted on to an existing product manufacturing sequence without modifying the set-up. Their benefits are normally felt quickly and fit in with business and profit cycles. They require no change in what consumers buy and allow consumption to continue unabated, with recycled materials not virgin ones. In some quarters this has led to a distorted view of the importance of recycling, where it is seen less as a way to manage waste (a means to an end), but more as an end or a goal in itself. The effect is for some consumers and producers to prioritize recycling over broader and deeper goals, mainly because it is easy and fits in with how things are done today. Yet recycling on its own it will never bring big change. It is ultimately a *transition strategy*; useful while society is transformed into something more socially aware and less energy intensive.[36]

A different way of thinking

A new vision for reuse and recycling – glimpses of which can be seen in the projects at the beginning of this chapter – requires an overhaul of the way we think about waste and its role and value in industry. It also means a reprioritization of the value placed on end-of-pipe processes like recycling and a profound shift away from accepting waste as an inevitable by-product of the sector to a future where the provision of fashion and textiles and their consumption is connected differently. What is radical here is the shift in perspective and not necessarily the solution. In the short term particularly, the solutions we use will probably be very familiar to us (and will inevitably rely heavily on reuse and recycling), but they will be part of an industrial system with a goal of integrating social and material assets and connections.

An industry goal of whole system material resourcefulness where untapped assets become a resource would transform the textile industrial system at the level of a paradigm (see Chapter 2 for a discussion of change in complex systems). It would influence the whole supply chain: farmers, brokers, designers, producers, retailers and consumers. It would influence the types of materials and chemicals used, the type of product designed and how it was used. It would alleviate problems of waste mountains and overflowing landfill sites because every product would be a potentially new product and never discarded. This describes a fundamental shift from a view of the economy as a linear system where we 'take, make, waste' (in which over 90 per cent of the resources taken out of the ground today become waste within only three months[37]), to a cyclical one where resources circle around the economy becoming the source material for new goods.

Resourcefulness is a core concept of ecosystem-inspired design approaches like permaculture and industrial ecology, where everything is recycled and all waste from one component of the system becomes 'food' for another. Here what appears to be waste is actually exchange. The concept of exchange when applied to fashion and textiles is both powerful and liberating. It helps emphasize collaboration, interconnectedness, cycles and forward planning and offers opportunity for checks, balances and feedback. The next part of this chapter reviews design concepts based around a principle of cyclical economies, feedback and resource exchange.

Industrial ecology

In its simplest form, industrial ecology aims to build societies, foster industries and develop products around ecosystem properties and dynamics, with the hope that they might be sustainable in the same way that ecosystems are.[38] This involves prioritizing materials cycles, improved material and energy efficiencies, and strategies to reduce dissipative consumption. In some instances this has lead to industries being built up in clusters or dependent communities around each other so that outputs from one facility form the raw materials for another, such as in the case of the wool scouring effluent project described below. In others it has led to a reorganizing of activities to prioritize improvement of whole product lifecycles across a number of future lives. In others still it has been used more metaphorically where principles observable in nature, such as cooperation, interconnectedness and symbiosis, form the basis of a company's ethos.

One of the earliest examples of interconnected material cycles in fashion and textiles is a conceptual project developed in 1993 at a working

conference of 02, the international sustainable design network.[39] The brief was concerned with the future provision of clothing and resulted in a multi-layered concept, where garments were made from locally produced durable materials with added 'experiential' qualities, which challenge the value and use of fabrics. Critically in the context of this chapter, the garments were also designed from the outset to be part of a cycle of use and reuse. The key idea here was to establish and plan for a hierarchy of users for the clothes: uncoloured virgin fibres in the first life produce a high-quality fabric for use in high-end menswear and womenswear. In subsequent lives, fibres are transformed into bulkier and lower-quality fabrics (as quality deteriorates with each recirculation) into fabric suitable for childrenswear. In the course of reprocessing the fibres are overdyed transforming them into brightly coloured pieces for the children's market. While a hierarchy of use for clothes is well established on an individual level – first a garment is worn only for 'best', then for everyday use and eventually for private use at home – there is no reason that similar hierarchies could not be established across user groups. A similar idea of preprogramming multiple future lives into a garment can be seen in the Nine Lives piece produced as part of the 5 Ways research project. Here the garment had a preordained 'future life' ready installed and the act of transforming old into new breathed new life into a tired garment. In the first life two separate pieces were produced: a knitted woollen top and simple printed A-line skirt. In the next life they were creatively morphed into one with embroidery. Using the yarn carefully unwound from the top and the sewing guide printed as a pattern on the skirt in its first life, the user stitches into the skirt to produce a new and unique piece.

As mentioned in the introduction to this chapter, Patagonia has established a more commercial example of a materials cycle through its 'Common Threads Garment Recycling Programme'. Unwanted polyester garments (including those made by its competitors) are collected from customers and transformed into fibre for use as new garments and not immediately downcycled into lower-quality end uses. This signals a departure from traditional polyester recycling routes in which high grade polyester (such as plastic drinks bottles) is downcycled into lower-value uses such as textiles that are then further recycled into even lower-grade uses, say filling materials. Instead, an industrial loop offers the prospect of old garments being recycled into new garments in perpetuity. Data provided by Patagonia itself reveals that the environmental feasibility of Common Threads is dependent on consumers returning old garments to a service centre in as low energy a way as possible (such as by post). If a well-meaning customer drives specially to a local store to drop them off instead, energy and carbon dioxide

▲ Synchilla Snap-T fleece by Patagonia made with 85 per cent recycled content, and completely recyclable through the Common Threads Recycling Programme

savings are substantially reduced. This highlights a critical and frequently overlooked point in the design of a new generation of fabrics and garments destined for reuse, that even the most progressive technology-based solutions can be undermined by consumer behaviour. While not explicitly the case with Patagonia's Common Threads project, other trade-offs, such as the costs of collection potentially outweighing the value of the raw materials recovered, also exist. If, for example, the units are small and widely dispersed the effort worth making to recover them is less than with large items rich in resources. This means that trends towards lightweight fabrics, while saving resources in production, may end up wasting resources at the end of product life.

A very different example of industrial ecology in practice is provided by the unlikely partnership of a Yorkshire steel mill and the raw wool sludge waste from the county's wool scouring industry.[40] The Yorkshire woollen scourers produce a highly polluting effluent that has to be captured, treated and is normally disposed of in landfill at significant cost. At the same time, waste paper, cardboard and wooden pallets were sent to landfill (also at a substantial cost) by giant steel mill AvestaPolarit. The industrial ecology initiative that resulted – an industrial cluster based on waste – was brokered by a local green business network and involved composting the scourers' wool sludge with the paper, cardboard and wood waste from AvestaPolarit in an empty warehouse at the steel mill. The resulting compost (with no apparent pesticide residues) is sold to agricultural and horticultural markets for use as a peat-based substitute for domestic gardens. The project, which is seen as a model for cross-industrial innovation, also provides employment opportunities for recovering drug addicts and young offenders.

Zero waste pattern cutting

Waste is not only a problem for the fashion and textile sector that arises after consumers have used and tired of a piece; but there are substantial losses of material and energy through the production chain. One of the most visible moments of waste production occurs in the cutting room, as the pattern blocks are laid out and the cut loss – the negative space around the pattern pieces – is discarded. Between 10 and 20 per cent of fabric can become waste at this stage depending on final layout efficiency.[41] While this may seem minimal, these scraps are more than just a tangible sign of a less-than-perfect pattern cutting method, for they reflect an approach and mindset that accepts such losses as an inevitable and acceptable part of the supply chain. Leading a different approach, designers Timo Rissanen[42] and Holly McQuillan[43] have been at the forefront of conceiving alternative formats of clothing configuration and construction in which the layout and shape of pattern pieces is altered to reduce to zero any waste from the layout and cutting process. The result is pieces with repositioned seams, exaggerated lines and a changed aesthetic; and a visible challenge to the unseen inefficiencies that occur at multiple points through the supply chain.

Cradle to Cradle

In a linear view of a product's life, disposal is frequently perceived as the end of the line. However, the Cradle to Cradle philosophy as developed by

▶ Zero waste pattern cutting concept shirt to address wastage, by Andrew Hague. The basic shirt pattern is manipulated to fill the entire fabric, affecting the proportions of the new garment and its design

architect William McDonough and chemist Michael Braungart[44] rejects this and extends its view of a product beyond a first life and into the next cycle of life as well – hence the term 'Cradle to Cradle'. To ensure ecological compatibility of the next life, the philosophy suggests that all industrial products must be designed to fit into one of two cycles: a biological cycle – where the loop is closed by returning products harmlessly to biology/nature (through composting); and an industrial cycle – where the loop is closed by recycling non-degradable materials and products completely and continually. In effect, nature closes one loop and industry the other. Everything has to fit into one of two categories – there is no place for materials or products to exist outside of this.

Cradle to Cradle thinking has been applied to a growing number of fashion and textile products. The first was an upholstery fabric, Climatex Lifecycle,[45] first developed in 1993 in a collaboration between Designtex and Swiss mill Rohner Textil. Designed around a biological cycle, the fabric was made avoiding synthetic fibres and certain processing treatments in order for it to be completely and safely composted at the end of its life. The process of biodegradation involves the breaking down of a substrate into simpler substances by microorganisms, light, air or water. Synthetic fibres from a carbon-based chemical feedstock do not biodegrade; instead they persist and accumulate in the environment because microorganisms lack the enzymes necessary to break the fibre down. In contrast, plant- and animal-based fibres do break down into simpler particles, although unless chemical treatments (such as dyes and finishes) are carefully selected, they can persist in the soil

▼ Upholstery fabric in wool and ramie by Climatex Lifecycle

after degradation, contaminating land and water with toxins released from multiple, tiny, dispersed particles. Thus, Climatex Lifecycle is made from biodegradable fibres (wool and ramie blend) and is coloured with only carefully selected chemicals (out of dye manufacturer Ciba's range of 4,500, only 16 were deemed suitable), manufactured without the release of carcinogens, persistent toxic chemicals, heavy metals or other toxic substances. The result is a fabric that when worn can be removed from the frame of a chair and composted, providing 'food' for the biological system.

Other fashion and textile products have been developed using the Cradle to Cradle philosophy, including: towels and bathrobes, carpets, shirts, blouses, socks and underwear. German brand Trigema[46] has produced a line of biodegradable T-shirts, made from 100 per cent cotton grown in the USA and Pakistan, chosen specifically to be free of pesticides and fertilizer residues, spun with natural paraffin and coloured with dyes which, as for Climatex Lifecycle furnishing fabric, have been specially identified to be biodegradable. A key challenge for biodegradable products is to develop all product components including sewing thread (which is normally made from non-biodegradable polyester or polyester blends), labels, zips, fasteners and elastomeric yarn to be compatible with a biological cycle. Recent fibre developments have moved a step towards this goal with the commercial production of an elastane stretch fibre based on 80 per cent corn starch (and 20 per cent petroleum-based material).[47] Also using Cradle to Cradle thinking – and designed to be part of the other Cradle to Cradle cycle, as a technical nutrient – is Eco Intelligent Polyester (EIP) produced by Victor Innovatex.[48] As well as being manufactured with 80 per cent fewer greenhouse gas emissions by lowering humidity pressures, improving heating efficiencies and implementing clean technologies throughout the operational plant, EIP is claimed to be the first antimony-free polyester that maintains its quality on recycling.

Moving forward

Connecting the systems of fashion provision and consumption in a web of resource exchange changes the goals and rules of the bigger industrial system and aligns them with sustainability. It requires a bold and innovative set of changes to the way our fibres and fabrics (as part of society at large) are designed, produced, consumed and discarded. It requires a reformulation of design priorities based around ideas of cycles where waste is re-conceived as a useful, essential and valuable component of another product's future life. Changes in the sector's approach to waste are also being encouraged by policy shifts. The EU's producer responsibility (or 'Take Back') legislation

requires the original manufacturer or producer of a product to take financial and/or physical responsibility for the collection, recovery or disposal of the product after the end of its useful life, a law already on the statute book in some product sectors. The European Directive on Waste from Electrical and Electronic Products (WEEE), adopted in May 2001 for example, requires manufacturers to ensure that 90 per cent of large household appliances and 70 per cent of all other electrical and electronic products be recovered and recycled.[49] While not formally in force in the fashion and textile sector yet, Take Back principles are being practised by some high-street brands. Early in 2012, Marks and Spencer introduced its 'shwop' bins into all of its UK stores, to encourage customers to drop off unwanted garments as they browse and shop, an initiative now also taken up by H&M globally. It is still unclear whether such programmes deliver a net reduction in impact, or whether any gains are wiped out by a fresh round of consumption. Yet the principle of Take Back is radical – to bring a critical change of emphasis regarding responsibility for waste and, because handling waste is expensive and brands will want to minimize exposure to such costs, it incentivizes the creation of products that are more durable and are easier to reuse and recycle. The challenge for the sector is to transform this change in emphasis into a strong force for sustainability.

Notes

1 Jill Danyelle's fiftyRX3 blog explored 'the crossroads of style and sustainability', Online http://jilldanyelle.com/ (accessed 8 February 2013).

2 LoooLo, Online http://www.looolo.ca/ (accessed 8 February 2013).

3 *Textile Outlook International* (2009), Textiles and Clothing: Opportunities for Recycling, 139, pp99–100.

4 Morley, N.J., Bartlett, C. and McGill, I. (2009), *Maximising Reuse and Recycling of UK Clothing and Textiles: A Report to the Department for Environment, Food and Rural Affairs. Oakdene Hollins Ltd*, London: Defra, p14.

5 Ibid., pii.

6 Morley *et al.*, Op. Cit., p3.

7 Gracey, F. and Moon, D. (2012), *Valuing Our Clothes: The Evidence Base*, London: WRAP.

8 Morley *et al.*, Op. Cit., p3.

9 Gregson, N. and Crewe, L. (2003), as cited in Morley *et al.*, Ibid., pii.

10 Cupit, M.J. (1996), *Opportunities and Barriers to Textile Recycling*, Abingdon, Oxfordshire: AEA Technology, p21.

11 Allwood, J.M., Laursen, S.E., Malvido de Rodriguez, C. and Bocken, N.M.P. (2006), *Well Dressed?*, Cambridge: University of Cambridge Institute of Manufacturing, p12.

12 Morley *et al.*, Op. Cit., p10.

13 Jackson, T. (1996), *Material Concerns*, London: Routledge, p2.

14 Laursen, S.E., Alwood, J.M., De Brito, M.P. and Malvido De Rodriguez, C. (2005), *Sustainable Recovery of Products and Materials – Scenario Analysis of the UK Clothing and Textile Sector*, Design and Manufacture for Sustainable Development, 4th International Conference, Newcastle, 12–13th July 2005.

15 Morley *et al.*, Op. Cit., p10.

16 Allwood *et al*. Op. Cit., p12.

17 Anson, R. (2010), Editorial: End of the Line for Cheap Clothing? *Textile Outlook International*, 147, p5.

18 Morley *et al.*, Op. Cit., p19.

19 See for example Swap Style, Online http://www.swapstyle.com/ (accessed 8 February 2013).

20 MEND*RS, Online http://mendrs.net/ (accessed 8 February 2013).

21 Traid Remade, Online http://www.traidremade.com/ (accessed 8 February 2013).

22 Junky Styling, Online http://www.junkystyling.co.uk/ (accessed 8 February 2013).

23 Mowbray, J. (2011), Playing Safe, *Eco Textile News*, 44, p43.

24 Global Recycle Standard (2013), Online http://textileexchange.org/content/global-recycle-standard (accessed 8 February 2013).

25 Muji, Online http://www.muji.eu/ (accessed 8 February 2013).

26 *EcoTextile News* (2008), The Carbon Challenge for Textile Fibres, 16, p31.

27 Patagonia (undated), Patagonia's Common Threads Garment Recycling Program: A Detailed Analysis, Ventura: Patagonia, p7; *EcoTextile News* (2007), Toray Offers Recycled Nylon, 4, p23.

28 McDonough, W. and Braungart, M. (2002), *Cradle to Cradle*, New York: North Point Press, p58.

29 Recyclon recycled nylon by Toray Industries, Japan, Online http://www.toray.com/ (accessed 8 February 2013)

30 *EcoTextile News* (2007), Toray Offers Recycled Nylon, 4, p23.

31 Keoleian, G.A. and Menerey, D. (1993), *Life Cycle Design Guidance Manual,* Washington D.C.: Environmental Protection Agency.

32 Cupit, M.J. (1996), *Opportunities and Barriers to Textile Recycling*, Abingdon, Oxfordshire: AEA Technology.

33 Laursen, S.E., Alwood, J. M., De Brito, M.P. and Malvido De Rodriguez, C. (2005), *Sustainable Recovery of Products and Materials – Scenario Analysis of the UK Clothing and Textile Sector,* Design and Manufacture for Sustainable Development, 4th International Conference, Newcastle, 12–13th July 2005.

34 Vaude, Online http://www.vaude.de (accessed 8 February 2013).

35 McDonough, W. and Braungart, M. (2002), *Cradle to Cradle*, New York: North Point Press, p62.

36 Holmgren, D. (2002), *Permaculture: Principles and Pathways Beyond sustainability*, Victoria: Holmgren Design Services, p115.

37 Chapman, J. (2005), *Emotionally Durable Design: Objects, Experiences and Empathy*, London: Earthscan, p8.

38 Ehrenfeld, J.R. (2004), Searching for Sustainability: No Quick Fix, *Reflections*, 5(8), pp1–13.

39 O2 Global Network, Online http://www.o2.org/ (accessed 8 February, 2013).

40 *ENDS Report* (2003), Making Local Connections for Sustainability, 339, p29.

41 Rissanen, T. (2008), Creating Fashion Without the Creation of Fabric Waste, in J. Hethorn and C. Ulacewitz (Eds.), *Sustainable Fashion: Why Now?*, New York: Fairchild Publishing, p184.

42 TImo Rissanen, Online http://timorissanen.com/ (accessed 8 February 2012).

43 Holly McQuillan, Online http://hollymcquillan.com/ (accessed 8 February 2012).

44 McDonough, W. and Braungart, M. (2002), *Cradle to Cradle*, New York: North Point Press.

45 Climatex, Online http://www.climatex.com (accessed 8 February 2012).

46 Trigema, Online http://www.trigema.de (accessed 8 February 2012).

47 *EcoTextile News* (2011), Bio-based Stretch on the Horizon, 43, p25.

48 Victor Innovatex, Online http://www.victor-innovatex.com/ (accessed 8 February 2012).

49 *ENDS Report* (2001), Council Agrees on WEEE, 317, p37.

PART 2 – SUSTAINABLE FASHION AND TEXTILE SYSTEMS

CHAPTER 5 Fashion, Needs and Consumption

It's an obvious truth that the relationship between fashion and high-volume consumption conflicts with sustainability goals. Today the language and expression of the consumer society in our experience of fashion is so overriding that we hardly notice it. In the collective cultural consciousness, fashion *is* consumption, materialism, commercialization and marketing. It is buying high street and high end. It is watching, shopping, purchasing. The prevailing consumerist fashion style and story appears 'natural' to our way of thinking and behaviour: it is normal to access and engage with fashion primarily by exchanging money for product; it is expected that these same products will

look dated and stylistically incongruous in six months; it is usual to discard rather than repair.

Indeed in the first decades of the twenty-first century, clothes are often shopped for habitually and the pressure to constantly reformulate identity in the light of changing fashion trends has been linked to psychological insecurity and rising levels of mental illness.[1] The garments themselves are created by a supply chain which exploits workers, fuels resource use and generates environmental impact; and they are the product of a business model that ensures its future growth by rendering existing products aesthetically and culturally obsolete so as to stimulate a fresh round of individual material consumption. We meet our desire for pleasure, new experiences, status and identity formation through buying goods, many of them clothes. And because we have an inexhaustible supply of desires, consumption – particularly of new items – continues to grow because we see the purchase of each new item as providing us with novel experiences that we have not so far encountered.[2]

Dig a little deeper and we see other forces at play. It soon becomes apparent that the prevailing experience of fashion provision and consumption is locked into a cycle of self-justification, creating the very conditions by which it becomes both dominant and credible. In consumerist fashion, the cycle of new product introduced in-store becomes more rapid (up to 12 seasons per year and moving towards a strategy of continuous replenishment)[3] because retailers compete on novelty and image. And psychological obsolescence, most commonly linked to changing appearance, has become the vehicle for a need for novelty, with the expectation that we will express newness through changing our garments. Indeed, perhaps no industry has better perfected the cultural cycle of invention, acceptance and discard of a continually changing series of temporary modes of appearance than fashion with each new cycle divergent from the old; and has so successfully delinked it from physical need or function. In the fashion sector each new circuit of this cycle offers little in the way of material development or progression. Rarely does a new item better protect our bodies physically or offer enhanced functionality; rather we buy afresh to make visible our identity both as an individual and part of larger social groups within a particular place and time. We buy items more often because the downward pressure on price leads to deteriorating standards of materials and construction and pieces fall apart increasingly quickly and need to be replaced. We grow our reliance on fashion that can be made into and traded as a commodity because the consumer society fails to value activities that can't be marketed. In the consumer society we organize our ideas about fashion around commerce and consumerism and

end up becoming dependent on them. Yet this state of affairs is not a conspiracy of the fashion industry alone, in which consumers are but coerced and unwilling victims consuming more than they would otherwise do; rather it is a symptom of wider economic logic and goals, business priorities, societal forces and combined individual practices.

Value-free fashion

Yet it is perhaps for all of the reasons highlighted above – its superficiality and impermanence, its position at the heart of consumerist materialistic culture and our imaginative dependency on it – that fashion appears anachronistic to sustainability values. Moreover, fashion is often positioned as the epitome of value-free expression, equipping us to appear in a world that is not rooted in the vitality of earth, the health of its soil or its people; but rather one that is 'essentially groundless' and a 'world of ideas'.[4] In this imaginary, emotional and physic world almost anything is possible – fashion is 'light' and free – there are few limits. Yet plainly as it exists today, fashion production and consumption does have physical limits. Planetary boundaries restrict and demarcate all human activity, including the production of fibre, fabric and garment. Agricultural land is finite and turned over to growing fibre for textiles cannot be used for the cultivation of other, perhaps more essential, crops like food. Access to clean water is becoming increasingly contested as populations rise, pollution increases and we divert more of it to dye fabric and launder clothes in our homes. Thus, to read fashion as free-floating and without limit is to see fashion out of context with the industrial system that gives it material form; and, most fundamentally, out of context with overarching planetary systems. Not only is this view of fashion at odds with the sustainability imperative; but it also creates an anachronistic form of fashion itself. Fashion, by definition, reflects its context; and its context patently includes its people, ecosystems and soil. So when we frame fashion as 'limitless' and/or achievable only through ever-greater consumption, this blinkered 'performance' is, quite simply, no longer fashion.

In the midst of this mire of contradiction and confusion, fashion trends themselves have promoted misconceptions around sustainability. In the early 1990s for example, the 'eco chic' trend of 'environment friendly' garments was dominated by natural-looking colours and fibres and did not reflect real-world progress. 'Eco chic' was more a stylized reaction against simplistic perceptions of chemicals and industrial pollution than a conversion to sustainability values. Fashion collections and magazines portrayed a pure, wholesome and unprocessed visual identity for sustainability and traded

on popular notions of environmental responsibility, notably that: natural is 'good', and artificial, man-made or chemical is 'bad': 'With natural fibres there can be no pretence, no artifice, there is no place to hide. They are clean, simple, honest.'[5] Such a message is, of course, simplistic and belies the complex range of environmental and social impacts associated with all textiles, both natural and manufactured. 'Eco chic' was shape and surface detailing, image layered on top of fibre and garment. It remained separate from key sustainability concerns – and effectively promoted an illusionary visual identity for the sustainability debate of the time. 'Eco chic's' visual message was alluringly simple and the result of an extreme case of reductionism; the sustainability message was reduced to an imaginary notion of what 'eco' must look like and became so removed from its starting point that it no longer reflected sustainability ideas. The superficial beauty, language and image of fashion trivialized the real debate and skimmed over the deeper 'ugliness' endemic in the sector.

There have been many repercussions of the treatment of environmental concerns by the fashion industry in early 1990s, not least the enduring legacy of a clichéd idea about what constitutes a sustainability aesthetic in fashion. Still today, two decades on, 'natural' colours, plant and animal fibres and nature-based imagery are frequently assumed to convey ecological credibility by a public with low sustainability awareness, irrespective of the design and production process. Further, levels of knowledge about sustainability in the sector – while improving – are still low and often based on popular understanding and reportage of key themes rather than on grounded assessment. This is caused by, and continues to perpetuate, the flippant way in which fashion is commonly viewed both from outside and inside the profession: 'an immoral, self-indulgent industry . . . that lacks gravitas and a strong conceptual framework'.[6] This perceived shallowness is further augmented by an ongoing gender bias that associates fashion with femininity[7] and a favouring of 'feminine' skills of intuition, personal creativity and craft over the 'masculine' intellectual enquiry that is seen as an essential part of sustainability.

Fashion based on values

Yet fashion is not bound in a fixed and narrow relationship with novelty-driven consumerism as part of some sort of 'natural order'; rather its relationship answers to particular strategies and tactics. Today these tactics are by and large those of the dominant mode of production – capitalism. Fashion is implicated in the wider systems of control and power of the modern era. Framed like this, our majority experience of fashion becomes exposed as

a way to expand the control of those with influence, as a power structure, rather than a reflection of fashion's wider potential and practice. Also uncovered is the realization that the type of fashion experienced today is not freely chosen by shoppers: for it is often the only option.[8] Neither are the fashion alternatives freely ignored, but rather these same shoppers simply do not know about them. Instead, it is the dominant ideas about economics, business practice, organizational structures, cultural preferences and what individuals do and how they imagine their clothes that dictate the prevailing view and experience of fashion and refute alternative ideas. Yet consumption – a search for satisfaction – is not innately negative nor are all desires to consume artificially created. Indeed material goods like garments are important routes to well-being, they can empower us, their users, to meet fundamental needs. Moreover, material culture and 'things' themselves are of key value to human society, and a dynamic, tangible record of cultural meaning.[9] Critically, as the economist Max-Neef argues it is the scale and pace of consumption that is damaging: 'the speed of production and the diversification of objects have become ends in themselves and are no longer able to satisfy any need whatsoever'.[10] Economic historian Avner Offer describes the ambiguities and challenges of the scale of consumption as a situation in which, 'the flow of new rewards can undermine the capacity to enjoy them'.[11] He calls for a sense of balance in consumption behaviours, which recognizes the positive role of consumption in delivering welfare as basic needs are met; but how beyond the point of basic needs additional consumption provides diminishing, negative or at best steady returns for well-being; summing it up adroitly: 'affluence has liberated people; though more moderate affluence would have sufficed'.[12]

Thus, to begin to evolve a changed approach to exploring fashion and consumption, grounded in natural and human systems and based on values, our analysis must recognize that not all consumption is negative; and by the same token, that neither is consumption the only route through which fashion can be configured and experienced – that other formulations of fashion provision and involvement are also possible, albeit if not widely practised today. As Jutta Gronow notes: 'originally fashion was not consciously created; it was born as a side-product of purposive social action which had totally different aims of its own'.[13] The task ahead is to separate the often conjoined ideas of fashion as a market-driven cycle of consumer desire and demand, and fashion as identity construction, as the creation of a sense of self which we are empowered to change; and in so doing to give rise to a role for fashion that helps us both identify the causes of sustainability problems and cultivate new aspirations, to develop fashion based on values.

Re-finding fashion relations and formations that exist separate from the dominant naturalized version of fashion involves fostering and bringing awareness to alternatives. Such alternatives garner a different set of experiences and expectations about what fashion provision and expression is and can be. They reflect, value and generate a broad spectrum of fashion activity, not just that which can be turned into a commodity and bought and sold. Perhaps they begin to showcase public and shared experiences of creating fashion; or they champion access to fashion in configurations extra to but not precluding the shopping mall. Maybe the skills of fashion are deployed and demonstrated through practising 'usership' rather than displaying goods as ownership; or novelty seeking in fashion is experienced not through consumption of the next season's look but through practising new processes of the 'craft of use'.[14] They offer the prospect of, say, a re-engagement with original encounters with fashion, which were as a practice of making clothing, often in groups. And with its effects: developing an aesthetic sense which evolves with understanding about how to make and use tools (such as needle, thread and scissors) and undertake cooperative projects. These alternatives explore fashion as a practice that is integrated and affirmative to our material, social and cultural lives and which can be experienced both inside and outside a market-driven cycle of consumer desire and demand and as a collective activity, involving complex flows of information and influence between businesses, groups and individuals. Framed in this way – as part of the process of life – fashion becomes dynamically interconnected with sustainability (another life process) and a key part of the relationship between material and human culture and ecological flourishing.

Needs

Central to these fashion alternatives is an understanding of needs. Not all garments meet the same needs in identical ways. While the ostensible function of all clothing is material, to protect our modesty and keep us warm, this function is supplemented – and often eclipsed – for fashion pieces, which are 'consumed' for their symbolic functions rather than their material ones: as a practice of identity formation, where we signal who and what we are to others and negotiate our place in social structure; of individual agency; and also simply to please ourselves. While some are reluctant to describe all contemporary clothing as fashion,[15] others consider it impossible, in the West, for clothes to be outside it: 'By the simple act of getting dressed in the morning [people] participate in the processes of fashion'.[16] This view is underscored by the deeply social nature of fashion. Where what one person chooses to

wear is very much affected by the decisions and actions of others. It is the fabrication of self-identity but within a social context: a collective activity involving the flows of information and influence between business, groups and individuals.[17] The emotional needs met by garments in such individual and social contexts are complex, subtle and inexhaustible. They defy the crude categorization of many environmental arguments that see them only as a set of practices that are ecologically damaging and resource profligate and detrimental to human well-being. Yet if we wish to avoid depriving people of their need for identity and participation, it is not as simple as forgetting about fashion and scrapping everything other than a few wardrobe basics. We cannot transform the sustainability potential of fashion until we begin to understand its significance as a satisfier of human needs.

Humans possess specific, identifiable needs that are the same, regardless of nation, religion or culture. Manfred Max-Neef has identified these as subsistence, protection, affection, understanding, participation, creation, recreation, identity and freedom, and they fall into two broad categories: physical (material) needs and psychological (non-material) needs[18] (see Table 5.1). Crucially while these needs stay the same, what changes with time and between individuals is how we go about meeting or satisfying these needs. Some of us may, for example, satisfy our need for identity with fashion while others may meet this need with religion, language, work, etc. Each way of satisfying needs has different environmental and social impacts. Where these satisfiers are products or services (though they can also be social practices, forms of organization, political models and values), they are the traditional – if unconscious – focus of design.

Humans consume materials to put a roof over our heads, keep us warm and well fed. Increasingly – as is the case with fashion – we also use them to

Table 5.1 *Fundamental human needs*

Fundamental human needs	
Material needs	Subsistence Protection
Non-material needs	Affection Understanding Participation Creation Recreation Identity Freedom

help meet our non-material or psychological and emotional needs. Here lies a paradox: psychological needs are not easily satisfied, and in some cases are even inhibited, by consuming materials alone. Consuming material goods does not stem our desire for more material goods if we are buying them to meet psychological needs. Many of us will, for example, be familiar with the feeling of a new want or desire surfacing no sooner than the first one is satisfied. Put simply, consuming materials gives us a false sense of satisfying our psychological needs. Avner Offer fleshes out this contradiction: 'Resources and cravings do not map precisely onto well-being. What we want and choose can often fail to deliver and even be counterproductive',[19] a fact long recognized by many religious communities as seen in their guidelines for living materially simple but active and spiritually rich lives. This point is further reinforced by a number of studies and indices that suggest we are no happier now than in the 1950s, even though we own far more material possessions.[20] In his work, Max-Neef stresses that needs are met by a combination of internal and external means, yet as Ann Thorpe points out, in our society most satisfiers come from sources outside of ourselves (like garments), with very little attention placed on internal means such as personal growth.[21] The pursuit of commercial opportunity has drawn psychological needs into the marketplace and can deliver a continual uplift of economic growth: 'if we are relying upon the properties of procured goods for our sense of identity, then we are compelled to procure again and again'.[22] This dependency not only creates negative environmental and social impacts of overconsumption; it also means we are forced to replace internal means of meeting needs with external objects, such as garments.

Understanding needs helps build knowledge about why fashion is important to us. According to Max-Neef, any fundamental need that is not adequately satisfied reveals a 'poverty'. Just as people are poor when they have insufficient food and shelter to meet their need for subsistence, poverties can also be experienced in relation to other needs. We are 'poor' if we experience bad health care, domestic violence, etc. (a poverty of protection); and 'poor' if we cannot, for reasons of widely dispersed family groups, oppression, etc., meet our need for affection. We are also 'poor' if we can't satisfy our need for identity, participation and creation – three needs which can (at least in part) be met by fashion. Yet fashion clothes as we encounter them today are also the cause of multiple poverties. They, for example, are complicit in impairing the possibility of garment workers to meet needs of subsistence, protection and freedom due to low wages, forced overtime, sexual harassment, etc.; they damage our collective rights to enjoy a safe and convivial natural environment through toxic pesticide use and chemical

pollution; and they inhibit our need to participate, understand and be creative by being sold 'closed' ready-made products that confer few opportunities to develop skills of making.

The challenge instead is to build alternative systems of fashion provision and expression that satisfy needs and minimize poverties while recognizing the value of material culture, the effect of social forces and the potential and limitations of existing industry structures and practices. Perhaps the first step is to build knowledge about what represses or stimulates opportunities for meeting needs; and then to apply this understanding so that we minimize negative effects and maximize positive ones. To minimize negative effects, simple changes can be made such as switching to fair trade and organically grown materials. To maximize positive ones, decentralized local production facilities could be established as could, say, cultural acceptability of fashion activity that takes place both inside and outside the marketplace. The goal here is to effect a change in emphasis of our practice away from producing goods that undermine environment and social quality and onto those that nurture our deeper well-being. Max-Neef describes this as a shift from a system where 'life is placed at the service of artefacts (artefacts are the focus) . . . to (one where) artefacts at the service of life (quality of life)'.[23] This seemingly simple shift changes profoundly the goal of the industrial system. It is a distinction between a culture defined by its material consumption and one that is catalysed by using material goods to help us engage, connect and better understand ourselves, each other and our world. John Ehrenfeld has described this as *flourishing*: 'our artefacts need to be designed to support conscious choice and reflective competence rather than blind consumption. . . . They should produce long-lasting human satisfaction. . . . We will be able to flourish simply by living life as we encounter it'.[24]

A systems goal of flourishing would transform the fashion and textile industrial system at root. Not only would it change what we design and produce, it also influences consumption. Max-Neef suggests that if we promote a broad understanding of needs that recognizes the importance of internal as well as external means of satisfying them, then we can start a process of transformation that draws us out of a narrow focus on material wealth (what we do or do not have) and instead motivates and mobilizes people to use their own skills and ideas to satisfy their needs. This same point is described differently by Nobel Prize-winning economist Amartya Sen: 'In judging the well-being of the person, it would be premature to limit the analysis to the characteristics of the goods possessed. We have to consider . . . what the person succeeds in doing with the commodities and characteristics at his or her command'.[25] (For more on the development of fashion

capabilities see Chapter 8 – User Maker.) One project that specifically worked with Max-Neef's ideas of needs was Super Satisfiers,[26] part of the 5 Ways project. Super Satisfier's aim was to develop a concept piece that explored the way we meet needs through garments by converting subtle and unconscious uses of clothing into a design brief. The hope was that this would imbue a garment with more meaning to try to break the cycle of consumption and dissatisfaction and make our hidden needs more obvious so that we can connect more with ourselves. The project focused on the need for affection

◀ Caress Dress produced as part of the 5 Ways Project

and developed the 'caress dress'; one designer's highly personal take on how she attracts attention from others through garments. The dress uses slits and subtle cutaways to reveal hints of bare skin at the shoulder, the waist and the small of the back. Its purpose is to invite friends to touch and embrace her and for the wearer to feel the warmth of others' affection for her.

Fashion that helps us flourish

Designing fashion to help us flourish provides a framework for action that reflects diversity, interconnectedness and care in both material and action. Yet the complex and extremely personal nature of needs and satisfiers suggests that if a needs-based approach to promoting sustainability is pursued, then a sector has to be created that respects – and actually finds business opportunity in meeting – our diverse, individual needs. That is a production system, perhaps based on nimble, flexible processes of making goods, that is personal and specific and 'just right' for us. This would see the evolution of a sector of 'millions of markets of dozens' (a plethora of different, small volume products), rather than the present day Fordist model of 'dozens of markets of millions' (a limited number of products produced in large volumes). A more differentiated, less homogenous approach to production chimes with predictions for the future of business more generally, which deploys social media and the Internet to match consumer needs with specific products. Yet to reflect alternative systems of fashion provision and expression based on needs, it is important to reiterate that fibre, fabric and garment only play a partial role in meeting needs; and it is the actions and functionings of the people who use these products that most influence long-lasting, deeply experienced human well-being, flourishing or as Aristotle described it, *eudaimonia*. It does not follow that products and the industrial sectors that produce them are not part of a needs-based approach; only that they are not all of it. There is also a key role in needs-centred design for the public sector, community groups and fostering different types of social practices and forms of organization.

A fashion ethic based on flourishing values a broad spectrum of activity, enjoys an alternative emphasis on the relationships it fosters. This unorthodox agenda is a call to get 'back to roots' and in essence describes a future for fashion and sustainability that *reconnects us with nature* and *with each other*. It works at many different levels: individual and industry, emotional and material, fashion and fibre. It encourages us to develop a sense of ourselves as human beings and witnesses the fostering of relationships as a key indicator of change. Beauty and greatness will be seen in garments that

value process, participation and social integration, in pieces that advance relationships between people and the environment. The activity of friends knitting together will be valued as beautiful. Compostable garments will have an intrinsic loveliness. Supporting a disadvantaged community with careful purchasing will become a jubilant act. Relationships will be fostered by designing garments that encourage us to ask ever deeper questions about our sense of place in the natural world; by creating pieces that start a debate, invoke a deep sense of meaning or call upon the wearer to engage his/her skill, imagination or flair. It is about designing confidence- and capability-inducing pieces that encourage versatility, inventiveness, personalization and individual participation.

A new aesthetic

Alternative systems of providing and experiencing fashion based on needs and relationships sit in marked contrast to the status quo. Today many of the products we see on the rails on the high street or catwalk shows of the high-end brands reinforce the idea that it is possible – and even desirable – to be ethically and politically neutral and separate from the world, and to aspire to design values of objectification and egocentricity. Yet, as discussed earlier in this chapter, it is impossible for us to detach ourselves from the political aspects of our work, that is, from how our work affects all citizens. We are part of the natural world, not separate from it and have a shared path with reciprocal actions: while we impact hard on nature, nature also influences us. Giving form to this interconnectedness and reciprocity is a key part of fashion and sustainability. Aesthetics are important to sustainability because they act as a great social attractor, an outlet for ideas, a form of cross-referencing and an agent of change, giving direction to the choices of a great number of individuals.[27] It follows from this by making sustainability-generating alternatives more attractive to people, we can encourage them to willingly embrace it.

The appearance of something is also linked to understanding and knowing and is therefore essential to a process of understanding and improvement. As the opening line of John Berger's classic text *Ways of Seeing* states: 'Seeing comes before words. The child looks and recognizes before it can speak'.[28] Thus, in 'seeing' sustainability in say, a permaculture garden, a community market or an engaging, responsible garment, we begin the process of understanding it. This process happens on an emotional and intuitive level – even before sustainability is explained we have some insight. It follows from this that we must use and value this potential as this 'experien-

tial' knowing is key to a richer, deeper and more true-to-life understanding of sustainability. Developing knowledge of the world because of an experience is recognized as one of the 'four ways of knowing' used to explain how we know something beyond the traditional reaches of scientific and academic study. The four ways of knowing are: experiential, presentational, propositional and practical and are said to have most value when they build on each other, that is when, 'our knowing is grounded in our experience, expressed through our stories and images, understood through theories which make sense to us, and expressed in worthwhile action in our lives'.[29] This transformation of an intuitive and empathic understanding of the world through to informed making maps well onto the design process. While a product may initially produce a positive aesthetic experience – outwardly it may be judged both beautiful and tasteful – knowledge of the environmental degradation, social inequity and exploitation associated with the piece may well change this experience. We may see the object in a new light – the object stays the same but now our knowledge alters our experience of it.

As it stands today it is difficult to see or sense sustainability in many of the 'promising' fashion and textile products available. But perhaps we simply do not know what we are looking for. The sustainability aesthetic characterized by 'eco chic' graphically reminds us that the look of sustainability is not based on arbitrary notions of styling, superficial differences and indiscriminate detailing; after all, most fibres can be processed to look 'pure', 'natural' or 'recycled', regardless of their true provenance. Indeed perhaps as a reflection of the fact that fibres can look identical regardless of whether they are conventionally or fairly traded, coloured with traditional or low-salt dyes, etc., most lower-impact fashion pieces are aesthetically indistinguishable from everything else on the market; in fact this is some designers' express intention. This has both good and bad implications. The implications are good if the product is allowed to trade on its own merits, rather than as an 'issue' product, where its success is linked to the popularity of the 'issue' at stake; and good if it means that a product is not tainted with some of the negative historical preconceptions of 'green design', such as poor quality and high price. The implications are less positive, however, if the appearance of a promising fabric or garment is purposefully limited to comply with today's aesthetic models, just to make it 'fit in'. For these models are based on production systems that are widely critiqued as value-free and from which the subtext of social and moral responsibility is missing.[30] Long-term sustainability requires a switch to an aesthetic that is based on values and takes its form from these values, not from how things look today. Stuart Walker[31] describes it thus:


SPORT SETS
YOU FREE


SPAM
KILLED MY COMPUTER

> Designers may be hesitant to acknowledge it, but the aesthetics of a product are, to a very great extent, a result of the system which produced it. The definition of form, detailing of shape and surface are both constrained and largely determined by the overall product system. Therefore, we should not be attempting to find a new style which we might characterize as some form of 'sustainable aesthetic'. Rather we should be developing products and restructuring our manufacturing systems so they are conceptually and pragmatically aligned with sustainable principles. As we do so, new types of products will emerge whose aesthetics go deeper than shape and surface and which start to embody ethics and to reflect these new sensitivities and understandings.

▲ Organic cotton T-shirt and jeans by howies

For the artist and author Suzy Gablik,[32] the form that products take is rooted in an individual or a particular place and yet it is not static, but constantly evolving into a new relationship with society and nature. This emphasis on strong roots and active partnerships mean that key sustainability values include: *community* where a new relationship is fostered between designer, producer and consumer; *empathy*, that is the capacity to share what another is feeling and to recognize this understanding as being part of a connection to the bigger system; *participation*, where we devolve fashion's power structures and take a more active role in its production; and *resourcefulness*, where we find opportunity in reducing the consumption of materials, energy and toxic chemicals.

One example of this new aesthetic is found in the West Wales' clothing company howies – both in its business model and the products themselves. howies, established in 1995 by Clare and David Hieatt, started by making T-shirts for BMX riders in a spare room. In 2008 the company had grown to 'Cardigan Bay's third biggest clothing company' and was sold in 2009 only to be bought back by its founders from VF Corporation in 2012, upon which Hieatt released a statement: 'We thank VF for allowing us to be small again'.[33] Its emphasis on its small size, its strong links to its community of sports and a sense of place permeate the company's values. howies' aim is to make people think about the world they live in. Its products, designed for functionality, simplicity and durability communicate this culture of questioning and respect for the environment through carefully selected materials, slogan T-shirts and a web presence that are as much about social comment and compassionate responsiveness as about selling clothes. Its aesthetic is pragmatic, goal directed and charged with ethical sensitivity.

Reversing the escalators of consumption

The process of transforming the fashion and textile sector into something more sustainability-focused – and more sensitive to needs – takes time. It is a long-term commitment to a new way of producing and consuming that requires widespread personal, social and institutional change. In the shorter term, there exist other, more easily won, opportunities to tackle consumption patterns, such as those that come from subverting well-recognized social and psychological mechanisms that induce blind, buy-as-much-as-you-can consumption. This can help buy time while a greater understanding is built of the way goods meet our needs and constrain, distort or enhance the quality of our lives. This chapter now turns its attention to some of these escalators of consumption, originally set out by Elizabeth Shove and Alan Warde[34] namely:

- The pressure to compare ourselves to others such as through the accumulation and display of possessions;
- The rolling replacement of things as each new purchase requires the buying of another to 'match';
- The cultural obligation to experience everything and buy things accordingly; and
- Constant consumption as part of a continuous process of identity formation.

Arguably one of the easiest places to start the process of slowing consumption is to piggyback on already existing trends and steer them in the direction of sustainability. Trends such as those for informalization or eclecticism, for example, have potential to influence the pace of consumption. In the move towards more informal ways of living, the relaxing of rules and codes of dress both in social and in business contexts leads to less specialization and more crossover between use of products. Amplifying this, designers can develop products that suggest a wealth of different use opportunities (multiple functions or shared products) to help reduce the quantity of what is bought.

The trend for eclecticism encourages people away from feeling impelled to sustain 'coherence' across all fields of behaviour and have a matching family of products for all occasions. Resources can be saved by instead mixing and matching a range of pieces including second-hand, organic, craft, home-made, etc., in addition to conventional garments. Here the potential to reduce impact comes from using more sustainable pieces alongside already existing ones. It also comes from designers working in new roles including as facilitators of change, as cultivators of widespread social innovation, as

fosterers of critical consumerism, where purchasers are supported to ask questions, buy from a range of retail forms (for example from second-hand shops, clothes swaps, the Internet and high-street brands) and to work and rework their existing wardrobe.

Other consumption escalators have the potential to be slowed by introducing lower-impact products. Where the pressure to consume is driven by *identity formation*, we regularly redesign ourselves by purchasing new items or forming new associations. If these associations are with sustainability, then we may feel compelled to buy ethical or organic across the board. This is an escalator catered for by ethical supermarkets that offer a complete range of alternatives.

If the pressure to consume is driven by *display* of 'green' goods, then it is likely that these have to be highly visible, like for example, solar panels emblazoned on the roof of a house, rather than loft insulation hidden from view. In this case, each 'green' product also has to be designed with an identifiable and visible mark to communicate this difference. This could be achieved with logos and labelling, such as the energy labels included on washing machines; buttons, as used by the MADE-BY supply chain traceability initiative (see Chapter 2); or with stitching – American Apparel for instance sew their organic cotton line with distinctive green contrast stitching. Importantly the pressure to consume driven by identity formation does not necessarily require the consumption of materials, but rather access to a throughput of new products. One potentially more resource-efficient way to lessen the impact of this drive to consume is to shift to a service economy, where materials and goods are used not owned (See Chapter 6 – Local and Light).

Service design could also help counter the negative consumption effects of buying things to experience *novelty* and *variety*. Here products would be leased for short periods; returned when their novelty wears off and replaced with a new hire good. Designing products for lease in this way is relatively unexplored in the fashion and textile sector outside formal dress hire or hospital and hotel linen services and offers major sustainability potential. Modular products also have the potential to suppress the consumption mechanism for novelty and variety. Here newness and variation could be ensured by developing products with a flexible core, with adaptable sections and removable portions that grow and change over time. Modularity has been explored by many designers including Rei Kawakubo at Comme des Garcons and Jun Takahashi in the 2003 Paper Dolls collection for the Undercover label; where aprons of clothing were fixed with Velcro tabs on basics. The use of new technologies such as wearable electronics also has

potential to reverse consumption for the sake of novelty, though with as yet unknown resource implications particularly in production and disposal. For example, garments are in development with an electronic interface that would allow new images and colours and even different garment shapes to be downloaded onto a piece – resulting in many new and different garments in one.[35]

Integrating knowledge of consumption escalators into design practice may influence what and how we buy as a tentative step on a journey to understanding the relationship between fashion, needs and the goods

▼ Green contrasting stitching on organic cotton T-shirt by American Apparel

◀ Modular concept top formed by construction of hexagonal fabric pieces that can be removed and replaced when needed or completely deconstructed and rebuilt, by Ariel Bishop

that constrain, distort or enhance the quality of our lives. Transforming this knowledge into fashion experiences that nurture us as humans and our relationships involves a step change that challenges the existing model's values, perceptions and habits of mind – for they themselves are widely held as the root cause of the problem of unsustainability.[36] Without changing how fashion is thought about, both as a sector and as a set of individual and social practices, the very issues that cause unsustainability will prove resilient.

Indeed it is these habits of mind and the associated economic, strategic and business rhythms that are perhaps the greatest barrier to more fundamental change. They are also the area where designers have, historically in any case, least interest in working. Yet in order for flourishing to be a genuine alternative to the addictive and destructive fashion industry, it is vital that wide-ranging economic and business questions are addressed. Our next step – and a huge challenge for all of us – is to move out of the 'safe' sustainability territory of small makers and 'slow' production and begin to explore what needs might mean for the large-scale rapid fashion rhythms of the high street. Yet for development practitioner Nabeel Hamdi,[37] 'going to scale' with these ideas requires, paradoxically, that we start small: 'in order to do something big . . . one starts with something small and one starts with where it counts'. Therefore, in the best tradition of Hamdi, giving form to flourishing in a fashion context requires that we design small, empathic, resourceful, local elements. Yet we do so with an awareness of the larger framework constantly alert to the 'emergent' or 'multiplication' potential of these small changes. Then we will begin to give form to a culture where quantity is superseded by quality. The following three chapters further explore this new culture of sustainability.

Notes

1 Thomsen, S.R., Weber, M.M. and Brown, L.B. (2002), The Relationship Between Reading Beauty and Fashion Magazines and the Use of Pathogenic Dieting Methods Among Adolescent Females, *Adolescence*, Spring, 37(145), pp1–18.

2 Campbell, C. (2006), Consuming Goods and the Good of Consuming, in T. Jackson (Ed.), *The Earthscan Reader in Sustainable Consumption*, London: Earthscan, pp278–290.

3 Anson, R. (2010), End of the Line for Cheap Clothing?, *Textile Outlook International*, 147, pp4–10.

4 Farrell, R. (2008), Fashion and Presence, *Nomenus Quarterly*, 3.

5 *Textile View* (1993), Trends, 22, p17.

6 Tham, M. (2008), *Lucky People Forecast: A Systemic Futures Perspective on Fashion and Sustainability*, PhD thesis, London: Goldsmiths, University of London, p194.

7 Vinken, 2005, as cited in Tham, Ibid., p193.

8 This argument builds on that developed in transportation by Williams, J. (2010), Bikes, Sticks, Carrots, in M. Maniates and J.M. Meyer (Eds.), *The Environmental Politics of Sacrifice*, Cambridge MA: MIT Press, pp247–269.

9 Appadurai, A. (1986), *The Social Life of Things: Commodities in Cultural Perspective,* Cambridge: Cambridge University Press.

10 Max-Neef, M. (1992), Development and Human Needs, in P. Ekins and M. Max-Neef (Eds.), *Real-life Economics*, London: Routledge, p204.

11 Offer, A. (2006), *The Challenge of Affluence,* Oxford: Oxford University Press, p2.

12 Ibid., p357.

13 Gronow, J. (1997), *The Sociology of Taste*, London: Routledge, p79.

14 Craft of Use, Online http://www.craftofuse.org (accessed 27 February 2013).

15 Kawamura, Y. (2005), *Fashion-ology*, Oxford: Berg Publishers.

16 Church Gibson, P. (2000), *Fashion Cultures,* London: Routledge, p353.

17 Blaszczyk, R.L. (2008), Rethinking Fashion, in R.L. Blaszczyk (Ed.), *Producing Fashion: Commerce, Culture, and Consumers*, Philadelphia: University of Pennsylvania Press, pp1–18.

18 Max-Neef, Op. Cit., pp197–214.

19 Offer, Op. Cit., pvii.

20 See for example: Spratt, S., Simms, A., Neitzert, E. and Ryan-Collins, J. (2009), *The Great Transition*, London: New Economics Foundation.

21 Thorpe, A. (2007), *The Designer's Atlas to Sustainability*, Washington: Island Press, p118.

22 Finkelstein, J. (1991), *The Fashioned Self,* Oxford: Polity Press, p145.

23 Max Neef, Op. Cit., p202.

24 Ehrenfeld, J.R. (2004), Searching for Sustainability: No Quick Fix, *Reflections*, 5(8), pp1–13: 7.

25 Sen, A. (1999), *Commodities and Capabilities*, New Delhi: Oxford University Press, p6.

26 5 Ways, Online http://www.5ways.info/docs/projects/super/projects.htm (accessed 2 July 2012).

27 Manzini, E. (1994), Design, Environment and Social Quality: From 'Existenzminimum' to 'Quality Maximum', *Design Issues*, 10(1), pp37–43.

28 Berger, J. (1972), *Ways of Seeing*, London: Penguin Books, p7.

29 CARPP, Online http://www.bath.ac.uk/carpp/publications/coop_inquiry.html (accessed 4 August 2007).

30 Gablik, S. (1991), *The Re-enchantment of Art*, London: Thames and Hudson, p62.

31 Walker, S. (1997), Conscientious Objects, in E. van Hinte (Ed.), *Eternally Yours: Visions on Product Endurance, Rotterdam*: 010 Publishers, p179.

32 Gablik, Op. Cit.

33 West, K. (2012), Independence Day: howies Puts Shirt on Organic Growth, *The Times*, 15 January 2012.

34 Shove, E. and Ward, A. (2002), Inconspicuous Consumption, in R.E. Dunlap, F.H. Buttel, P. Dickens and A. Gijswijt (Eds), *Sociological Theory and the Environment*, Boston USA: Rowman and Littlefield, pp230–251.

35 Tao, X.M. (2005), *Wearable Electronics and Photonics*, Cambridge: Woodhead Publishing.

36 Ehrenfeld, J.A. (2008), *Sustainability by Design*, New Haven: Yale University Press.

37 Hamdi, N. (2004), *Small Change*, London: Earthscan, pxix.

CHAPTER 6 Local and Light

Many of the questions at the heart of the fashion and textile sector's relationship with sustainability are connected to issues of scale, efficiency and place. These defining themes have a complex relationship with the ecological health and social value of both individual garments and the sector at large; and defy easy categorization. For instance, high volume, mass production can be – and often is – resource efficient, especially if measured on a metric of inputs of materials, energy and chemicals *per garment* produced. But what if the scale of the unit of analysis is changed and looked at from a systems level, across the industry-as-system as a whole? The sector at large is growing: in the first five years of the twenty-first century we bought one-third

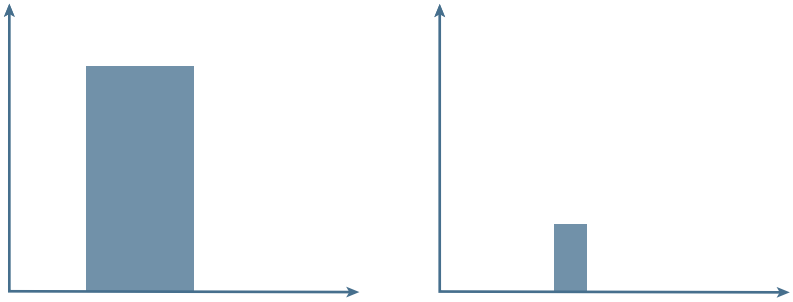


Figure 6.1 *Changing the scale at which we view an issue or activity impacts upon how they are perceived*

more pieces[1] and while improvements in the efficiency of production have led to a decline in impact per garment, this is overshadowed by ever-higher levels of consumption. In effect a component part of the system is reformulated to cause less impact; but the size and impact of the system as a whole grows. When viewed at different scales, improvements and their effects are perceived and valued differently (see Figure 6.1). Indeed all too often our lens of scrutiny is set at one magnification: we look, think and act at a single scale only. Yet the challenge of sustainability is to refocus this lens at many different resolutions. With it, we can 'pixelate' our activities into thousands of interactions, thoughts, experiences, design opportunities, commercial exchanges and ideas about what is valuable. We can begin to look at more dynamic, meaningful scales of analysis other than economic indices of number of units sold, perhaps an individual wardrobe, a community, a society. We can design a system to shelter, shield, adorn and create identity for our collective body in ways that add to, what Aristotle called, *eudaimonia* (the actualization of human potential or flourishing). Here our metric shifts from efficiency per piece to the nurturing of communities of people, where a garment takes its place as one of many connected and moving parts in a bigger fashion system.

With an attention to scale, fashion and sustainability activity can be schooled and shaped by a sense of appropriateness of ideas and actions to context, place, time, people and size; by an honest awareness of what it is we are actually doing – and whether that is 'good'. Its concern is to direct our efforts to the right place, at the right time, in the right way; and sinuously connect these moral judgements to the integrity of big ideas and the more individual-scale practical wisdom of everyday experiences with our clothes. This chapter explores sustainability opportunities linked to an alternative view of scale and resource use in fashion and textiles as compared with the prevailing view of the sector: specifically, designing local and designing light.

Designing local is concerned with developing a sector with a greater sensitivity to place and scale; a sector devised to sustain communities and support jobs while protecting the quality of the environment. Designing light is focused on promoting resourcefulness in production and consumption. This gives rise not only to lightweight materials and structures but also to lighter, less material-intensive ways of organizing consumption, like shared products and services.

Local and light are both principles inspired by ecosystem properties and dynamics. Natural forces and processes tend to evolve and self-organize to maximize lightness and minimize materials and energy use, 'curbing excess from within', and most biological systems use local expertise to produce the materials they need and to process their waste. This chapter begins its exploration of the potential of local and lightweight design as a creative force for change in fashion and textiles with a short introduction to their common starting point, nature-inspired design and specifically biomimicry.

Biomimicry

While imitating or copying nature is not a new idea, the science and potential of biomimetic design has developed rapidly over the last decade and a half. In her seminal book *Biomimicry,* Janine Benyus[2] talks about biomimicry's three approaches: the first, the use of nature as a model to inspire approaches that solve human problems; the second, employing nature as a judge or measure of the 'rightness' of our innovations; and the third, nature as mentor, looking metaphorically at us designing with values and perspectives present in the natural world. Biomimicry has a long history of influencing textile products – indeed perhaps the most commercial biomimetic product of all is Velcro, first patented in the 1950s by Swiss inventor George de Mestral after he noticed how burrs stuck to his woollen trousers and his dog's fur while out walking. His investigations revealed that each burr consisted of hundreds of tiny hooks that 'grabbed' into loops of thread or fur and subsequently set about developing a hook and loop tape as a strong, reusable fastening system. More recently the same approach of copying features of plant or animal design was used by swimwear manufacturer Speedo who developed a fabric and full body swimsuit, Fastskin FSII,[3] which was inspired by the way a shark's skin reduces friction and channels the water over the body as it moves through the water.

Other biomimetic products, like the pigment-free, coloured fibre Morphotex,[4] bring specific sustainability benefits. Developed by Teijin of Japan and inspired by the iridescent morpho butterfly of South America,

Morphotex achieves its colour by causing light to diffract and interfere with the fibre in ways that amplify certain wavelengths. This creates brilliant colours to the viewer through the use of physical structure rather than with pigment or dye. In effect, the surface layers play with light and produce a coloured fabric without the energy and resource impacts associated with dyeing and printing. The Morphotex fibre has a multilayer stack structure made up of 61 layers of polyester and nylon, each with different refractive indexes. By controlling the thickness of the layers it shows variations of the four primary colours red, green, blue and yellow, dependent on the angle and intensity of light.

Yet perhaps the greatest contribution of biomimicry ideas to fashion, textiles and sustainability is that it provides a new philosophy and language for how to interact with, innovate and develop fibres, fabrics and garments that are as resourceful, resilient and beautiful as the natural systems they are modelled on. In *Biomimicry*, Benyus introduces a way to judge whether our innovations are 'good' for us:[5]

- Will it fit in?
- Will it last?
- Is there a precedent for this in nature?
- Does it run on sunlight?
- Does it use only the energy it needs?
- Does it fit form to function?
- Does it recycle everything?
- Does it reward cooperation?
- Does it bank on diversity?
- Does it utilize local expertise?
- Does it curb excess from within?
- Does it tap the power of limits?
- Is it beautiful?

Armed thus with a powerful checklist of possibility, this chapter now explores opportunities for 'good' innovation specifically in two of these areas: local and light.

Local

The fashion and textiles supply chain is today characterized by being global, not local. Indeed the *Ecologist* reported that the average T-shirt travels

the equivalent distance of once around the globe during its production.[6] Transportation and logistics of global supply chains are not without impact, though they are commonly regarded as 'free', that is no barrier to producing in any location. Their costs, such as air pollution or the impact of water resources diverted away from other needs, are externalities, and are not factored into price on a hangtag. One illustrative American study,[7] now almost 20 years old, converted these external costs into dollars and priced these transport-related costs for a cotton T-shirt, moved between different growing and processing regions of the USA. It concluded that the environmental cost of transportation was significant and would, if included in the price of a T-shirt, amount to about half the cost of growing the cotton. This figure now seems conservative in the light of the continued shift of textile and fashion manufacturing away from high wage economies and the continued growth of China's and other BRIC countries' manufacturing capabilities.

Certainly transport distances provide a ready sketch of the extent of globalization in fashion and textiles and a proxy for the scale of challenge posed by sustainability to the sector. They also give a rough metric with which we can begin to measure a move towards a system that transports goods both less and with greater efficiency. Nature – with the exception of migrant species – 'shops' locally, using local expertise to produce the resources it needs and process its waste. Indeed the proximity of place of production to consumption, the act of sourcing and making with those skills and resources found close to 'home', reflects the overarching ambitions of localism; that of economic resilience, social engagement and cultural and aesthetic diversity. Many sustainability initiatives have sprung up from local actions and the grassroots. Indeed few ideas are more ecologically powerful than those linked to designing and developing products to sustain communities, providing people with meaningful work and a sense of connection with the place and the people with whom they live.

For many, localism is an antidote to unsustainability. According to David Pepper, 'revising the scale of living will solve at root many of society's theoretical and practical problems'.[8] For in small communities people see and sense the effects of their own actions on each other and the environment and are quicker to enjoy the benefits of change. Localism promotes a field of vision that is 'human' in scale. It has been argued that smaller scales help us to feel that our world is more intelligible and allows us to be responsible for it.[9] Perhaps it is for this reason that Pepper also suggests that the division of power based on area is predicted to best promote, 'equality, efficiency, welfare and security in all society. This will produce more cohesion, less crime, more citizen participation in government and sensitivity to the needs

of others'.[10] Local action is also thought to help foster human creativeness as we inventively respond to problems with the resources and expertise that are to hand. The result is a less homogenous or cloned society, one that reflects the ideas, skills and resource flows of a local place and an aesthetic agenda – of garments or textiles – that grows from the ground up and is not set by and for the convenience of big business (see Chapter 1 – Material Diversity). Other designers acknowledge the importance of the local agenda. McDonough and Braungart[11] for example talk about the 'best' product being one with a human and material engagement with place. For John Thackara,[12] the 'best' product is one that makes citizens look at their community with fresh eyes. For Stuart Walker,[13] the 'best' product creates work at the local level that is socially enriching and economically viable in the product's production, use and disposal.

Locally made, globally relevant

Localism represents an opportunity to foster change within fashion and textiles; an opportunity to design for distinctiveness, limited editions and fibre grown within 50 miles. It presents us with an occasion to produce and consume based on models that recognize natural limits, the importance of reliable work to strong and resilient communities, while affirming the central role fashion and textiles play in our culture. Yet localism poses very particular challenges for fashion and textiles. In a globalized world, no industry is more broadly dispersed around the planet than textiles and apparel. Just as the textile industry led the Industrial Revolution, fashion and textiles has been among the first sectors to be part of today's international division of labour. The sector is particularly fluid and mobile and over the past 30 years it has fundamentally changed the scales – and the transparency – of its operation. Apparel companies largely have moved their manufacturing facilities from industrialized to lower-wage countries overseas, resulting in an already complex supply chain now having a wide geographic spread. A changing landscape of international trade quotas and the easing of caps and restrictions has greased the wheels of this process. Indeed the UK has been part of this shift, with almost all textile, garment and footwear manufacturing, even for the most iconic British brands, now taking place overseas. During this same time period, one particular business model has come to dominate globalized production: profit delivered through economies of scale, i.e. large volumes at low prices. A scenario where low cost, 'big box' retailers create a dynamic that prioritizes cheapness, mass availability and high volume, high quantity purchasing above all else.

Against such a context, examples of truly local products are rare and getting rarer – as are the small-scale, regional, specialist spinners, weavers, knitters, dyehouses and tailors who once dominated production worldwide. Indeed in recent years there has been a strong resurgence in interest in 'local' production in many industrialized countries, no doubt spurred by a desire to create jobs and restore manufacturing capability in economies struggling to emerge from recession. Yet few would suggest that local production should attempt to replace global production, but rather its role is to complement, learn from and then in time, begin to influence it. Some global production pressures, such as the push to cut lead times, increase speed-to-market of a design and rapidly respond to consumer trends, are actually cutting the distances textiles and garments are transported. Zara, for example, produces its clothes in Spain and Portugal near to the markets of Europe and while this adds a price premium to their clothes due to higher labour rates, it avoids expensive stock build-up and waste. Yet while this saves on fuel and cuts waste, and by one measure can be seen as local (at least in terms of distance travelled to European markets), by others, not least, product diversity, a sense of human scale, an element of influence that wearers of clothes have over the technologies that affect their lives, it falls well short. Localism at its most radical calls for a move away from a monoculture of globalized production dominated by the power, concentration and international reach of big business.

Contrary to received wisdom, local and small scale is not simplistic or sentimental, in fact making things locally is frequently more complex than its one-size-fits-all alternative. Neither is local corny or rustic: just because local products are designed and made at decentralized factories far away from fashion capitals using regional-specific materials or traditional techniques does not mean that they are not a part of the global fashion system. Their complexity comes from networking multiple small makers and their success lies in cultivating the strengths of local production (diversity, closeness to audience, traditions) while carefully connecting it to the information flows (fashion symbols and visual language) of the global network (the fashion system). A strong example of local production with global fashion system caché is Alabama Chanin[14] in which Natalie Chanin initiated a series of US-based community revitalization projects that combine old-world craft with couture style and reuse of materials. She employs local women – former factory workers, retired teachers, widows, housewives and secretaries – to help sew one-of-a-kind, handmade garments for her fashion line. Gathering together to work in circles reminiscent of Alabama's dwindling tradition of quilting, the women forge friendships while stitching, embroidering and

beading Chanin's much coveted designs. Chanin initially used only vintage fabrics found at local charity shops, then relying on bulk shipments from the Salvation Army to fill all the orders. She prepares her seamstresses for the task with lessons of mindfulness, instructing them to handle the thread with love as they sew. She believes that, 'If you love your thread, it brings something to the wearer'.

▲ Skull dress by Project Alabama

Local and connected

The Internet and other new technologies have helped revolutionize the network potential of local by driving down the costs of production and distribution. One effect is to better connect consumers to the right product for their specific needs while allowing small independent producers to make money from their highly specialized items. Other changes include the rise of open source models of production, as typified in Linux and Wikipedia. Here groups of people form active cooperative networks, organizing themselves to solve problems and practise the solutions they want and offer potential to promote diverse, decentralized local values. *Sustainable Everyday*,[15] Ezio Manzini and François Jégou's exhibition and book of the same name, builds on the theme of local and connected, drawing together a whole series of 'living strategies' that offer sustainable alternatives for urban living from ten different countries. The result is a collection of cosmopolitan ideas of local origin that are focused on small, local systems change that when connected together bring the potential of big systems transformation.

Other types of technological developments are also revolutionizing the potential of the fashion and textile sector, and crucially also the mass market, to respond more locally. The digitization of production, for example, where computer-aided design technology (CAD) is interfaced with whole-garment knitting machines, body-scanning technologies and digital printing makes possible the 'mass customization' of garment production at multiple locations, perhaps even in stores and in collaboration with consumers.[16] Mass customization is concerned with best fit rather than exact fit and tries to find the closest match for a consumer's needs from a selection of predefined options rather than making individually tailored garments. Mass customized jeans, such as those offered by Bodymetrics,[17] are now available in high-end department stores. Here body-scanning technology is interfaced with software programmes and a virtual viewer to provide a 'best fit' for the consumer. In another example, Lands' End,[18] the USA's largest catalogue sales company has also explored mass customization for its products. Trials with body scanning proved uneconomic (as the process is labour intensive and slow, taking

around 15 minutes), but through its 'custom' service, information about a customer's size is used to adapt standard patterns and produce garments cut and sewn in single units using modular manufacturing techniques.

Some technologies, however, are not viable at the local level – instead local production will prioritize different processes and perhaps combine pre-manufactured pieces together with local expertise, to begin to use the flexibility and skill of regionally distributed human creativity with some of the resource efficiencies brought by producing large volumes centrally.

Local knowledge

The knowledge and experience of those who discover things by living and working in one place can bring a wealth of new perspectives and practical solutions to many environmental and social problems. Such understanding of a place rarely influences business agendas yet it has the potential to generate solutions that solve the problems of millions of people. In India, Professor Anil Gupta of the Indian Institute of Management and founder of the Honey Bee Network[19] collects village wisdom by walking between rural communities, gathering local lore, knowledge and innovations on the way and so far has posted 50,000 of these village sustainability ideas on the Internet. These walks, or journeys of discovery (Shodh Yatra), involve Gupta and his entourage 'seeking solace at the feet of creative people' – recognizing, honouring and giving credit to the creative grassroots, which in India's case is the rural poor. The wisdom that emerges typically uses few materials but an abundance of experience and ingenuity. It also has other basic characteristics such as ease of making and repair, energy efficiency and production of little waste. Gupta sees the very act of gathering these local ideas as a transformative act, building confidence while both recognizing and encouraging a community's potential. Gupta's work has inspired one of my fashion research projects, *Local Wisdom,*[20] which involves looking to everyday use practices for the alternative views of creativity necessary for sustainability.

Distinctiveness

The local agenda is concerned with enhancing diversity, celebrating traditions, building communities, creating meaningful employment and respecting local environmental conditions – it is a combination of body, mind, object, knowledge, philosophy and action. When scales of operation are small and relationships direct, it is simply more practicable for wearers to be part of a deign process; to develop new or reinstitute old styles as appropriate and

perhaps build a job-rich infrastructure for repair and reuse. At its heart, the essence of localism is distinctiveness, guidelines for which have been drawn up by the New Economics Foundation[21] and which offer countless opportunities for design innovation:

- Distinctiveness is not neat, it is fuzzy, overlapping and necessarily inclusive;
- Local people have primacy: if they feel a place is distinctive, then it is – and this can be used to draw in outsiders;
- Distinctiveness must be authentic: what is distinctive is not usually susceptible to marketing unless it has genuine roots – often historic roots – in the places where it is claimed;
- Assets are more than just economic: they might be a communal memory about a place or a sense of good neighbourliness. They will not always be assets that can be exploited economically, though they may make economic exploitation easier;
- Small things are as important as big things: it is the texture that makes a place authentic as much as recordable economic assets, and very small changes can enhance people's sense of distinctiveness as much as anything that requires major investment;
- Distinctiveness requires a sense of responsibility: building distinctiveness normally requires new local institutions or practical alliances capable of bringing local stakeholders together to make things happen;
- History gives depth to a place: it gives added dimensions – but it has to be about history alive and well today, rather than just about the past which leads to deadness.

▶ Jacket made from 100 per cent hemp grown in England from fibre grown and processed by Bioregional

Local examples

Localism sets out a mandate to adapt our appetites to where we live and to celebrate this as a necessary alternative to globalized production. Shopping locally for fibre and fashion requires a local knowledge that few of us have today. Who amongst us knows what would we wear if we had to grow and process fibre and fabric locally and reflect a discrete local identity? The answers are beginning to be formulated by an emergent and ever more visible group of entrepreneurs, who are building products and businesses that suit the land and the local culture and utilize the skillsets of people who live there. Some of these groups have begun to use the concept of 'clothes miles', trading on the now familiar idea of 'food miles' – a method of communicating 'hidden' transport-related emissions and fossil-fuel consumption in the food industry – to promote a sense of an alternative to global production.

Knowing more about history, community and our 'natural address' provides important starting points from which to develop different ways of clothing ourselves.

BioRegional,[22] an independent environmental organization that is focused on developing sustainable products and services, has invested years of research into growing traditional fibre crops in the UK for use as local textiles. The climatic conditions of BioRegional's natural address – the South East of England – favour the growing of hemp, a crop that in the sixteenth century was grown by every farmer in the UK, by order of an act of parliament introduced by Henry VIII to ensure the supply of sails and ropes for Royal Navy ships. However, today very little hemp is cultivated in the UK even though it is easy to grow, needs low financial, chemical and labour inputs. The reasons for hemp's minority status are partly to due to its market (heavyweight fabrics) having been replaced by lighter-weight fibres and fabrics (such as cotton and synthetics) and partly due to it being a low narcotic strain of the plant *Cannabis sativa*, the cultivation of which is illegal in many parts of the world (see Chapter 1). Yet the main obstacle to successfully developing UK hemp textiles is the process of mechanically harvesting and processing the fibre so as to produce a high-quality product. BioRegional has carried out a number of practical trials that resulted in the production of the first UK-grown pure hemp fabric for generations and found that new harvesting technology is needed to produce fibre of the right quality and price (hand processing, while producing high-quality fibre, makes fabric too expensive). New processing methods have now been developed which include retting with enzymes (*CRAiLOR* technology – see Chapter 1) that reduce the economic risk and pollution potential of traditional fibre extraction techniques.

Another cornerstone of the UK's local fibre economy is wool – and it is one of the few fibres that can still be grown, scoured, spun and woven within the shores of the UK. Ardalanish,[23] a small farm and mill on the Isle of Mull off the West Coast of Scotland, has developed a range of organic tweeds that combine tradition, community and local resources in a beautiful, distinctive and high-quality fabric. The fibre for the cloth, from rare-breed Hebridean sheep, comes in a range of natural colours from black to chocolate brown through to silver grey and it is carefully separated to give a variation of natural shades without dyeing. At the farm mill, in a restored cowshed, the fine Hebridean woolen yarn is woven with the natural whites and fawns of the yarn from organic Shetland sheep to make ten different tweed cloths.

Local can find expression far beyond fibre choice; it can also be about celebrating local culture. Toronto-based designer Joanna Notkin,[24] for example was asked to create a product that would celebrate her native

▶ Fly skirt in organic tweed, part of the Ardalanish Collection by Anja Hynynen for Isle of Mull Weavers

▲ Moth blanket by Joanna Notkin

Canada through the myth of the cabin. In response, she took the tradition of using mothballs to preserve fabrics in places like log cabins and turned it on its head, creating a line of textile products with delicate blemishes so that any additional holes added by moths would serve to enhance the beauty of the product.

Local culture was also at the centre of another project, Local, part of the 5 Ways research project,[25] which captured the essence of an area and asked you to wear it proudly on your back. Local in the case of 5 Ways meant Brick Lane, London, UK. Brick Lane has a very special character; now the centre of London's Bangladeshi community, it has a street market, acts as a base for large numbers of designer-makers and artists and is also a thriving textile and leather area. The resulting product, a bag hand knitted from leather scraps gathered from local workshops, evolved out of a mix of these influences. The leather was cut into strips, knotted into a ribbon and then knitted on chunky needles into a soft, tactile, extendable pouch. The bag is something to carry your fruit and vegetables home from the market stalls (shop local), something to indicate your community identity (this is where I live), something made

from a local source of waste employing local people in the process (use waste as a resource).

Light

Like the principles and practices of local design, designing for lightness is based on an awareness of scale, both literally and metaphorically. In a literal sense, lightness conveys a focus on the intensity of resource use for every functional unit (garment), perhaps reflected in lightweight structures that maximize material and/or use efficiency. More figuratively, lightness reflects qualities of 'just rightness', or 'fit' for an appropriate use; and metaphors of weight are often used when discussing taking action for sustainability. We talk for instance, about 'living lightly' and 'treading lightly on the Earth'. Such metaphors acknowledge that weight is a problem and that the greater the amount of physical 'stuff' and processes needed to make something, the greater its impact. They also acknowledge, by extension, that lightness is our challenge.[26] One key barrier to designing light is that its opposite, heaviness, has long been used as a measure of economic (and de facto societal) success: the more resources and energy we use and the more waste and pollution we emit, the more gross domestic product (the standard measure of economic success) increases. As wrongheaded as it may sound, things widely regarded as undermining ecological and social value – ranging from oil spills to domestic break-ins – actually grow the economy (as measured by the traditional indicator of gross domestic product), for they set in train a chain of work to clean up pollution (in the case of oil spills) and replace locks and process insurance claims (after a burglary). For several decades, alternative measures of success have been developed and increasingly accepted, though have not replaced GDP. These include the Genuine Progress Indicator that measures well-being rather than increased production of goods. Lightness, sometimes called dematerialization, is part of this approach.

Lightweight materials and structures

Designing lightness in products aims to give the same functionality, but with lower resource intensity and environmental and social impact. Lightweight materials such as polyester and other synthetics need fewer kilograms to make each garment – reducing energy and resource consumption compared to heavier-weight fabrics. Such lightweight, low bulk fabrics are also more efficient to transport and can bring energy savings in laundering for example,

for they wash well on low temperatures and dry quickly with few creases (see Chapter 3 – Use Matters). Using synthetic fibres as a low-impact solution highlights an important point: while light design is inspired by nature, it may not always use natural materials. It is a reminder that change comes by pushing in directions that are not just familiar or conventional and which often require lateral thinking. Typifying this complexity, designing light does not bring uncomplicated benefits. Many of the lightest and strongest materials are composites, like technical sportswear fabrics for example, which while delivering superior function fulfilment with minimal materials are very difficult to reuse or recycle and do not biodegrade. The ongoing challenge is to investigate whether such innovations contribute more to the overall system (less materials, efficient laundering) than they take out (adding to landfill) and explore alternatives where they exist.

Designing light also pertains to structure. Innovative hexagonal, waffle and honeycomb assemblies enclose the maximum amount of space with the minimum amount of materials and so give us more cover, warmth and strength for fewer kilograms. Likewise the age-old string vest, when worn in combination with other layers, is a classic example of warmth with minimal materials. Designing light through construction opens up a rich opportunity for innovation in knit and weave – and also in efficient pattern cutting (see also Chapter 4); changing the proportions of a garment or the number of pattern pieces to maximize use of fabric uses lightness to save resources by altering garment construction.

Lightness can also be achieved through multiple functions. By designing and developing one product that performs many functions, the overall effect is that we can do more with less. The Cambia T-shirt made by Páramo[27] for example has two fabric faces and can be reversed depending on whether you need to keep cool or warm. When the smooth side is worn next to the skin, moisture is kept near the body and helps with cooling. If it is turned inside out the function of the fabric changes and the honeycomb structure directs water away from the body and keeps the wearer drier and warmer. Lightness is achieved by the constant adapting and reassessing of resource use for a particular need.

Negademand

A key aspect of the lightness agenda involves developing systems that use and not just create products more efficiently. While such systems are still relatively unexplored in the fashion and textile sector, other industries have been developing efficient use ideas for well over a decade by changing

conventional business relationships in a way that improves business and resource efficiency. Utility companies, for example, have realized that helping consumers to use energy more efficiently – and thereby reducing actual demand for their product – can be good for their business. While at face value this seems to make little sense, as electricity companies' profits are linked to selling more units of power, these companies now recognize that if they persuade their customers to save energy (switch off lights, install insulation, etc.), then profits increase by not having to invest in and build more power stations, substations, electricity cables and pylons to meet growing demand. Here both supplier and customer profit from working collaboratively to eliminate wasteful consumption. This idea, termed negademand (negative demand), is central to designing light. Negademand works for corporations because they also diversify their business activity. No longer do electricity companies just sell power, they also own businesses that advise on energy efficiency, that produce energy-efficient light bulbs and fridges and install insulation in people's homes.

Negademand switches the onus away from selling products to selling efficiency. In fashion and textiles, negademand would mean that companies would sell fewer fibres, but make their money by developing businesses around forging partnerships with customers that make the use of fibres more efficient; thereby dissociating economic activity and profit from selling more materials. So for example, a high-street store could employ advisors to help paying customers 'stretch' their wardrobe and extend the wearing potential of each piece. Companies could also site repair facilities in-store and even provide paid, supervized access to sewing machines, transfer presses and digital printers to encourage repair, reuse and customization. They could also branch out into web publications and style blogs – providing us with the opportunity to consume immaterial fashion imagery and information, rather than material products.

Sharing

Other key ways to use products more efficiently are to share them; allowing one item meets many people's needs. In recent years a movement around collaborative consumption has developed, setting out the philosophical benefits and economic and social opportunities of sharing goods.[28] While many of us may already share clothes, borrowing clothes from our friends, housemates and parents, few of our garments are designed explicitly to be shared. To make garments easy to share, they have to be adaptable enough to fit a range of body sizes and shapes, perhaps making use of tapes and ties

◀ JP Donleavy shrug, Spring/ Summer 2005, 100 per cent cotton by Keep and Share

to help adjust to fit or developing pieces with as few tight-fitting points as possible. This latter approach of designing unisize – and even unisex – garments with minimal fitting points so as to maximize their share-ability can be seen in the work of Amy Twigger Holroyd's innovative knitwear label, Keep and Share.[29] Typical Keep and Share garments are items like shrugs, wraps and cardigans, based on loose geometric shapes and seamless finishes. While the personal and, in some cases intimate, nature of garments means they are perhaps unlikely to be shared with strangers, online systems to foster sharing with people not known to you, such as EcoModo,[30] work to establish 'circles of trust' to encourage the confident lending and borrowing of each other's everyday objects, skills and spaces.

Services

Switching from selling products to selling the use of products through services has considerable sustainability potential, offering up to a factor 10 (i.e. 90 per cent) improvement in efficiency.[31] Services provide opportunities to meet needs with fewer resources and less energy (i.e. lighter) because they are focused on utility or results and not strictly on materials. The logic they employ is that users seek not the product (say for example, towels), but rather the functionality that it offers us (dry hands). Moreover, if business can be structured to encourage this shift in focus, perhaps users can begin to meet needs with fewer physical goods, which in turn leads to fewer environmental and social impacts. The opportunities to reduce impact emerge from designers being able to think about customer needs in new ways. No longer limited by their traditional view of what they must deliver to the customer (continuing the example above, cotton hand towels), designers can develop the best solution to meet the customer need (paper towels, air driers, etc.). This in itself is a challenge as the 'best' solution may well fall outside traditional industry boundaries and so be difficult to achieve unless sustainability initiatives work in trans-industrial groups. Real gains are also dependent on using designers' expert knowledge of consumption and knowledge of how to make products desirable for the service sector. As Chris Ryan notes:

> market success depends on the way (cultural and social) meanings are materialized and projected onto a product. . . . Designers are skilled in manipulating material form to create products that function to fulfill human needs and make an emotional connections with the consumer. If there is to be a replacement of products by services, these new systems will have to be designed to be more desirable than material goods for consumers.[32]

It is important to stress that a shift towards a service economy is not necessarily a shift towards sustainability. In the information-rich, knowledge-based service economy of the first decade of the twenty-first century – the service sector makes up almost 70 per cent of the European economy[33] – consumption has increased, not reduced. Thus, services are not better for the environment per se; they have to be so by design. For example, in the case of frequently laundered garments, the most resource-intensive phase of the lifecycle is use or laundering. Sharing a garment with multiple users has little effect on how it is washed and dried, in this instance switching to a service chases the wrong goal (See Chapter 3 – Use Matters). Yet services might be the right solution for other textile products, like carpets or furnishings say, where most impact is amassed in production.

There are a number of commercially viable businesses that offer fashion and textile services, though very few of them are examples of 'transformed systems' – businesses that use services proactively to promote sustainability. Perhaps the best-known 'transformed' business based on services in the fashion and textile sector is American carpet company Interface and its Evergreen Lease carpet rental system.[34] Evergreen Lease sells customers underfoot colour, comfort and warmth by leasing carpet tiles. Under the lease arrangement, the tiles remain the property of Interface and when worn are removed and returned to its factory for closed-loop materials recycling, which aims to reduce the amount of virgin material used and the amount of end-of-life material being disposed of in landfills or by incineration. Evergreen Lease makes money by designing tiles to last, so that replacement costs are kept to a minimum, and adds value by being easy to recycle, so reclaiming and reusing the valuable raw materials in a worn carpet. The system is attractive to consumers because it saves money, Evergreen Lease is priced cheaper than the bought equivalent over the lifetime of a carpet and in addition companies no longer have to buy a carpet outright, so taking a significant cost off the balance sheet. Yet disappointingly, Evergreen Lease has not brought huge business or environmental benefits to Interface, chiefly because of cultural issues and resistance to new ways of being supplied with products. Research carried out by Marcus Wong[35] at the University of Cambridge investigated the barriers to the successful introduction of Evergreen Lease. These include, among others:

– The complexity of selling services – involving more people than for selling products, an understanding of more detailed contracts and a better knowledge of the customer organization;
– The customer's education – customers need to have a long-term view

of their organization to see the benefits of the service and know how to communicate this to the different budget holders involved; and

– The resistance to change – if customers fail to see a problem with their existing solution, there is a very low level of motivation to change and an accompanying high level of skepticism about the alternative.

The experience of Evergreen Lease highlights the innate difficulties of introducing services into a market traditionally dominated by the selling of products. However, other companies have carved out a successful service niche in the existing market and provide, for instance, formal or evening wear hire, lease of maternity clothes or linen hire. In the case of formalwear like suits, evening dresses and wedding outfits, hiring allows consumers to wear an expensive garment that is going to be worn as a one-off without buying it outright; the same advantages enjoyed by celebrities when they 'borrow' gowns for red carpet gala events. For maternity wear, rapidly changing body shape means that the garment (particularly something formalwear or office attire for professional women) is only going to be worn for a short period before it no longer fits. Hiring can allow women to get appropriately sized or special occasion maternity clothes more cheaply. In the case of textile or linen rental, uniforms, bed or hospitality linen for the catering industry, services can loan just the products or also offer laundry and dry-cleaning facilities, saving companies time and capital expense of buying and running cleaning equipment.

Thus, leasing can make a profit for both retailer and consumer. What is more a different study from the University of Cambridge suggests that a system of leasing clothing could bring substantial environmental benefits, saving water, energy and chemicals and reducing the amount of garments being sent to landfill.[36] Importantly, the research also recognized that leased clothing would only be possible under certain conditions and if social and cultural changes took place, including a change in consumer attitudes and behaviour towards environmental issues. Also needed would be substantial changes from retailers, redesigning their manufacturing expertise to also include repair, changing the layout of their stores and buying laundry equipment. In favour of a shift to leased clothing are new business practices like just-in-time manufacturing, where high-street retailers respond to changing trends not just in seasonal collections seasonally but by bringing new garments in-store every two weeks (see Chapter 2 – Ethically Made). The prevailing fashion business model, based on selling high volumes at low prices, has led to rapidly increasing rates of consumption and has changed our relationship with clothes. Fast-to-consume clothes are more throwaway and perhaps

less personal, something that may indicate consumers' readiness to lease, not own, garments in order to utilize their material and symbolic functions.

In this chapter the collection of projects, companies and ideas introduced support a wealth of differentiated and sustainability-focused activity. Indeed many of these projects simultaneously influence sustainability in all of its four domains: culture, society, environment and economy. Yet for these alternatives to bring big change and become widely adopted, they also have to be experientially and physically beautiful. After all, it is the prestige and high levels of cultural attractiveness of alternatives that is central to a smooth transition to sustainability.

Notes

1 Allwood, J M., Laursen, S.E., Malvido de Rodriguez, C. and Bocken, N.M.P. (2006), *Well Dressed?*, Cambridge: University of Cambridge Institute of Manufacturing, p12.

2 Benyus, J. (1997), *Biomimicry,* New York: Quill Press.

3 Speedo, Online http://www.speedo.com/ (accessed 2 July 2012).

4 Morphotex, Online http://www.teijin.co.jp/english/about/fields/poly/index.html (accessed 2 July 2012).

5 Benyus, Op. Cit., p291.

6 Lee, M. and Sevier, L. (2007), *Sacking the Sackcloth Image: Ethical Fashion Special*, London: Ecologist, p13.

7 Walsh, J.A.H. and Brown, M.S. (1995), Pricing Environmental Impacts: A Tale of Two T-shirts, *Illahee*, 11(3&4), pp175–182.

8 Pepper, D. (1996), *Modern Environmentalism*, London: Routledge, p306.

9 Crawford, M. (2009), *The Case for Working with Your Hands*, London: Viking Books.

10 Pepper, Op. Cit., p306.

11 McDonough, W. and Braungart, M. (2002) *Cradle to Cradle*, New York: North Point Press, p120.

12 Thackara, J. (2005), *In the Bubble*, Cambridge, Massachusetts: The MIT Press, p94.

13 Walker, S. (2006), *Sustainable by Design*, London: Earthscan, p128.

14 Alabama Chanin, Online http://www.alabamachanin.com/ (accessed 2 July 2012).

15 Manzini, E. and Jégou, F. (2003), *Sustainable Everyday: Scenarios for Urban Life,* Milan: Edizioni Ambiente.

16 Larsson, J. (2010), *Mass Customized Fashion*, PhD Thesis, Boras: Swedish School of Textiles, University of Boras.

17 Bodymetrics, Online http://www.bodymetrics.com/ (accessed 2 July 2012).

18 Lands End, Online http://www.landsend.com/ (accessed 2 July 2012).

19 Honeybee, Online http://www.sristi.org/hbnew/ (accessed 2 July 2012).

20 Local Wisdom, Online http://www.localwisdom.info (accessed 2 July 2012).

21 Taylor, J., Oram, J. and Kjell, P. (2004), *Clone Town Britain: The Survey*, London: New Economics Foundation, p28.

22 BioRegional, Online http://www.bioregional.com/ (accessed 2 July 2012).

23 Ardalanish, Online http://www.ardalanish.com/ (accessed 2 July 2012)

24 LoooLo (2012), Online http://www.looolo.ca/ (accessed 2 July 2012).

25 5Ways, Online http://www.5ways.info/docs/projects/local/projects.htm (accessed 2 July 2012).

26 Beukers, A. and van Hinte, E. (2005), *Lightness: The Inevitable Renaissance of Minimum Energy Structures*, Rotterdam: 010 Publishers.

27 Páramo, Online http://www.paramo.co.uk/ (accessed 2 July 2012).

28 Botsman, R. and Rogers, R. (2010), *What's Mine Is Yours*, London: Collins.

29 Keep and Share, Online http://www.keepandshare.co.uk (accessed 2 July 2012).

30 EcoModo, Online http://ecomodo.com/ (accessed 2 July 2012).

31 Brezet, H. (1997), Dynamics in Ecodesign Practice, *UNEP Industry and Environment, 20(1–2), January*–June, pp21–24.

32 Ryan, C. (2000), Dematerialising Consumption through Service Substitution Is a Design Challenge, *Industrial Ecology*, 4(1), p5.

33 Euromonitor (2000), *European Marketing Data and Statistics 2000*, 35th Edition, London, UK: Euromonitor.

34 Interface, Online http://www.interfaceglobal.com/ (accessed 2 July 2012).

35 Wong, M. (2005), *Industrial Sustainability and Product Service Systems*, Online http://www.sustainablepss.org/casestudies/interface/interface.php (accessed 16 July 2007)

36 Crehan, S. (2005), *Leasing Clothing: A Scenario Analysis*, Cambridge: University of Cambridge, Department of Engineering.

CHAPTER 7 Speed

Fast speed has become a defining characteristic of today's textile and clothing industry. It is a combination of rapid production; where sales are tracked with electronic tills and just-in-time manufacturing that has now made it possible to turn a sample or design sketch into a finished product in as little as three weeks. And high-velocity, high-volume consumption: statistics reveal that people are buying one-third more garments than four years ago,[1] a purchase rate made possible by the increasing availability of large quantities of cheap clothes as typified by the so-called 'big box' retailers; and the readiness of consumers to buy them. Yet super cheap, 'value' or 'fast-fashion' garments are no quicker to make or consume than any other garment.

The fibre takes the same amount of time to grow/extract regardless of a product's speed to market (in the case of cotton, around eight months to cultivate and two to ship). Likewise the raw material takes the same amount of time to be spun, knitted or woven, cleaned, bleached, dyed, printed, cut and sewn; and the activities of shopping and laundering take the same amount of time regardless of how fast a design makes it from studio to high-street retailer.

In the last decade and a half the term 'fast' has been paired with 'fashion' and 'textiles' to denote a range of practices that are large scale, logistics dominated, economic growth focused; in ways influenced by the food sector. Indeed like fast food, fast fashion is mass-produced and standardized. The unbeatably cheap top, dress or pair of jeans, like the hamburger, is traded in large volumes, is globally ubiquitous and is homogeneously served or styled. Designed to be cheap, easy and rapid to produce, it draws on low-cost materials and labour, short lead times and efficient large-volume production. Sales and growth are increased by maximizing economies of scale and minimizing costs. In both food and fashion, 'fast' is an economic tool, a lever to be pushed and pulled, in order to increase product throughput and grow profit. Fast fashion is fashion shaped not by speed but by a set of business practices focused on achieving continual economic growth.

In the fashion and textile sector, the logic of growth is well established as the basis of power and prosperity. The system that grows fastest is considered best and is sustained because people are invested in it. Belying this apparent simplicity, the implications of economic growth are complex. In the last 60 years the size of the global economy has increased by a factor of five[2] yet a slew of indicators reveal the implications of this growth imperative on environmental and social quality: compared to just two generations ago, global poverty is just as endemic – with two billion people still living on less than $ 2 a day; social cohesion, particularly in the rich West, is weaker;[3] atmospheric carbon concentrations are at far higher levels; natural environments are more degraded; and there are growing numbers of conflicts over land use and access to water.[4]

In fashion, the low-cost, homogenous, 'quantity' dressing that has seen the UK's budget clothing market grow by 45 per cent in the last five years, twice the rate of the normal clothing market,[5] has also raised questions about whether the volume-budget model, and the economic growth it is designed to generate, actually reduces society's wealth, rather than increases it. Low price has overseen a change in purchasing and wearing habits. Garments are often bought in multiples and discarded quickly for they have little perceived value. Fabric quality is poor and garment construction often fails to withstand

laundering, promoting rapid replacement. Unlimited wants, given succor by rapidly changing trends, are treated with unlimited production.

There are, however, other views of time and speed, which acknowledge not just the quickness of economic turnover but also nature's speed and the pace of change of culture. These other views give us a key portal into the designing and making of more ecological, user-centred and resourceful fabrics and garments. These views provide us with a multilayered focus on speed that is a marked shift in emphasis away from the status quo in today's industry where fashion is mass-produced and fashion and textiles are consumed en masse. They are part of a different world view, where a sensitivity to speed in both production and consumption is transformed into a force for quality (of environment, society, pay, working conditions and products, etc.). Its aim is to reframe the use of speed as a force for sustainability and not just as a vehicle for promoting discontinuity (by introducing contrasting styles each collection); consumption (as we replace old styles with new); and wealth (almost exclusively for the fashion industry elite). Speed can be both fast and slow (and an infinite variety of other paces). Fast actions innovate and can bring rapid feedback and speedy take-up of improved products. Slowness provides stability and can promote holistic thinking and causal chains of responsibility. Combining the two brings newness underpinned by resilience; revolution bolstered by remembrance and fashion supported by nature and culture.

Speed and rhythms in nature and culture

Nature supports combinations of fast and slow speed. Ecosystems achieve balance and long-term resilience of the larger system by adjusting to change at different paces. Nature typically combines change that happens on a big scale but very slowly (like the time needed to grow a mature, established forest) with fast, small-scale change (such as in the lifecycle of a flowering plant). Here the varying rates of change within the ecosystem effectively help sustain it, allowing it to survive potentially damaging events. This is because the fast parts react while the slower parts maintain system continuity.[6]

This same sense of combining different speeds can be seen in the views of time of many indigenous and ancient cultures. The ancient Greeks, for example, talked of two different kinds of time, *kairos* (opportunity or the propitious moment) and *chronos* (eternal or ongoing time). Building on both this cultural legacy and nature's use of speed, Stewart Brand[7] proposes that any resilient human civilization needs similar layers of fast and slow activity to balance each other. He suggests six levels of pace and size (see Figure 7.1)

Figure 7.1 *Layers of activity in a resilient human civilization*

noting that when the whole system is balanced, it 'combines learning with continuity'. From fast to slow (and increasing in size) the layers are: Art/fashion, Commerce, Infrastructure, Governance, Culture and Nature. The fastest layers, like fashion, bring rapid imaginative change, while the slowest layers maintain constancy and provide long-term supporting structure. Crucially, the system works when each layer respects the pace of the others.

Yet the fashion and textile industry, as it exists today, has limited respect for system layers like nature and resilience of culture other than when they impact directly on its own commercial activity. It vigorously draws upon such strata, mining their various resources, with little recognition of these layers' value to broader systems beyond their usefulness to industry. The system imbalance created when most importance is placed on the success of commerce over other layers is at the core of the crisis of unsustainability. In fashion terms it is reflected in consumerism's dominance of our majority experiences of fashion and can be evidenced by the increasing standardization of fashion products across the high street. Economic speed promotes a one-size-fits-all culture and a herd mentality among designers, producing 'clone' products and obscuring other types, values and layers of human activity (see Chapter 8 – User Maker). For resilience over the long term we need, following Brand's suggestion, to strike a balance of different speeds and agendas. This could give a voice to nature, society and culture in our design and production decisions and build more user-centred, heterogeneous and resourceful fabrics and garments.

Thus, the challenge of sustainability is to better integrate and balance the commercial layer of fashion and textile activity with multiple other layers; to continue to generate prosperity but from a broader engagement with the integrity of natural systems and cultural systems, while at the same time meeting our requirements for newness and change as expressed through our garments. In applying the lens of speed to fashion and textiles, several

concepts are critical, including user behaviour, appropriateness and durability. They draw together production and use and relate not only to how long materials last, but also to how long they are in active use and how we care for them. Design has potential to influence both groups and affect change across these areas, working both to shape products and to facilitate behaviour change. More poetically, ideas of speed foster a sense of celebration; celebration of the glorious bits of fashion (a fast layer, dealing with novelty, change and being here, now) and its underpinning value (a slow layer, dealing with resourcefulness, optimization and connectivity). It invokes ideas of extending and intensifying the value and use of some products while simultaneously learning how to express the fashion moment in different ways.

Durability

Durability enjoys an easy relationship with sustainability. Resilient materials and products have potential to lengthen product lifetimes. Longer lifetimes, in turn, provide us with more opportunities to access a product's utility. By extending the potential for satisfaction with existing pieces, no additional ones are required. New consumption is forestalled, resources are saved, waste is reduced, needs are met. Indeed a recent piece of research for WRAP suggested that if the lifetime of a garment was increased by nine months, demand for water, carbon emissions and waste generated could be reduced by up to 30 per cent.[8]

It is perhaps unsurprising therefore that durability is a key component of any sustainability-charged exploration of speed in design. It is a popular strategy perhaps because of its association with long-established features of 'good' design like quality and timelessness, and evidence suggests that extending the life of products does bring benefits. According to Tim Cooper,[9] a long-term advocate of durable products, environmental benefits are accrued from extending product life (of all products – not just textiles and clothing) in all but the most extreme cases where technological change brings greatly improved efficiency. As such, designing for durability appears a legitimate design and production activity in a world already choked with products and where consumers buy more than they need. This leads durability, and the associated ideas of resilience and constancy, to act almost as an ideological counterweight to the unsustainability of disposable material culture; a ballast perhaps essential in an age where resources are becoming increasingly expensive to access (as is conveyed by the term 'peak oil', 'peak water' and even 'peak cotton') and where biophysical planetary boundaries are exceeded with unpredictable consequences.[10]

In practical terms, the durability of textiles and clothing can be increased in a variety of ways. One common approach is to focus on improving the physical and technical robustness of the fabric/garment so that it defies the ageing process. This can be done by using hard-wearing materials that are slow to show signs of wear and tear; high-quality making techniques that ensure a product keeps its shape; and avoiding the use of highly stylized prints or patterns that quickly date a product. It is often argued that durable products are particularly suited to the high-end market where there is a tradition of specifying quality materials (although quality does not necessarily equate to robustness) and using highly skilled craft techniques in classic designs.[11] Yet pursuing a blanket strategy of expensive materials and craft making is exclusive and unrealistic. Not only would demand massively outstrip supply and these objects become the preserve of the rich, but a strategy of all-embracing durability also fails to appreciate that a garment's ability to last is influenced by many factors, only some of which are material in nature – and that enduring garments rarely prevent consumption of additional pieces. Evidence from several surveys bears this out. A study of Scandinavian consumers in the mid 1990s shows that new clothes are bought primarily because of a change in fashion and only very rarely to replace old, worn-out garments,[12] so suggesting that enhancing the durability of clothes would likely impact little on consumption patterns; as the majority driver for garment purchase is novelty not the replacement of worn-out items. A different study, this time of British clothing designers, exposes further a simultaneous preference for both durability (often seen as synonymous with quality) and additional consumption. In this survey the designers reported that, 'all materials should be very durable' at the same time as predicting that the average length of time their garments will stay on trend is, 'around six months'.[13] Such evidence reinforces the point that the length of time for which a garment lasts is influenced by culture, behaviour, psychology, knowledge and skills as well as purely technical or material factors. Without this broader appreciation, a strategy of making all fabrics and garments last decades, even if they are only worn once, may waste resources.

▶ Eugenia dress, Spring/Summer 2006, 100 per cent cotton by Keep and Share

Appropriateness

Thus, making a product last is very different to making a long-lasting product. At the core of a fabric or garment's lasting usefulness is the idea of appropriateness. Appropriateness reflects the degree of 'fit' that an object has with place, function, user, maker and environment. Ann Thorpe has described this quality as 'finesse', the 'artful restraint and delicacy of performance or

behaviour . . . finesse means not doing everything it is possible to do. Rather, finesse means resisting the force of speed through aesthetic and sensitive behaviour'.[14] Carl Honoré, a voluble advocate of slow culture, describes this natural metronome, which is different for different people, products and contexts, as 'tempo giusto', the suitable or right speed or inner tempo.[15] Sustaining the use of a fabric or garment into the future requires sensitivity to the 'life world' of the piece beyond the point of purchase; knowledge about which is currently seldom collected and is not the usual concern of designers today.[16] It can comprise knowing more about how long materials last, about how products are used and about why products stop being used. The result should be the selection of materials appropriate to their expected lifetime's task; the development of design strategies such as versatility and reparability; an overall sensitivity to how fabrics and garments are actually used; and the fostering of clothing competencies and ideology of use among wearers of clothes that ensure that pieces are kept in active and satisfying service.

Many designers and companies, some of whom work regularly with sustainability ideas, have produced pieces that exemplify appropriateness. Keep and Share,[17] for example, specializes in versatile, long-life garments. Designed as unisize, unisex, its knitwear has anchor points to attach to a wrist or shoulder combined with loose geometric shapes for a range of fit possibilities. Sharing such pieces over an extended period of time intensifies use and saves resources because the same piece meets a number of people's needs. Appropriateness can also be secured by developing repairable, upgradable products. A Barbour[18] jacket, for instance, the quintessential garment of the English countryside, can be sent away for repair and refurbishing. Re-stitched linings and re-waxed outer layers keep a garment functional for longer – and as with select other garments – the more battered and worn they become; the more they are prized.

Emotionally durable design

In his book, *Emotionally Durable Design*, Jonathan Chapman[19] explains appropriateness as a function of a product's emotional presence, evolution and growth. He contends that products are discarded when they display an absence of meaning; and by cultivating an emotional and experiential connection between person and object, we can disrupt our dependency on consumption of new goods to construct meaning and our sense of self. As part of his doctoral research in which he surveyed the product relationships of over 2,000 users of domestic electronic products, Chapman developed a six-point experiential framework to initiate engagement with emotional

durability and design, specifying points of intervention and pathways which offer starting points and lend structure to investigations:[20]

– Narrative: Users share a unique personal history with the product;
– Detachment: Users feel no emotional connection to the product, have low expectations of it and thus view it favourably because it makes few demands;
– Surface: The product ages well physically and develops a tangible character through this process;
– Attachment: Users feel a strong emotional connection to the product;
– Enchantment: Users are delighted by a product and the process of discovery of it;
– Consciousness: The product is perceived to have free will. It is temperamental and users need to acquire skills to interact with it fully.

Other thinkers have also developed categorized approaches to emotionally durable design. Batterbee and Mattelmäki for example classify three groups of objects with meaningful associations: meaningful tool (the object enables satisfying activity); meaningful association (the object acts as carrier of cultural or individual meaning); and living object (the object fosters an emotional bond).[21] Alistair Fuad-Luke collates a number of different approaches to extending product-user relations.[22] A summary is offered here:

– Extended durability via high-quality, good-design, reliable, upgradable, maintainable products;
– Sharing products;
– Cooperatively designing and producing products together with users;
– Retention of narrative and aesthetic appeal through use personalization and ageing with dignity;
– Creating personal narratives through customization, personalization and memory;
– Increasing sensorial variety;
– Making social connections.

Notwithstanding the challenges of transposing these ideas from the arena of product design, there has been a groundswell of work in this area in fashion in both commercial and research contexts. Perhaps the first example of this was Sigrid Smits'[23] furnishing fabric developed as part of the noteworthy project *Eternally Yours*[24] specifically designed to age with the user. Growing old with a fabric (perhaps upholstered on a chair), witnessing it change over

time and in response to the user's actions and behaviour, is fertile ground from which emotional attachment and long-term product use springs. Smits' blue velour furnishing fabric was pleated, tucked and shorn, to enhance (not resist) ageing and to further emphasize unique and beautiful qualities that spring from user engagement. As the velour ages, the orange backing fabric becomes more visible, especially in stitched or shorn areas, and helps mark the passing of time.

▶ Blue velour pleated furnishing fabric by Sigrid Smits

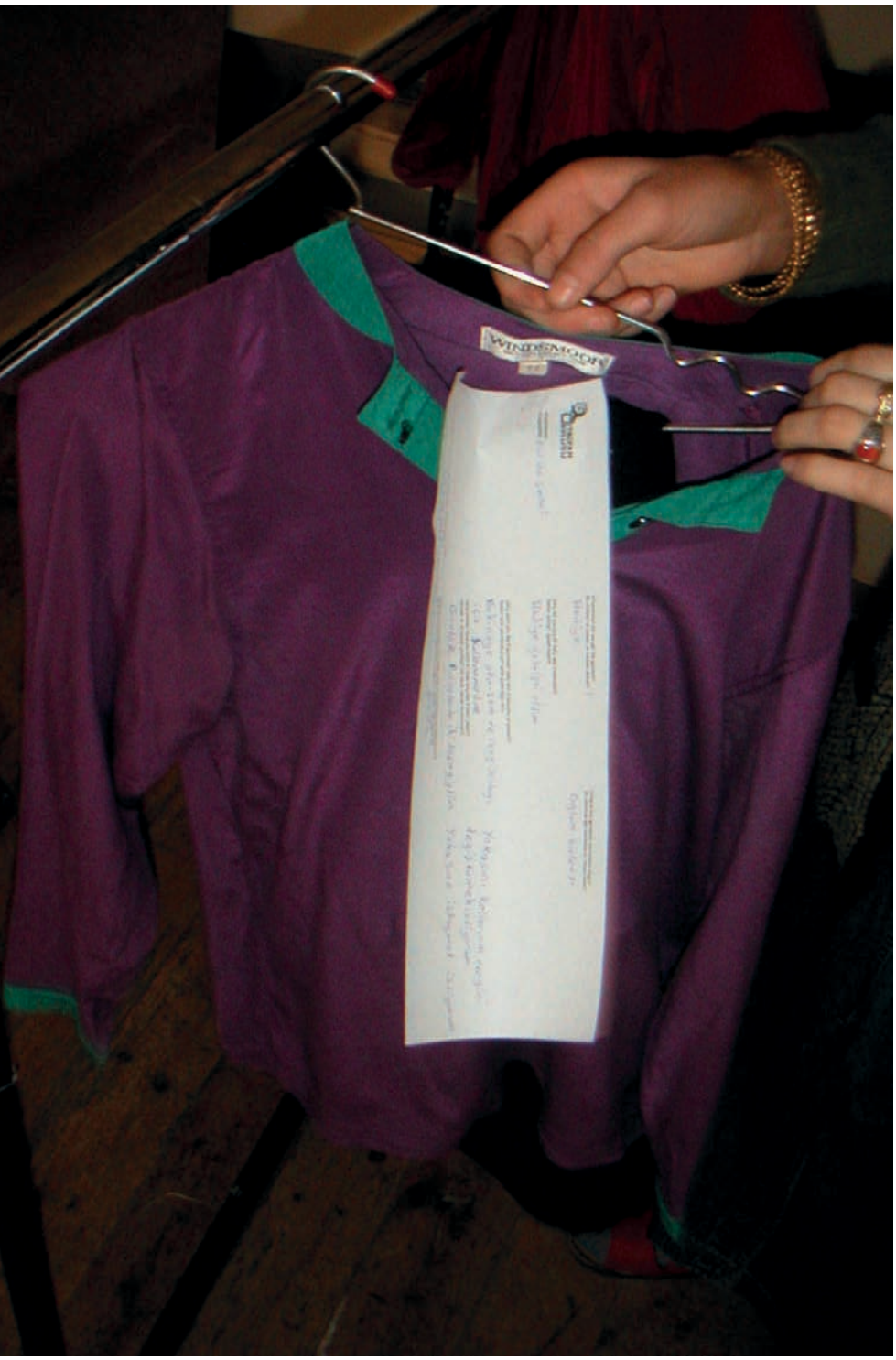
Small acts can begin to trigger meaning and emotional connections. Such things as oversized labels which come with an invitation for a user to sign it (like those in Hussein Chalayan's 2005 Spring/Summer collection) can connect a person with a garment and reinforce a bond of ownership. But more than that, signing a garment as you would a contract can also be seen as declaration of responsibility and expression of long-term commitment, an act can help bring to the surface the relationships we have with our clothes. One aspect of an experimental project by Otto von Busch[25] explored some of these ideas further. von Busch set up a small temporary shop with a rail of clothes, none of which could be exchanged for money, but were instead 'bought' by swapping them for an item of clothing that the 'customer' was wearing that day. To make the exchange, the customer had to first write down their feelings about their garment, why they no longer liked it and why they had originally bought it, on a large label that was then attached to the piece. The simple act of thinking about their garment and articulating their emotions and preferences about the piece meant that most people changed their minds about the swap and elected instead to keep the piece they were wearing. Hence it seems that while value and meaning are influenced by a complex combination of factors, it seems that they can be triggered in simple ways. Learning to trigger enduring meaning in a user's experience of their clothes may keep pieces in active use for longer and also, for example, add reuse value and caché to second-hand pieces, possibly increasing the likelihood of a second life (see Chapter 4).

Yet irrespective of the originality and value of work to animate a product in order to foster emotional bonds, engagement and delay disposal, the findings of consumer studies research reveal that consumption patterns are not necessarily impacted by emotionally durable design. Sian Evans and Tim Cooper note that, 'attachment doesn't necessarily lead to lifespan optimizing behaviour'.[26] Simply because users have formed a bond with a piece does not mean it will be used or replacement consumption prevented. They go on, 'In cases where such attachment was identified, new products were no less likely to be purchased; attachment merely led to

accumulation and storage of seldom-used items'.[27] This is evidenced by statistics for the UK which reveal that the volume of clothes bought per annum is nearly double that which is discarded, suggesting rising rates of ownership and storage year on year; rarely used garments are being widely stockpiled in homes.[28]

Chapman himself recognizes the limitations of designing for attachment and engagement:[29]

> Although a designer can certainly elicit within users an emotional response to a given object, the explicit nature of the response is beyond the designer's control; the unique assemblage of past experiences that is particular to each user, their cultural background and life journey determines this. Designers cannot craft an experience but only the conditions or levers that might lead to an intended experience. What those required conditions are, however, is still unclear to design.



◀ Oversized labels and clothes rails in Itaylan Avlusu project swap 'shop' set up by Otto von Busch

This is corroborated by research that reveals that those products that defy obsolescence do so in informal or unintentional ways, rarely as a result of design planning[30] and which show that consumers often behave in a way so as to reduce the lifespan of products, with an idiosyncratic approach to maintaining quality.[31] Such empirical evidence supports the view that durability is an outcome and not an aim of using products. A point underscored by durability's non-linear relationship with user satisfaction. It has been suggested that while lack of durability of products is a source of dissatisfaction to consumers, neither is perpetual durability valued: 'a lifespan considered reasonable is a prerequisite for satisfaction, but does not ensure it'.[32] Thus, product life extension becomes a nested system within broader discussions about satisfying fashion practices which recognize the importance to durability of a garment's materiality – its fabrics, construction and design – and the overriding influence of these practices on a product's eventual length of life.

Walter Stahel describes this expanded view of durability as 'user-ship',[33] that is, something which emanates from performance rather than products. Evoking ideas of *user-ship* as distinct to *ownership* moves the durability debate away from product-centric business language which has largely dominated product lifetimes' discussions to date and back to a debate of wider society; reflecting the reality of durability as a behavioural issue related to material objects. It emphasizes that durability in fashion is user-based rather than product-based, though played out in material form.

Understanding patterns of use

Opening up the social context and the user's 'life world' of fabrics and garments is central to using ideas of appropriateness, balance and speed to promote sustainability. In recognizing the differences with which people use garments we raise the prospect of designing, in parallel, a number of different and more resource-efficient rhythms and speeds of consumption for different textile products. In the case of furnishings, designing to enhance durability and a 'slow' rhythm of use would likely bring resource benefits. For clothing, however, the picture is more involved because of the relative importance of laundering behaviour in determining overall lifecycle impact and because not all types of clothing are worn and washed in the same way. For those garments that are rarely washed and which are worn for years, slow rhythms of use (and related design strategies supporting physical robustness and meaning) are likely to bring most benefits. Yet for long-haul, frequently washed garments, substantial resource savings are more likely to be achieved by targeting the impacts arising from intensive washing and drying.

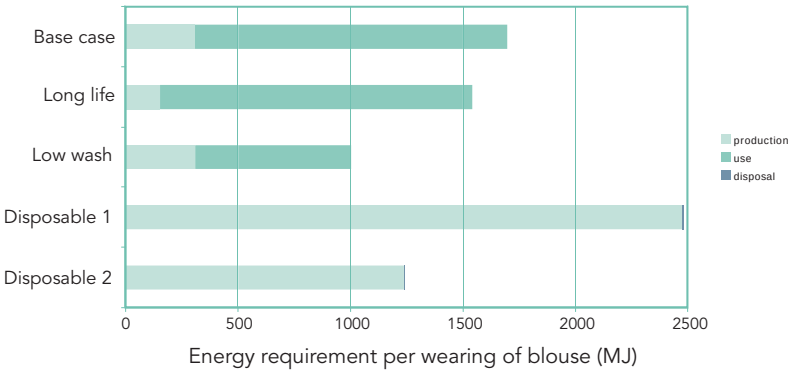


Figure 7.2 *Energy requirements per wearing of a polyester blouse for a range of use scenarios*[34]

Speculatively, this might mean that designers focus on changing people's laundering habits (see Chapter 3 – Use Matters) or introducing fast rhythms of use, where garments are disposed of before laundering.

To further illustrate how patterns of use can affect lifecycle impacts of clothing, Figure 7.2 shows energy data from Franklin Associates'[35] LCA of a woman's polyester blouse (see Chapter 3 for a discussion of this study) extrapolated for five different use scenarios. The base case used in this study assumes that the blouse is worn 40 times in its life and is laundered after every other wearing (i.e. 20 times). The other scenarios are: long life, where the blouse is worn for twice as long as in the base case (i.e. 80 times) and like the base case is laundered after every second wearing; low wash, where the blouse is worn 40 times (as in the base case) but is washed half as often (after every four wearings); disposable 1 where the blouse is worn five times, then discarded and never laundered; and disposable 2 where the blouse is worn ten times, then thrown away without washing.

While it is important not to over-interpret the results of these scenarios as they only show energy consumption and therefore do not give a complete picture, they do illustrate the extent to which use patterns can influence a garment's overall energy profile and in which lifecycle phase the majority of impact arises. For the two disposable scenarios, the energy burden is almost exclusively in the production phase – the implication here is that more efficient production processes or different materials could radically cut lifecycle energy use, while for the other three scenarios impact arising from laundering is the biggest factor; thus perhaps suggesting that targeting laundering would likely bring the biggest gains. Above all, the results reiterate the point that for frequently washed clothes the biggest resource savings

come from influencing use patterns, a finding reiterated by a recent study exploring consumption behaviour in the clothing industry by the Carbon Trust.[36]

One way to influence use patterns is to design garments for short lives and no laundering, in effect designing for disposability. Disposability is a loaded concept in sustainability terms as it is readily associated with profligate resource use and disposal. Yet for products where the cost of upkeep is high relative to the cost of production – like frequently washed clothes – carefully designed short-life garments may save resources overall. Yet to make short-life products a viable and more sustainable alternative, innovation in materials and material recovery is essential. Low-impact, short-life products would have to be made from materials of a quality that matched the short life. They would be resource efficient in production and in disposal – either readily biodegradable or effectively recycled without losing quality (see Chapter 4) and only then could they be seen to offer a real alternative for certain products.

Slow design

At the core of sustainability is a requirement to make our systems of wealth creation and prosperity less dependent on resource use. One way to do this is to re-evaluate our relationship with quantitative abundance and speed – and normally to slow it down. John Thackara, for instance, suggests that the cultural paradigm of speed is in decline and recommends instead a culture built around a greater variety of speeds and 'selective slowness'.[37] Continuing this theme, Manzini and Jégou describe a shift away from today's (unsustainable) product-based society to a new culture where community assets are valued more highly and where we develop 'islands of slowness'.[38] Ideas of slow culture, production and consumption were first developed in the food sector as a response to the opening of a McDonalds fast-food restaurant – the epitome of homogenized and 'quantity' eating – in the center of Rome 25 years ago. A group of Italian activists, used to long, family meals and traditional, highly regionalized cuisine responded to the expansion of the 'fast' model with a social movement, known as Slow Food.[39] Slow Food began as the defence of the quiet material pleasures of cooking and eating and has since grown into a vehicle for reconnecting people to their communities and bioregions through the food on their plate. It has a vocabulary and set of nested values based on local, artisan and traditional production, on material pleasure and convivial experience, on diversity and ecosystem health, and on awareness, responsibility and information and a rejection of a set of

economic priorities which mean that large-scale, mass-production business models thrive above all else. Slow Food has spawned a wealth of other slow movements. Slow Cities, for example, design with slow values but within the context of a town or city and are committed to improving the quality of life of its citizens. Slow Food makers along with artisan producers and farmers markets have experienced rapid growth in recent years, establishing slow as a viable alternative to our current culture. The Slow Food Movement provides us with ample evidence that people are prepared to pay for what is scarce, customized and carefully made – a finding that is likely to be at least partly applicable to the fashion sector.

Slow fashion

As in food, and against a similar backdrop of growth-obsessed activity, a movement promoting slow culture and values in fashion has emerged, albeit with less coherence than in food.[40] And just as in the food sector, the slow movement in fashion has grown into something more than just 'fast fashion minus the bad bits'; for that would confine it to tinkering with today's practices. Similarly slow fashion is not a descriptor of speed, but a different world view that promotes variety and multiplicity of fashion production and consumption and that celebrates the pleasure and cultural significance of fashion within biophysical limits. Clearly, time has a part to play in this and slower approaches often allow, for example, longer-term relationships to develop that recognize the value of wisdom from experience; though speed is but one of many mechanisms for inducing diversity, pleasure and quality. As I have written elsewhere,[41] slow fashion is not business as usual but just involving design classics. Nor is it production as usual but with long lead times. Rather it is about a piece's inner metronome, its appropriate speed for people, workers and context.

The slow culture vocabulary of small-scale production, traditional craft techniques, local materials and markets, that has proved so successful in food, offers starting points for the cultivation of an appropriate speed, a 'tempo guisto' in fashion. It supports a changed set of power relations between fashion creators and wearers compared with one-speed consumerist fashion, based on the forging of relationships and trust that is possible at smaller scales. It professes a heightened state of awareness of the design process and its impacts on resource flows, workers, communities and ecosystems. It prices garments higher than in the growth model to reflect true ecological and social costs and as a production model it offers a radical alternative to high-volume, standardized fashion, making profit by selling

fewer higher-priced items. Slow culture, even with associated high prices, is also seen to promote the democratization of fashion, not by offering more people access to clothes by lowering prices (a claim often made in support of fast-growth fashion), but by offering these same people more control over institutions and technologies that affect their lives.

Notions of balance permeate ideas of slow culture, as they do of sustainability more broadly. For the economic historian Avner Offer, it requires us to, 'balance immediate desires against the interests of the future',[42] and is enacted by strategies of cognitive and social self-control he calls prudence. In Stuart Brand's vision of a more resilient human civilization described earlier (see Figure 7.1), balance again is reflected as respect for the novel, innovative, fluid present and long-term stability. Accordingly the challenge for slow fashion is to combine these strata in ways that foster personal capacities for commitment over time and to design pieces for rapid imaginative change and symbolic (fashion) expression as well as those designed for long-term service: 'For satisfaction balance is the key: . . . not too much, not too little. . . . Too little stimulation gives rise to the desire for novelty; too much and habituation sets in, and swamps the capacity of drives to deliver satisfaction'.[43] Balance is, however, far from easy to achieve and is subject to countervailing forces: 'Knowledge of how to speed the availability of reward has outdistanced knowledge about how to delay it. Recent developments in our technology have served our short-term interests better than our long-term interests'.[44] Yet it is here in the garnering of just the right amount of stimulation, in learning the conventions of how to pace consumption and the techniques, knowledge and practice of combining fast with slow that we will begin to engage with a process of human flourishing and sustainability.

Table 7.1 *Characteristics of ecosystems in different stages of evolution*[46]

Developing stages (fast species)	Mature stages (slow species)
Small body size	Large body size
Low species diversity	High species diversity
Short, simple lifecycle	Long, complex lifecycle
Production - quantity	Production - quality
Pattern diversity - simple	Pattern diversity - complex
Stability/resilience - poor	Stability/resilience - good

Nature offers valuable insight into designing balanced, prudent and respectful systems. Janine Benyus in her book *Biomimicry*[45] provides a series of descriptors of ecosystems in both their developing stages (where fast proliferating species predominate) and mature stages (where slow species prevail) (see Table 7.1). This provides clues as to how nature has evolved to balance long- and short-term interests as part of the process of ecological succession. Fast species tend to be small, simple and quick to breakdown. Slow species are complex, robust and long lasting. Designing with a full awareness of these differences and their broader implications may help evoke a more sustainability-focused approach to producing and using fashion and textiles.

The Lifetimes project

The idea of prudent, satisfying 'slow' fashion tied to rhythms of use was perhaps first developed in the *Lifetimes* project.[47] Lifetimes explored the potential for designing garments sensitive to users and notions of time. Its aim was to develop a more sustainability-focused and complex model of fashion design, where account was taken of use patterns, fashion levels and how long garments last. This involved finding ways to extend value of some pieces while simultaneously looking to find ways to express fashion, change and communication with minimal consumption (by looking to new types of materials, new cycles of use and service opportunities). Critical to the project was the notion of balance. Just as in ecosystems where fast change and renewal is complemented by slowness and stability, balance would also need to be achieved in the speed of consumption of fabrics and garments. Otherwise there would be no net reduction in consumption.

The project's outcome was a series of design scenarios visualizing alternative rhythms of consumption, dictated by people who use clothes, rather than the fashion system. The scenarios of fast and slow fashion were concerned with saving resources while simultaneously providing for people's symbolic, social and material fashion needs. By designing garments with fast and slow rhythms of use, transience and durability can both be celebrated but within a holistic value system concerned with efficiency and well-being. For each of four garments, data was gathered about their resource consumption and patterns of use, through user diaries and wardrobe inventories. This informed the building of scenarios whose aim was to inspire the design of new more user- and resource-sensitive garments. The four garments were: a party top, basic underwear, utility trousers and a plain coat. They were chosen because they reflect short- and long-life pieces, a variety of launder-

ing profiles, and because they meet needs in a range of ways. A description of these scenarios follows and concludes this chapter with multifarious, highly contingent, user-specific responses to challenges of sustainability in fashion. Arguably, speed is an ideal lens through which to both problematize and develop creative responses to sustainability; for it asks deep questions of entrenched and dominant ways of doing things and at the same time also provides inspiration for the development of work that is balanced and appropriate to needs now and of future generations – something widely seen as essential for well-being, or in the words of Amartya Sen, 'being well'.[48]

Party top

The party top is an impulse buy. Feeling good, buying something for a specific occasion and being 'in' are the primary motives for its purchase. The top's fashion level is high and it is worn a number of times for a short period and then relegated to the back of the wardrobe.

The assumption is that the top is made from polyester and because it's worn for such a limited time, and may never be washed, the production phase of the lifecycle has the highest impact. Key environmental impacts of the polyester party top include:

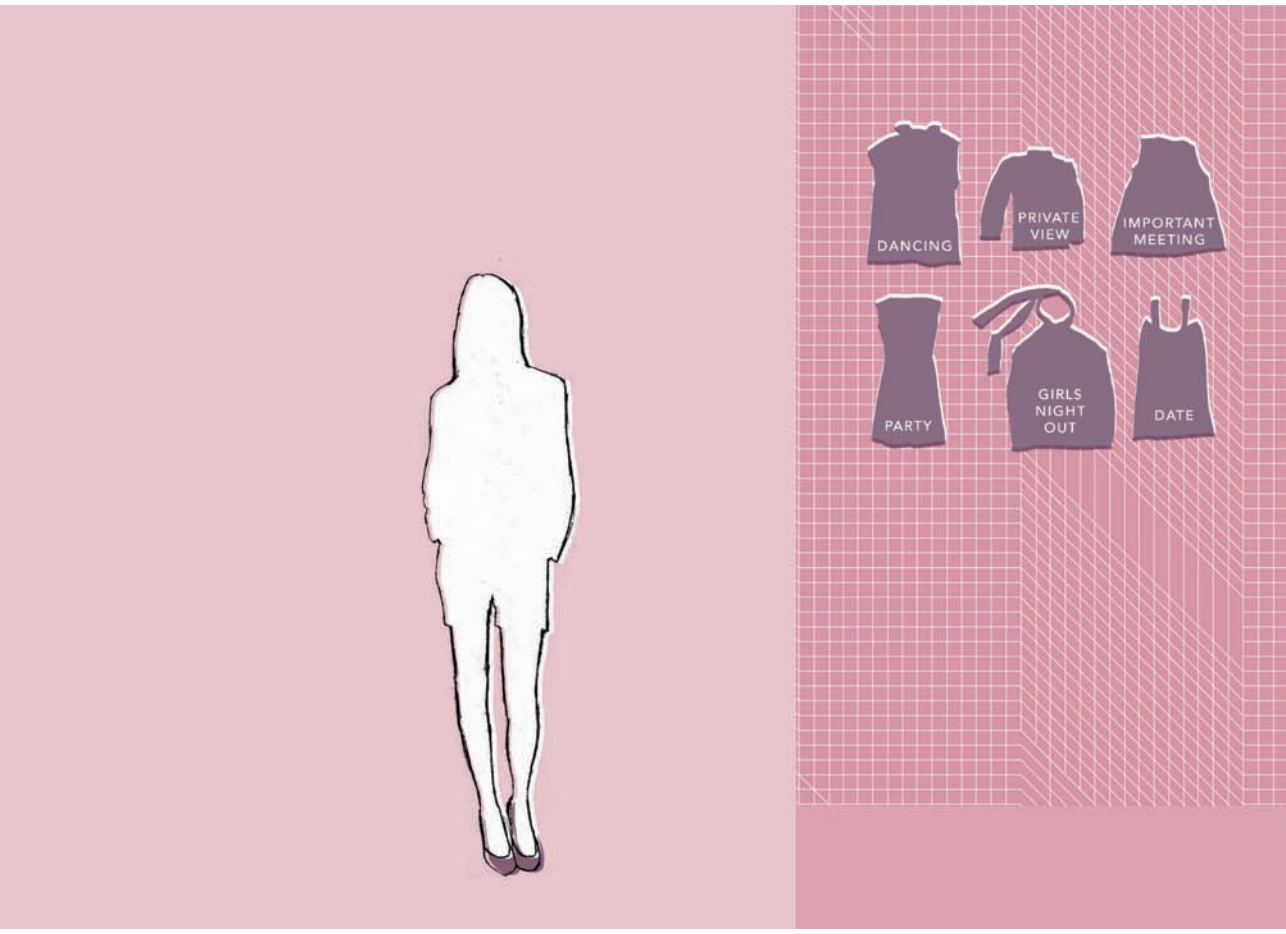
- Energy use in production of the polyester;
- Emissions to air and water from polyester production that have a medium to high potential of causing environmental damage if discharged untreated including: heavy metal cobalt; manganese salts; sodium bromide and titanium dioxide;
- The cost of disposal – synthetic fabrics like polyester are non-biodegradable and while they can be effectively recycled, most are currently sent to landfill.

Design scenario: One-night wonder

One night a glamour queen, another a fashion butterfly. Short-wear party tops have short lives, like the paper dresses of the 1960s and experimental wedding dresses of today. These garments have a low-impact production profile, fastidiously avoiding the use of virgin materials and keeping the amount of material in the garment to a minimum. They are either completely biodegradable or highly recyclable and are 'taken back' by producers from consumers. The cost of recycling or composting is included in the price and a deposit paid back to the customer when she returns the garment. New trends emerge around themes of temporary beauty and ornate yet transient garments.

In contrast to the ultra-disposable party top, the one-night wonder is also the ultra-covetable vintage piece and is perfect to rent, as it's desired for reasons of 'fashion' and 'occasion' and not for sentimental value. Just like celebrities borrow designer gowns or jewellery for film premieres, 'ordinary' people rent a desired garment for a specific time. The rental shop is organized like a high-street shop and takes influences from lifestyle concepts such as Colette, Paris or vintage shops, thus answering the growing trend for one-offs and individual choice.

▶ One night wonder. Design scenario from the Lifetimes project


DANCING
PRIVATE VIEW
IMPORTANT MEETING
PARTY
GIRLS NIGHT OUT
DATE

Basic underwear

Basic underwear has a low fashion level and is bought because it provides comfort at a good price. Therefore it works almost exclusively at the biological, material level, i.e. for warmth and protection. Underwear typically has a long, regular use and is laundered very frequently.

It is assumed that the underwear is made from a cotton/elastane mix, and as a result of its frequent washing the consumer care stage of the lifecycle has most impact. Key environmental impacts of the mixed fibre basic underwear include:

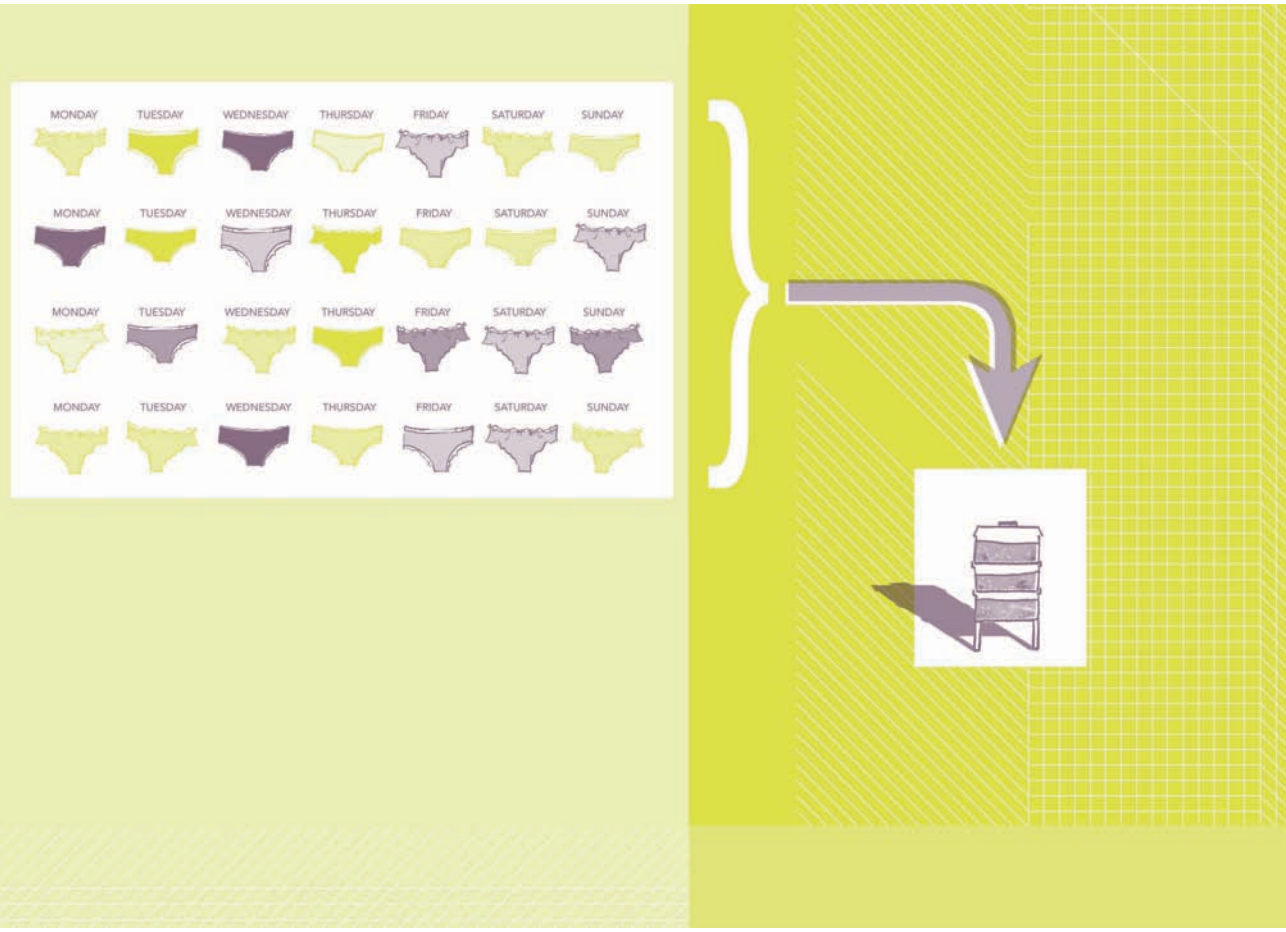
- The consumption of large amounts of energy, water and detergent in laundering;
- Emissions to air, water and land arising from laundering.

Design scenario: Fancy pants

Above all comfortable, basic underwear screens other garments from bodily dirt and smells and acts as the sacrificial layer that is washed often and changed daily. Underwear is either disposable or designed for low-impact laundering. Disposable knickers are not ugly NHS-surplus, but are soft, delicate and lacy, laser cut to precision. They are made from a low-impact fabric (such as a non-woven cellulose) and are coloured only with readily biodegradable pigments. They are supplied in bulk and come complete with composting instructions to rapidly transform your undergarments along with vegetable peelings into garden mulch.

Low-impact laundering for the non-disposables takes the form of advice on spot cleaning, 'freshening up', correct dosing of detergents and how long to leave clothes in the washing basket before washing to facilitate stain and smell removal. This advice comes neatly interwoven with the design of the underwear in the form of storage bags, ribbons and labels, one not complete without the other.

▶ Fancy pants. Design scenario from the Lifetimes project


MONDAY TUESDAY WEDNESDAY THURSDAY FRIDAY SATURDAY SUNDAY
MONDAY TUESDAY WEDNESDAY THURSDAY FRIDAY SATURDAY SUNDAY
MONDAY TUESDAY WEDNESDAY THURSDAY FRIDAY SATURDAY SUNDAY
MONDAY TUESDAY WEDNESDAY THURSDAY FRIDAY SATURDAY SUNDAY

Utility trousers

▶ Who wears the trousers? Design scenario from the Lifetimes project

Utility trousers occur in a variety of styles, most frequently in the form of combat trousers or denim jeans. Combats, like jeans, can be bought new or second-hand. Since many of these trousers are bought ready customized, it is the individual's ability to choose and style well, rather than the brand or price tag of the garment, that determines the fashion level.

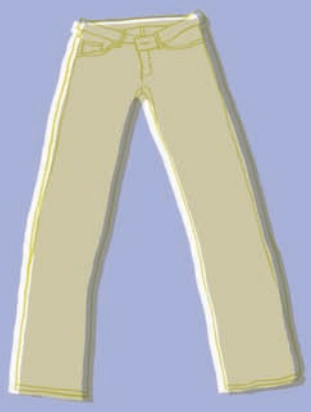
It is assumed that the utility trousers are made from cotton and are washed and dried regularly (although not every wearing). The use phase of the lifecycle generates substantial environmental impact, however, production costs are also important. Key environmental impacts of cotton utility trousers include:

- Impacts of industrial scale cotton growing including use of toxic chemicals (pesticides) and major water consumption;
- The consumption of large amounts of energy, water and detergent in laundering;
- Emissions to air, water and land arising from laundering.

Design scenario: Who wears the trousers?
New trousers are made from materials that age well and have the flexibility to adapt to the wearer over time. Rather than designing this garment to look 'worn' or 'distressed', this is up to the user. Over time, her own pain (they need to be broken in) along with marks and scuffs build up a web of affection and story around the trousers which means she wants to keep wearing them.

But if she wants to buy them ready 'worn', then she buys second hand. Several high-street brands such as H&M and Top Shop already offer second-hand clothes in-store and this would be rolled out across the high street. This drags the charity shop treasures out of smelly jumble sales and into mainstream stores to be mixed and matched more freely with new items. This is accompanied by a high street patching service that smartens, cleans up and extends the life of these 'friends'.

Stories are a big part of the trousers' past and future. They remind her of a night out in Berlin/eating chips on Brighton Pier. The story also promotes low-impact maintenance. A detailed, yet easy-to-follow set of instructions printed on deliciously tactile labels in the pockets remind you to wash on low temperatures and 'freshen up' in a steamy room.



Plain coat

▶ Great coat. Design scenario from the Lifetimes project

The plain coat is the archetypical slow garment; it is generally bought only after due thought and consideration (although to what degree is determined by its price). The motives behind its purchase are both material functionality and stylishness. Even those brands with a high fashion level tend to design coats for the medium to long term. The coat is used intensively for some periods of the year and is dry-cleaned once a season. It is stored carefully in between times.

The assumption is that the coat is made from 100 per cent wool and because it is never/rarely cleaned, the main environmental impact is in the production phase of the lifecycle. Key environmental impacts of a plain woollen coat include:

– Pesticides used on sheep which cause harm to human health and water courses both on the farm and in subsequent downstream processing;
– Effluents arising from wool scouring – which are significant in terms of their pollution potential to both water and land (in the form of wool grease sludge).

Design scenario: Great coat

The coat is produced in enduring virgin material with high-quality finishing, accessories and tailoring. Rather than resisting all signs of wear and tear, the fabric ages gracefully and fits like the proverbial glove. The coat has a definite yet flexible design and comes with spare buttons, thread and swatches of fabric for mending and an ongoing relationship with the designer/store to restyle or refit the coat. The fashion company offers new accessories according to trends, updating the coat through the seasons. Other slow coats are designed as modular systems where parts are acquired and discharged according to the customer's desire.

The coat comes with meticulous instructions of maintenance attached, well-designed labels and packaging, a history of its origin including who designed it, where and what the inspiration was and where it was made so as to help crystallize a life-long relationship between user and garment. Advice on how to rid the coat of 'pub smells' and how to keep it in shape, along with a storage bag, hanger and cedar block to deter moths, are designed into the coat.

Notes

1 Allwood, J.M., Laursen, S.E., Malvido de Rodriguez, C. and Bocken, N.M.P. (2006), *Well Dressed?*, Cambridge: University of Cambridge Institute of Manufacturing, p12.

2 Jackson, T. (2009), *Prosperity Without Growth*, London: Sustainable Development Commission, p5.

3 Hamilton, C. (2003), *Growth Fetish*, London: Pluto Press.

4 Stern, N. (2007), *The Stern Review: Economics of Climate Change*, Online http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/media/3/6/Chapter_1_The_Science_of_Climate_Change.pdf (accessed 31 March, 2010).

5 Shah, D. (2008), View, *Textile View Magazine*, 82, pp10–11.

6 Thorpe, A. (2007), *The Designer's Atlas to Sustainability*, Washington: Island Press, pp48–49.

7 Brand, S. (1999), *The Clock of the Long Now*, London: Phoenix.

8 Gracey, F. and Moon, D. (2012), *Valuing Our Clothes: The Evidence Base*, WRAP, Online http://www.wrap.org.uk/clothing (accessed 17 February 2013).

9 Cooper, T. (Ed.) (2010), *Longer Life Products*, Farnham: Gower.

10 Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. and Foley, J. (2009), Planetary Boundaries: Exploring the Safe Operating Space for Humanity, *Ecology and Society* 14(2), article 32, Online http://www.ecologyandsociety.org/vol14/iss2/art32/ (accessed 1 November 2011).

11 Mackenzie, D. (1997), *Green Design: Design for the Environment*, Second edition, London: Laurence King.

12 Paakkunainen, R. (1995), *Textiles and the Environment*, Eindhoven: European Design Centre.

13 Fletcher, K.T. (1999), *Environmental Improvement by Design: An Investigation of the UK Textile Industry*, PhD thesis, London: Chelsea College of Art & Design, The London Institute.

14 Thorpe, A. (2004), Time in Design, in E. van Hinte (Ed.) *Eternally Yours Time in Design: Product Value Sustenance*, Rotterdam: 010 Publishers, p236.

15 Honoré, C. (2004), *In Praise of Slow*, London: Orion.

16 Norman, D.A. (1998), *The Psychology of Everyday Things*, New York: Pantheon.

17 Keep and Share, Online http://www.keepandshare.co.uk/ (accessed 6 March 2012).

18 Barbour, Online http://www.barbour.com/ (accessed 2 August 2012).

19 Chapman, J. (2005), *Emotionally Durable Design: Objects, Experiences and Empathy*, London: Earthscan.

20 Chapman, J. (2009), Design for (Emotional) Durability, *Design Issues*, 24(4), p33.

21 Batterbee, K. and Mattelmäki, T. as cited in Chapman, J. (2010), Subject/Object Relationships and Emotionally Durable Design, in Cooper, Op. Cit., p64.

22 Fuad-Luke, A. (2010), Adjusting our Metabolism: Slowness and Nourishing Rituals of Delay in Anticipation of a Post-consumer Age, in Cooper, Op. Cit., p147.

23 van Hinte, E. (2004), *Eternally Yours: Time in Design*, Rotterdam: 010 Publishers, pp128–131.

24 Ibid.

25 Kulturservern, Online http://www.kulturservern.se/wronsov/italyanavlusu/italyan_BookletODA-transCS.pdf (accessed 2 August 2012).

26 Evans, S. and Cooper, T. (2010), Consumer Influences on Product Lifespans, in Cooper, Op. Cit., p334.

27 Ibid.,p334

28 *Textile Outlook International* (2009), Textiles and Clothing: Opportunities for Recycling, 139, June, p100.

29 Chapman, J. (2010), Subject/Object Relationships and Emotionally Durable Design, in Cooper, Op. Cit., p65.

30 Park, M. (2010), Defying Obsolescence, in Cooper, Op. Cit., p81.

31 Evans and Cooper, Op. Cit., p321.

32 Mackenzie, D., Cooper, T. and Garnett, K. (2010), Can Durability Provide a Strong Marketing Platform? in Cooper, Op. Cit., p307.

33 Stahel, W. (2010), Durability, Function and Performance, in Cooper, Op. Cit., p175.

34 Adapted from Ibid., pES–8.

35 Franklin Associates (1993), *Resource and Environmental Profile Analysis of a Manufactured Apparel Product: Woman's Knit Polyester Blouse*, Washington DC: American Fiber Manufacturers Association.

36 *EcoTextile News*, (2011), Longevity: Tackling the Carbon Crisis, 44, pp66–68.

37 Thackara, J. (2005), *In the Bubble*, Cambridge, Massachusetts: The MIT Press, p29.

38 Manzini, E. and Jégou, F. (2003), *Sustainable Everyday: Scenarios for Urban Life*, Milan: Edizioni Ambiente, p48.

39 Slow Food, Online http://www.slowfood.com/ (accessed 2 August 2012).

40 Fletcher, K. (2010), Slow Fashion: An Invitation for Systems Change, *Fashion Practice*, 2(2), pp259–266.

41 Ibid.

42 Offer, A. (2006), *The Challenge of Affluence,* Oxford: Oxford University Press, p2.

43 Ibid., p9.

44 Ainslie as cited in Offer, Op. Cit., p60.

45 Benyus, J. (1997), *Biomimicry*, New York: Quill.

46 Ibid., pp252–253.

47 Lifetimes, Online http://www.lifetimes.info (accessed 2 August 2012).

48 Sen, A. (1999), *Commodities and Capabilities*, New Delhi: Oxford University Press.

CHAPTER 8 User Maker

Today it seems that many of our fashion expectations are cut in the cloth of consumerism. The stories, language, images and garments of fashion are shaped by our past experiences of it and set by an ideology of 'more and cheaper' that has become both a necessity and aspiration in contemporary Western society. Understanding this relationship is central to a shift to a sustainability-focused fashion and textile sector. Many of the ideas and approaches explored in this book signal the start of this change. These ideas, which include slow fashion, designing with needs and development of local products among others, are types of design activism and relate less to design as a creator of things and more to design as a promoter of social change.

Action and change are of central importance to sustainability, as long-term environmental and social quality requires that we develop a new model of individual and social action that is different to the one we have today. The challenge of sustainability is to learn to live better, enriching the ties that bind us together as a society and regenerating environments while also consuming much less.

This chapter looks at another form of this design activism, participatory design (sometimes called metadesign or co-design) and the potential of designing together to foster a more connected and active engagement with fashion and textiles. This type of design involves itself in a different distribution of power and inclusion than we see in most mass-produced and mass-consumed fashion and textiles today. It is concerned with a more active and skilled role for users and a system of production that is more decentralized. Accordingly, participatory design is an unabashed challenge to the hegemony of high-street consumerist fashion and a stand against the dominance of elitist brands and the identical products on offer. Its aim is to help the values of sustainability – which include appropriateness, connectedness and engagement as well as the more strictly environmental values like resourcefulness – become more embedded in our ideas of material culture and to help change our everyday relationships with fashion and textiles.

Passive fashion

For most of us today, our everyday relationships with clothes are probably fairly lifeless and a little disappointing. This lack of engagement starts as we go shopping for clothes and continues as we wear these garments. Most fashion on offer in the high street is formulaic and gives consumers little choice. A survey of UK town centres found that almost half were virtually indistinguishable from each other, dominated by the same large chain stores that sell the same choice of products at all locations, giving the consumer the same experience – down to the sales assistants' outfits.[1] Formula fashion and formula consumer experiences may be 'easy' to manufacture for brands and retailers, but their effect is typically to mollify consumers and limit expectations. Formula fashion stifles the growth of alternatives, pushing down prices and making it uneconomic for small makers to compete in the market. The result is to further diminish choice. As a chain store replaces an independent store, distinctive products embodying local difference, flavour and fit are erased in the pursuit of standardized easy- and cheap-to-manufacture uniformity. While mass manufacturing and cheap high-street stores have provided us with more products to choose from, these choices are more

restricted – ask anyone who is different to the 'standard' body shape about the difficulty of finding clothes to fit. The products on sale on the high street are becoming homogenous and this lack of choice erodes our individuality and dulls our imagination, limiting our confidence about what clothes can be.

Not only does the homogeneity of fashion on offer in the high street have a pacifying effect on consumers, suppressing expectations, but the products themselves are presented as complete or 'closed' with an almost untouchable or sacrosanct status. The effect is to dissuade us acting as if we properly own them. It makes us wary of cutting off a collar, ripping out a lining or tucking a waistband. Closed products are one-way information flows from designer to consumer. Users 'follow' the trends prescribed by the industry elite and become increasingly distanced from the creative practices surrounding their clothes. This severing of the tie between users and fashion skills marks a conspicuous cultural shift. As recently as two generations ago and for centuries before that, textiles and garments were regularly made and maintained by those who wore and used them, yet few people have those same skills today. Ready-made garments appear to offer us the promise of something better than we could make ourselves. Although when we go down the route of buying into this perceived perfection, we end up forgoing an opportunity to learn how to make things and become better skilled.[2] As deskilled individuals, we play into the hands of consumerist fashion. The fact that consumers can't do-it-themselves reinforces the fashion system's current power structures and boosts the status of those at the top because it resists input from outside. Further the industry controls and 'professionalizes' the practice of designing and making clothes resulting in consumers having little idea how, from what and by whom these goods are made. Instead, a myth is created of a 'genius' designer, who synthesizes trends, concepts and fabric into an inviolable piece. The result is deskilled and ever more inactive individuals, who feel both unrepresented by the fashion system and unable to do anything about it. The system, and the clothes that represent it, appears to undermine our self-esteem and yet we lack the knowledge and confidence to change this ourselves. From this position of passivity the only choice available to us seems to consume.

New model of action that deposes passivity and indifference, not fashion

Participatory design reflects a changed set of power relations associated with fashion; a rebalancing of ambitions about who holds power and influence

in the sector and the option to produce garments by different means. Such a shift is implicit in a shift from an agenda of quantity (i.e. more and more cheaply) to one of quality that is central to sustainability. This shift underpins many of the ideas explored in this book, such as the move from wants to needs (Chapter 5), from global to local (Chapter 6), from fast to slow (Chapter 7) and now in this chapter, from consuming and having to making and being. This quality-based agenda promotes a new model of action that recognizes the importance of fashion to our culture but disassociates it from the disengaged indifference that is frequently induced by consumerist fashion. It is also concerned with the process of designing and making as a route to satisfying fundamental human needs – a significant step towards a deeper, more involved human culture.

▶ Hand-stitched recycled quilt by Alabama Chanin

These ideas are not new. In the 1970s, the cultural critic Ivan Illich wrote:

> I believe that a desirable future depends on our deliberately choosing a life of action over a life of consumption, on our engendering a lifestyle which will enable us to be spontaneous, independent, yet related to each other, rather than maintaining a lifestyle which only allows to make and unmake, produce and consume – a style of life which is merely a way station on the road to the depletion and pollution of the environment. The future depends more upon our choice of institutions which support a life of action than on our developing new ideologies and technologies.[3]

Illich's ideas of a 'life of action' have major and multiple implications for sustainability and the relationships people have with their fashion and textiles today. They recast people in roles other than as just consumers but also as competent individuals who are potential actors in the provisioning of their clothes or suppliers of skills and resources enabling them to create as well as consume.

The idea of a life of action found form in Alvin Toffler's 'prosumer'[4] (a portmanteau of producer and consumer), again in the 1970s, and sought to challenge the consumer society's division of the world into either companies/manufacturers or consumers; the effect, in the fashion sector, of questioning the simplistic and market-driven partition that relegated non-commercial activity, such as the practice of using garments in creative and satisfying ways, to the fringes of fashion activity far away from glossy fashion titles and high-street brands. Demos, a UK think tank, coined the term Pro-Am[5] (Professional Amateur) to describe this group of creative activists, who it sees as having an increasingly important role in our society and economy. These enthusiastic amateurs, pursuing activities to professional standards, have substantial


under their feet and

knowledge and skills that have been developed through experience and over time. Demos calls this 'cultural capital', suggesting that this knowledge (which cannot be bought) can improve our satisfaction with material consumption because when we are more confident about an activity we gain more pleasure from it. One study[6] that looked at wearers' favourite clothes seems to confirm this. It found that when people list their favourite clothes, handmade items were highly represented. It is suggested that having some control over garments, either in a practical way through making, or more conceptually through influencing the design, brings people pleasure.

Pro-Ams are thought to benefit in other ways from being active and creative. They have an improved sense of belonging which flows from being part of a creative community, where they collaborate, share ideas, learn from and teach each other; and a strong sense of self-worth which makes them more resilient as people. These dedicated amateurs also play an important role in innovation particularly in emerging fields (like say, design for sustainability in fashion and textiles) that are too marginal to attract the interest of companies. They can, for example, pursue new ideas even when it appears there is no money to be made from them – and so aren't of interest to industry. Yet developing these ideas can eventually influence the way in which an industry operates, or test out how new, sustainability-creating products will actually be used in practice. Pro-Am networks seem to offer the potential of a complementary mode of production for fashion that could facilitate a sustainability agenda based on local production. It could suit the needs of today's fashion designers as well as their global markets and at the same time use the considerable skills of individuals. This is a mode of production employed to great effect by Alabama Chanin[7] in the making of its exquisite hand-stitched products. These products enlist the craftsmanship of local artisans and strive to bring a contemporary context to age-old techniques.

Open source design

One of the best examples of Pro-Am-led innovation is the Linux open source software movement that was developed and continues to be driven by its unpaid and widely distributed user communities. Open source initiatives, many of which are made possible by the Internet, including blogs, Wikipedia and YouTube, are all built on the premise that people have skills and are willing to share them and can successfully collaborate on large-scale projects without being controlled by markets or management. In effect these initiatives put a stop to the one-way only stream of information that flows from companies to consumers and instead opens up new channels of

messaging, material (re)use and innovation. They are seen by some design-for-sustainability activists as at the heart of a revitalization of design in a more ethical age.[8] And by others as a new type of democracy relevant to fashion: 'We should not only receive but also broadcast, not only consume, but also produce. Every reader is a potential writer and the language shall not be controlled by the provider. Free speech has to be fought for even in the fashion system.'[9]

Open source offers the prospect of a more inclusive and participatory model for fashion and textiles. In open source people are deemed to be active and progress towards a collective goal. They share the work and share the benefits. A sense of network is also important – while they may be autonomous individuals, they are also part of a bigger project. The key questions for those embarking on open source projects in fashion and textiles are about the shape and direction of our shared goals; and about what it will take to make them happen. Inevitably the critique of sustainability, with its mandate to transform to underlying sustainability problems, would require deep questioning of influential underlying social structures, such as consumerism. John Ehrenfeld[10] has proposed one way to build understanding of such structures is by developing expertize and knowledge about design and production in order to help facilitate a shift from 'blind consumption' to 'reflective competence'. This promises the additional bonus of a heightened sense of satisfaction for those involved; to tap into the fulfilment experienced when we are actively engaged in, learning about or teaching something. Here we are drawn out of a passive state where our focus and goal tends to be 'having' a garment and into the more active states of being (engaged and creative), doing (making) and interacting (with each other). These active states have a requirement for an evolving set of knowledge and skills so that we don't become bored or frustrated. The aim is to enable us to engage in a process of enrichment that is chiefly concerned with skills, knowledge and experience and one where our focus is switched away from the accumulation of possessions to one where possessions, while still important, are used as tools to help us to become better skilled and to better meet our needs through internal means.

Significantly, open source fashion isn't led or monopolized by mega brands or retailers, but rather guided by widely distributed individuals; consumers, creators and designers. This is in contrast with some eco-efficiency-led approaches to design for sustainability, which are directed regularly by large corporations (see Chapter 2). Instead, it is an approach that flows from the small actions of creative individuals or communities and is characterized by being unscripted and improvizational. James Gustave Speth[11]

has described these activities as 'green jazz' and sees them as a key way to promote sustainability: jazz describes a world in which people harness situations and opportunities to find solutions and in the process create 'a complex market-led world of ad hoc experimentation'.[12] It involves partnerships, alliances and fluidity to meet civil demands. Fashion and music have always influenced each other and green jazz presents a new opportunity to this in a sustainability context. It would involve exploring new ground and improvising and experimenting in different ways with new groups in order to develop products and projects for the common good.

More than a trend

In the last two decades there has been a shift in attitude towards user engagement, perhaps mirroring a larger discussion about social aspects of design and the influence of the Internet in affecting communication and access to people and products.[13] In fashion, this has led to a number of different pieces exploring user engagement ranging from underwear sold with fabric pens to personalize intimate items; to pieces like the Muji Freecut raincoat, where the user is encouraged to cut along preprinted lines on the sleeves, body and hood of the unisize coat to improve fit. While these products reflect a different relationship with users, they stop short of challenging the top-down hierarchy of fashion, instead using the prospect of user engagement to amuse the user and perhaps improve details of fit without affecting design concepts or supply chains. By contrast, participatory design involves a shift in emphasis away from control; a change in the distribution of power, where systems of production and ideas about design, manufacture, work and outcomes alter. The hope is that a broad distribution of fashion 'power' would foster skills, pieces, relationships and experiences that allow us become better engaged with ourselves, each other and the material world, what has been called, 'human Being'.[14]

Participatory design and designers

Participatory design is built on the idea that those who ultimately use a product are entitled to have a voice in determining how it is designed; and that the quality of design increases if the stakeholders are included in the design process. The implication here is that all those who use products are potential designers and that design is no longer just the work of specialists. Tim Brown sees such would-be designers as calling upon 'design thinking' (the ability to be intuitive, recognize patterns, construct ideas with emotional

as well as functional meaning, express ourselves in media other than words[15]), rather than necessarily formal training or education in design. Instead, users (employing design thinking) and designers themselves learn and create together. Designers still play a strategic role in the process, acting as a catalyst for product development, but they no longer exclusively control form, function or use.[16] This is a substantial change for many designers as user involvement with the design process or extended user engagement with the product is rarely part of the brief. If it happens at all, it tends to be something that happens in spite of the will of the designer, rather than because of it. When design is no longer about surface styling and more about promoting action, its aim is to increase the potential of the user and its focus becomes social change. The wearer is no longer a passive audience, but rather a co-creator and partner.

Otto von Busch describes this new role for designers as 'a street level collaborative practical facilitator and creative teaser'.[17] The role of the creative teaser is to orchestrate change by creating the opportunities for people to work collaboratively. This role is seen to be more complex than the traditional design role, dealing with more and different variables and uncertainties and involves intense negotiation, steering a course between open conversations between stakeholders and the need to take practical action. It is also unpredictable, something that is an implicit part of working with cooperative processes. The garments or products produced may also look very different to those designed today. It is likely that they won't conform to visual norms, and perhaps appear 'clunky' and confusing; although of course, they may be nicer too.

As discussed in Chapter 5, Suzy Gablik in her classic text, *The Reenchantment of Art,*[18] describes the different visual agenda associated with social and ecological models of creation as compared with those directed by the logic of economics and growth. She describes the latter as 'the dominator model of aesthetics' associated with 'authority, mastery, invulnerability and a strong association of ego- boundaries'. She argues forcefully for this to give way to the 'partnership model' in which 'relationships are central and nothing stands alone in its own power or exists in isolation, independent of the larger framework or process in which it exists'.[19] The different aesthetic which emerges from participatory processes can lead to the development of pieces easy to reject by the mainstream because cultural conditions create desire for the current set-up and alternatives from outside the status quo appear inferior, impractical and unattractive. Against the current context of consumerist fashion, alternatives are often seen not to cut it, to be the fashion 'booby prize'.[20] Yet the relationship model of action can already

be seen as supporting a more participative process in other sectors. John Thackera, for example, describes an approach to medical care where the doctor and patient form a therapeutic alliance to promote health and prevent illness.[21] Here the relationship is proactive, shifting away from our typical reactive experience of health care where individuals come together only when one is already ailing and needs the advice and medicine of the other. Participatory design in fashion and textiles is concerned with a similar 'therapeutic alliance' between designer and user and is concerned with developing pieces and conditions for their use that promote the Aristotelian idea of *eudaimonia*, that is the actualization of human potential or flourishing, so central to sustainability.

It seems essential that in order to foster participatory design, the process of design thinking and making itself have to become more understandable, in order that we humanize processes and encourage collective intelligence. Here we act not only on a practical, physical level, cutting and sewing fibres and garments but also politically, ecologically, socially and even economically. A more transparent process has, for example, allowed the Linux programmers to become a key economic and political force in the world of computer operating systems, so much so that Linux is a major challenger to Microsoft. The same can be said for websites like YouTube that have bypassed the traditional routes of music, film and video production by providing an opportunity to self-publish creative work, so challenging the dominance of traditional forms of broadcast media like television and radio. In the world of fashion, websites like US-based *Betabrand*[22] are now crowdsourcing and crowdfunding pieces into existence, presenting would-be users with choices about which pieces will be put into production or invested in and in the process wrestling back some of the power over what is available to be worn from select groups of buyers, brands and retailers.

Design academic Stuart Walker has suggested that in order to make user involvement practical for people it must be both low tech and inexpensive.[23] Indeed this provides no barrier in fashion and textiles as most user involvement necessitates hand work with needle, thread and scissors or at the most high tech, a domestic sewing machine. While the goal of participatory design is to devolve the role of the 'genius' creator and promote action and participation in users, a key spin-off of these design processes may be that in a small, widely dispersed way these may lead to a reduction in what we buy and discard. For they make use of the materials that are to hand, promoting reuse in unplanned ways. Not only that but anecdotal evidence suggests that when people begin to appreciate the level of skill and massive investment of time involved in making a piece, it is valued more highly.[24]

The remainder of this chapter is dedicated to a small selection of examples of participatory design in fashion and textiles. In some of these examples, their aim is to devolve the role of creator. For others, user engagement is used as a route to producing more customized and unique products. For others still, user interaction is designed-in as the only way to produce a fully functioning and complete item.

Reform

In the Reform project,[25] the fashion designer, activist and researcher Otto von Busch freely distributes a series of DIY methods for remaking new pieces from old garments. He describes them as 'cook books' and produces collections of methods (not collections of garments) where the aim is to teach basic skills to liberate the 'chef' from the buying of ready-made pre-packaged items – which is the category in which von Busch places most high-street fashion in today. For each method a photographic step-by-step process is provided, as is a list of items needed to make the transformation. Reform's aim is to elevate cutting, sewing and making into micro-political acts that subvert current power structures in the fashion sector and are 'an insurrection against a state of (consumer) resignation'.[26] These acts are seen as a way for

▼ High bag pants by Wronsov a.k.a. Otto von Busch

◀ Short sleeve suit, vest suit and oblique collar shirt by Wronsov a.k.a. Otto von Busch

users to intrude into the closed world of fashion production, but still tap into the global fashion system and use its magical and culturally rich symbolism as a tool for wider expression and participation. von Busch is clear that the act of reform is political in nature and describes the reforming of clothes as a way to reprogramme these garments' meaning when their fashionable image has gone 'dry' and then insert them back into the fashion system, 'acting in reverse consumerism'.

The Reform methods form part of von Busch's extensive work in this area, the effects of which he sees in broad terms:

> They reawaken a spirit by lowering the threshold to own activity and give immediate response in social situations. They give voice to the silent by breaking the pacifying system of consumption. They build self-reliance by teaching basic skills and improving an understanding of reform. They mobilize resources by using recycled material often with personal connection. They make micro plans by creating other forms of social organization.[27]

Do shirt

The do shirt[28] is one of a range of products developed in collaboration between do and Droog design, called dosurf. The collaboration's aim was to promote a more dissipated approach to production that encourages users to shape their own products. The do shirt was designed expressly for user interaction; the T-shirt can't be worn until the owner has played their part. The do shirt is huge – ten times too big – but the claim is that this makes it ten times more useful. The T-shirt comes with a booklet of do shirt sculptures plus an invitation to contribute to the do shirt exhibition. The product only comes alive when the user adds his/her own interpretation and because it is hard to wear the T-shirt in the same way twice, each time the garment is worn it is in effect an unique piece and far beyond the control of the designer.

Updatable

Fashion clothes capture a moment in time and are as quickly forgotten. But what if that moment was not one but many moments, a process of transformation? What if that process required you to reach into the sewing kit and update that garment yourself? The Updatable T-shirt was developed as part of the 5 Ways research project and involved users making a series of transformations to a T-shirt.[29] Updatable was concerned about a switch in emphasis:

◀ do shirt by do/KesselsKramer

from one garment to many garments; from passive consumers to active users; from a single snapshot in time to an ongoing movie. This project's aim was to build skills and confidence and to promote a greater understanding of the many small processes at work in creating a garment and encourage people to 'do-it-yourself'. Layered on top of this capability-inducing agenda was a desire to reduce material consumption by cutting, stitching and styling a piece. The project involved design ideas, methods and props sent through the post to a small group of users, who then interpreted the instructions and produced a singularly stylish piece that they documented and wore over the next months. What resulted was a widely eclectic range of garments that emerged out of a unique collaboration based on change.

The ground between fashion and textiles and participatory design processes, that is, fabrics and garments designed and made *with* rather than *for* people, has over the last ten years become far better understood but is still potentially abundant, perhaps because it is complex ground in which to affect change. Yet with each new wave of interest in sustainability comes a deeper understanding of the issues associated with fashion and textiles, making it likely that participatory design and individual and social action will define an important component of sustainability activity in the sector into the future.

▼ Updatable T-shirt from the 5 Ways Project

Notes

1 New Economics Foundation (2005), *Clone Town Britain*, Online http://www.neweconomics.org/sites/neweconomics.org/files/Clone_Town_Britain_1.pdf (Accessed 12 September 2012).

2 von Busch, O. (2008), FASHION-able: Hactivism and Engaged Fashion Design, PhD thesis, Gothenburg: University of Gothenburg.

3 Illich, I. (1973), *Deschooling Society*, Harmondsworth: Penguin, p57.

4 Toffler, A. (1970), *Future Shock*, New York City: Random House.

5 Leadbetter, C. and Miller, P. (2004), *The Pro-Am Revolution*, London: Demos.

6 Raunio, A-M. (1995), Favourite Clothes – A Look at Individuals Experience of Clothing, in U. Suojanen (Ed.), *Clothing and its Social, Psychological, Cultural and Environmental Aspects.* Proceedings of a symposium on textiles, clothing and craft design, Helsinki, 18–20 May 1995, pp179–194.

7 Alabama Chanin, Online http://www.alabamachanin.com/ (accessed 12 September 2012).

8 See for example: Thorpe, A. (2007), *The Designers Atlas of Sustainability*, Washington: Island Press; Fuad-Luke, A. (2007), Redefining the Purpose of (Sustainable) Design: Enter the Design Enablers, Catalysts in Co-design, in J. Champan and N. Gant (Eds), *Designers, Visionaries and Other Stories*, London: Earthscan.

9 von Busch, O. (2005), *Re-forming Appearance: Subversive Strategies in the Fashion System – Reflections on Complementary Modes of Production*, Online http://www.selfpassage.org (accessed 12 September 2012), p3.

10 Ehrenfeld, J R. (2004), Searching for Sustainability: No Quick Fix, *Reflections*, 5(8), pp1–13.

11 Speth, J.G. (2005), *Red Sky at Morning: America and the Crisis of the Global Environment*, New Haven: Yale University.

12 Infed, Online http://www.infed.org/community/jazz.htm (accessed 12 September 2012).

13 Fuad-Luke, A. (2009), *Design Activism*, London: Earthscan.

14 Ehrenfeld, J. (2008), *Sustainability by Design*, New Haven: Yale, p126.

15 Brown, T. (2009), *Change by Design*, New York: Harper Collins, p4.

16 Fuad-Luke (2007), Op. Cit., p59.

17 von Busch (2005), Op. Cit., p10.

18 Gablik, S, (1991), *The Reenchantment of Art*, London: Thames and Hudson, p62.

19 Ibid. p62.

20 Williams, J. (2010), Bikes, Sticks, Carrots, in M. Maniates and J.M. Meyer (Eds.), *The Environmental Politics of Sacrifice*, Cambridge MA: MIT Press, p263.

21 Thackara, J. (2005), *In the Bubble*, Cambridge, Massachusetts: The MIT Press, p119.

22 Betabrand, Online http://www.betabrand.com/ (accessed 12 September 2012).

23 Walker, S. (2007), Design Redux, in J. Champan and N. Gant (Eds), *Designers, Visionaries and Other Stories*, London: Earthscan, p83.

24 Local Wisdom, Online http://www.localwisdom.info/gallery/view/229/investment-of-time (accessed 17 February 2013).

25 von Busch (2008), Op. Cit.

26 von Busch (2005), Op. Cit.

27 von Busch (2005), Op. Cit., p16.

28 Dosurf, Online http://dosurf.com/ (accessed 12 September 2012).

29 5Ways, Online http://www.5ways.info/docs/projects/update/projects.htm (accessed 12 September 2012).

Conclusions

This book sketches out an involved model of relationships and resource flows that reflects the burgeoning ecological, social, creative and economic potential of the fashion and textile sector. Many of the themes explored are multi-part, multi-scale and draw upon multiple intelligences. In some ways they go against the grain of popular attempts to make sense of what is happening in society in general and the fashion and textile sector in particular where, despite our groups and cultural conditions having become increasingly complex, our theories of society – whether social or economic – have grown more simplistic.[1] In contrast, what emerges through these pages are ideas, stories and practices about and for a complex and unpredictable future for the fashion and textiles sector. The Design Journeys set out in this

book along with their complex information, varying time frames and contexts are early exercises in resilience for the fashion and textile sector. They are tentative steps in developing the wherewithal to cope with uncertainty, deal with risk and befriend the undetermined ambiguities of our world. They are directed to not just develop what we know, but to also finesse how we respond. These are the skills and functionings of both sustainability and the future, two sides of the same coin.

A fundamental and explicit theme of the book is an exploration of the reframing and rebalancing of cultural conditions and industrial models including consumerist materialism. Indeed such critique is essential both to the book's argument and pursuit of opportunity and innovation. Yet elsewhere in the field there has been, and indeed continues to be, great timidity in directly confronting consumerism in the sustainability debate in fashion and textiles. Perhaps this is due to the way in which fashion and textiles have become so bound up in many of our minds with consumerism, such that we now struggle to 'think past' our current experiences and imagine fabric and garment in other configurations, with other agendas and possibilities. Certainly fashion has come to represent much of that which is destructive and morally unconscionable about modern, globalized mass production and consumption. Indeed fashion is condemned for its commerciality; for the trivial temporariness of perpetually changing styles or trends as a way to influence consumer spending; and a consumer habit of mind attuned to understanding fashion only as 'the new', to looking or watching (rather than say, active making) and instant gratification through consumption. Yet, while the problems and their effects are well rehearsed, what is persistently overlooked is a sustainability response that deals with the underlying forces that direct activity exclusively down consumerist routes. These are not forces unique to the fashion and textile sector. On the contrary, they suffuse all parts and products of consumerist societies, and perhaps it is their pervasiveness and dominance that makes them so difficult to identify and change. They need to be understood within a broader framework of economic imperatives, business practices and culture; to be engaged with for what they are: business models, marketing tools and social behaviours tied to a specific set of economic priorities. It is certainly the case that these models, tools and associated behaviours have become synonymous with the fashion sector; but the source of unease with them is found at a deeper, more systemic level than an industry designing and manufacturing fabrics and garments. It lies within the larger systems of economics, culture and society and the commercial agendas, political priorities and technical mechanisms of our world. It is with reference to these larger systems that this book has attempted to direct attention to alterna-

tive ways of organizing fashion provision and consumption that can both be imagined and that are already emerging around us. It is our ongoing task to try to make sense of them. Whether we can or not depends on the openness and rigorousness of our imagination.

Without imagination we will stay 'locked in' to the current fashion model's world view and conception of the way things are done. Just as the gauge of train tracks limits ideas about the sorts of train that can operate on them, prevailing ways of thinking lock us into particular ideas about the shape and practice of the fashion sector. While the effects of inefficient fashion production and consumption are often portrayed as undesirable, solutions tend to be couched as extensions and/or modifications of these undesirable practices and the status quo. 'Lock in' confers apparent immutability to current industrial structures, putting paid to scrutiny of the structures themselves and whether they actually lead to social and ecological richness and satisfaction. Sustainability, rather being allowed to seed a radical new approach, gets passed through the sieve of understanding and hierarchy of priorities and goals prevalent in today's industry and becomes absorbed not as high-level systems change (where the rules and goals of the industry are transformed) but as a marketing angle or alternative distribution channel in the current model, a tweaked version of today's practices. Seen against an unchanged economic model in the fashion sector, sustainability jars and makes little sense, for its goals and ambition are broader than can be measured by the narrow metric of sales figures, today's preferred measure of success. Here 'sustainability' is reduced to the status of paradox in fashion and textiles. It becomes transmogrified into a trend and because of the elaborate relationship between trends, commerce and fashion, sustainability becomes seen as a tool for increased material throughput and continual economic growth.

This book has sought to set out an alternative approach, rooting the provision and experience of fashion and textiles in ideas, aspirations and habits of mind of sustainability. The preface and the introduction describe alternative frames, values and points of departure for engaging with fashion and textiles within a context of sustainability, as opposed to looking for sustainability opportunities within a context of existing industrial activity; and the following chapters have set out to explore and illustrate what this could be. The resulting picture shows how an affirmative, reflective and practical approach based on design thinking might be more engaged with the process of sustainability and fully consider the deep nature of the challenge for the fashion and textiles sector to create opportunity and optimism, despite uncertainty. In drawing this book to a close I would like to briefly explore four themes that set out some of the future challenges for fashion and textiles.

Explore deeper ideational forces

The areas of the fashion, textiles and sustainability space that are best understood and receive most attention are material phenomena. This is reflected directly in the firm ongoing interest in cultivation, processing and selection of fibre and fabric as a chief route to sustainability innovation (see Chapter 1). These material dimensions are also evidenced in environmental themes that influence contemporary debate in the sector, ranging from climate change, triggered in recent years by public concern over extremes of drought and flood, heat and cold, so-called 'weird weather'; to chemicals use as instigated by Greenpeace's Detox campaign. In the near future these themes will be supplemented and even eclipsed for the fashion and textile sector by a global crisis over access to and use of water, which will become the defining challenge for fashion and textiles in the next 50 years. Yet, while these issues are of critical importance, the challenge remains to explore sustainability in fashion and textiles not just as a *material* phenomenon but to also recognize the deeper *ideational* forces at work.[2] That is, to cast environmental crises and our technical, material responses to them – which range from application of technology, economic approaches and ideas of political adjustment – within a broader moral framework and deeper systems of meaning. This will allow us to see and sense sustainability in fashion and textiles as a dynamic process of human actions, relationships and their associated material effects. The result is to value material and technical contributions and also to recognize that they will be most effective when supported by overarching moral principles that direct their actions to certain places. In Chapter 2 such a guiding force was introduced in the shape of systems thinking, and Part II of this book as a whole directs attention to the often overlooked underlying ideational forces that profoundly influence the habits of mind, discernments and societal forces that shape the sustainability potential of fashion and textiles.

Pixelate

Over the next years, a key challenge will be to break down or 'pixelate' generic views about fashion and textile practices into numerous interactions, experiences, design opportunities, commercial exchanges and ideas about what is valuable (see Chapter 6). The hegemony of power of industry and big production upholds a view of one economy, beyond our control; but multiple scales show that resources, production and consumption of fibre, fabric and garment are diverse ecologies that are within our influence. An attention to and awareness of scale helps change horizons and thoughts about what is possible and who can act; treading a course between social forces, industrial

structures, individual action and ecological integrity through connected and sliding scales and moving parts. It helps direct our actions in ways that are a corrective for standard, glib assessment of both problems and solutions; and builds an approach to fashion, textiles and sustainability that is granulated sufficiently to challenge mono-logical ideas about who holds power, invoking instead a sense of potential, the taking up of responsibility and the development of multiple ideas of fashion and textile provision and experience in a context of sustainability.

Value a broad spectrum of activity

As has been shown throughout this book, sustainability in fashion and textiles is not just about increasing efficiency or gathering additional data about transparent production chains; but rather about adding other values, measured differently. The ideas developed in Chapters 5 to 8 argue that sustainability is an invitation to create wealth and cultural capital in all sorts of ways, including outside of the industrial system as part of a journey to improve deeper, eudaimonic well-being. They invite the design of our own ideas of values, profit and sense of expression in fashion; to develop cultural conditions and appetites that prize a broad spectrum of fashion provision and experience, beyond ideas of fashion as a market-driven cycle of consumer desire and demand. Stepping beyond the consumerist fashion machine – the product of deep societal forces, aggregated individual practices and strong influence of commercial interests – and imagining a role for fashion which both acknowledges the value of material culture and the benefit of the consumer society to deliver change at speed is likely a key task for the sector going forward, particularly as new sets of business models are developed which work to disassociate profit from material consumption. The shape of these alternative models of activity are still in development. Some early insight into a broader spectrum of fashion provision and opportunity is offered by the Local Wisdom project[3] and its exploration of ideas and practices of the 'Craft of Use', the garment-related 'doings and sayings' that constitute satisfying and resourceful use and experience of fashion. Here, through sustained attention to tending and using garments as much as creating them, opportunity emerges for fashion to find broader representation in our lives.

Shared use

Sharing clothes saves resources if it means fewer pieces are bought. For garments to have multiple users, fit matters; but they also have to be shared with

◀ The story 'Colour Connections' from the Shared Use category of use practices in the Local Wisdom project

the right people. Sharing works when a bond and joint identity is reinforced by common use; when a memory is relived; and when access is gained not just to more and different pieces but also to the values, taste and sensibilities of the owner.

Colour connections

"This pink silk shirt was given to me by one of my closest friends who I've known since I was eleven . . . it's testament to a very long and very strong friendship. I think one of the things I like most about it is it's a bright, coral pink and the girl who gave it to me has a tendency to wear one colour head to toe . . . And so I think a little bit of her and her attitude to dressing has come through to me . . . It it's really beginning to show the signs of wear. It's got biro on it from where I wear it at work and then kind of a bit of suntan cream here and there from where I've worn it on holiday and also a big red wine stain which is where my flatmate wore it. It's beginning to show the marks of quite a few lives."

Experiment with design thinking

The pages of this text provide layer upon reinforcing layer of support for an approach to engaging with sustainability that champions design thinking, that is a set of skills that are iterative, affirmative, reflective, practical, visioning. Such thinking seems suited not just to the complex, multifaceted, unbounded shape of sustainability issues; but also to the responses that such challenges necessitate: the ability to work across disciplines, at the interface of different ideas and actors, the requirement to change entrenched habits of mind, to make metaphorical leaps to understand and view ideas in different ways. As has been said elsewhere in this book, design thinking is not just the preserve of professionally trained designers, but rather open to all who seek to alter courses of action into preferred ones. It is this way of thinking that offers to seed, with richness and diversity, the prospect for new and alternative sustainability-oriented journeys in fashion and textiles. These journeys will need to be embarked on without security of knowledge that things will work out. Yet paths are made by walking: it is as we trample the grass, ford the stream, climb a fence and take this same way and others often that we establish a route that others can follow. It is as we engage with the process of sustainability that sustainability prospers. And as we uncover and develop alternative ideas of provision and experience that fashion and textiles will flourish today and in the future.

Notes

1 Max-Neef, M. (1991), *Human Scale Development: Conception, Application and Further Reflections*, New York: Apex Press, p97.

2 Lifkin, K. (2010), The Sacred and the Profane in the Ecological Politics of Sacrifice, in M. Maniates and J.M. Meyer (Eds.), *The Environmental Politics of Sacrifice*, Cambridge MA: MIT, p118.

3 Local Wisdom, Online http://www.localwisdom.info (accessed 1 March 2013).

Image Credits

Chapter 1

Eco jeans in 100 per cent organic cotton with sustainable product components and production processes by Levi's
Image courtesy of Levi Strauss

White 100 per cent African cotton dress by Noir
Image courtesy of Noir. Photography: Marc Høm

Organic wool tweed by Isle of Mull Weavers
Image courtesy of Isle of Mull Weavers

Bette hemp dress by Enamore
Image courtesy of Enamore. Photography: Richard Bridge

Woven fabric in 100 per cent peace silk by Denise Bird Woven Textiles
Image courtesy of Denise Bird Woven Textiles and Shri Shradhey Ji Maharaj

T-shirt in 100 per cent Ingeo produced as part of the 'Genetic Modification' collection by Moral Fervor, inspired by the quandary surrounding GM technology
Image courtesy of Moral Fervor

Suit in lyocell by Linda Loudermilk
Image courtesy of Linda Loudermilk

Yarn made from 50 per cent recycled London textiles and 50 per cent pure new wool, by EcoAnnie
Image courtesy of Annie Sherburne. Photography: Annie Sherburne

Chapter 2

T-shirts in 100 per cent Fairtrade mark cotton by Marks and Spencer
Image courtesy of Marks and Spencer

ONE T-shirt made from 100 per cent Lesotho cotton by EDUN
Image courtesy of EDUN

Pillows produced by Armenian craftspeople supported by Aid to Artisans
Image courtesy of Aid to Artisans

MADE-BY button indicating supply chain transparency
Image courtesy of MADE-BY

Purple hooded sweatshirt by American Apparel
Image courtesy of American Apparel

Slip dress in 100 per cent silk by Dosa
Image courtesy of Dosa

Chapter 3

Modular garments designed for low laundering
Illustration by Lucy Jane Batchelor

No Wash top from the 5 Ways Project
Image courtesy of Kate Fletcher & Becky Earley. Photography: Tom Gidley

Stain dress by Lauren Montgomery Devenney
Image courtesy of Lauren Montgomery Devenney. Photography: Julianna Clark

Chapter 4

Windows blanket by LoooLo
Image courtesy of Joanna Notkin at LoooLo Textiles

Back2Back dress by Junky Styling
Image courtesy of Junky Styling. Photography: Ness Sherry

Reused yarn vest by Muji
Image courtesy of Muji

Synchilla Snap-T fleece by Patagonia made with 85 per cent recycled content, and completely recyclable through the Common Threads Recycling Programme
Image courtesy of Patagonia

Zero waste pattern cutting concept shirt to address wastage, by Andrew Hague. The basic shirt pattern is manipulated to fill the entire fabric, affecting the proportions of the new garment and its design
Image courtesy of Andrew Hague

Upholstery fabric in wool and ramie by Climatex Lifecycle
Image courtesy of ROHNER Textil AG

Chapter 5

Caress Dress produced as part of the 5 Ways Project
Image courtesy of Kate Fletcher & Becky Earley. Photography: Becky Earley

Organic cotton T-shirt and jeans by howies
Image courtesy of howies

Green contrasting stitching on organic cotton T-shirt by American Apparel
Image courtesy of American Apparel

Modular concept top formed by construction of hexagonal fabric pieces that can be removed and replaced when needed or completely deconstructed and rebuilt, by Ariel Bishop
Image courtesy of Ariel Bishop. Photography: Nick Schreiner

Chapter 6

Skull dress by Project Alabama
Image courtesy of Alabama Chanin. Photography: Natalie Chanin

Jacket made from 100 per cent hemp grown in England from fibre grown and processed by Bioregional
Image courtesy of Bioregional

Fly skirt in organic tweed, part of the Ardalanish Collection by Anja Hynynen for Isle of Mull Weavers
Image courtesy of Isle of Mull Weavers

Moth blanket by Joanna Notkin
Image courtesy of Joanna Notkin

JP Donleavy shrug, Spring/Summer 2005, 100 per cent cotton by Keep and Share
Image courtesy of Keep and Share. Photography: Meg Hodson

Chapter 7

Eugenia dress, Spring/Summer 2006, 100 per cent cotton by Keep and Share
Image courtesy of Keep and Share. Photography: Meg Hodson

Blue velour pleated furnishing fabric by Sigrid Smits
Fabric courtesy of Sigrid Smits. Photography: Jonathan Moore

Oversized labels and clothes rails in Itaylan Avlusu project swap 'shop' set up by Otto von Busch
Images by Otto von Busch from the Itaylan Avlusu project together with Oda-projesi

One night wonder. Design scenario from the Lifetimes project
Illustration by Lucy Jane Batchelor

Fancy pants. Design scenario from the Lifetimes project
Illustration by Lucy Jane Batchelor

Who wears the trousers? Design scenario from the Lifetimes project
Illustration by Lucy Jane Batchelor

Great coat. Design scenario from the Lifetimes project
Illustration by Lucy Jane Batchelor

Chapter 8

Hand-stitched recycled quilt by Alabama Chanin
Image courtesy of Alabama Chanin. Photography: Natalie Chanin

High bag pants by Wronsov a.k.a. Otto von Busch
Image courtesy of Otto von Busch. Photography: conjunction.se

Short sleeve suit, vest suit and oblique collar shirt by Wronsov a.k.a. Otto von Busch
Image courtesy of Otto von Busch. Photography: conjunction.se

do shirt by do/KesselsKramer
Image courtesy of do/KesselsKramer. Photography: Maurice Scheltens

Updatable T-shirt from the 5 Ways Project
Image courtesy of Kate Fletcher & Becky Earley. Photography: Becky Earley

The story 'Colour Connections' from the Shared Use category of use practices in the Local Wisdom project
Image courtesy of the Local Wisdom project. Photography: Kerry Dean.

Index

A
accessories 214
accountability 54
accreditation 27
acrylic 15, 18, 20–1, 63
Adidas 60
advertising 73, 82
aerial spraying 14
aesthetics 150–4, 167, 196–7, 229
affection 145–6, 148–9
affluence 143
Africa 32, 78, 117, 119
ageing process 194
agriculture 8–9, 13, 25, 27, 29–30, 32, 34
agrochemicals 15–16, 20, 32
Aid to Artisans 78–9
AIDS 78
Akin Tekstil 63
Alabama Chanin 169, 226
algae 13
alginate fibres 101
alternative fibres 26–43

American Apparel 80, 82, 156
American Fiber Manufacturers Association (AFMA) 24, 94
Anderson, R. 84
animal husbandry 14
animal-based fibres 12, 14–16, 132, 142
antimicrobial coatings 101–2
antimony 124, 133
appropriateness 194–6, 201–3, 222
aprons 156
Aral Sea 13
Ardalanish 176
Aristotle 149, 164, 230
Armenia 79
artefacts 147
Asia 69
Asia Floor Wage (AFW) 69
attachment 198–9
auditors 70
Australia 108
authenticity 174
AvestaPolarit 130

B

Bacillus thuringiensis (Bt) 29–30
bacteria 67
bags 178
bamboo 18–19, 41
Bangladesh 68–9, 80
Barbour 196
bast fibres 16, 34–5
bathrobes 133
Batterbee, K. 197
beech 18
Benyus, J. 165–6, 205
Berger, J. 150
bespoke production 118
best available techniques (BATs) 55
best clothes 128
best practice 16, 52, 56–8, 61, 65–8
Betabrand 230
Better Cotton Initiative (BCI) 30
biocides 56, 67, 102
biodegradability 9, 11–12, 40–1, 44, 56; ethics 58–9, 65; local/light design 180; reuse 114, 132–3; speed issues 203, 208, 210; use phase 98
biodiversity 13, 24
bioengineering 41
Biological Agricultural Systems in Cotton (BASIC) programme 29
biological cycles 132–3, 165
biomass 38
biomimicry 165–6
biopolymers 36–8
BioRegional 176
biotech industry 30, 41
blankets 114
bleaching 19, 38, 40–1, 57–9, 61, 82
blended fibres 67, 102, 118, 124, 133
blogs 113, 181, 226
blouses 92, 94–5, 133, 201–2
Bluesign 56
body scanners 172
Bodymetrics 172
Bono 78
borrowing garments 181–3, 185
Brand, S. 191–2, 205
Braungart, M. 132, 168
BRIC countries 167
Brick Lane project 178
bring systems 116
British Bangladeshi community 178
Brown, T. 228
business models 140, 143, 154, 159, 168; local/light design 172, 181, 185; participatory design 223–7; role 240, 243; speed issues 190, 203
buttons 156

C

calendering 67
California 29
Cambia T-shirts 180
Cambridge University 25, 184–5
Canada 16, 114, 178
capitalism 142
Carbon Trust 202
carbon-neutral fibres 11, 18
carcinogens 17, 37, 55, 59–60, 67, 124
cardigans 183

carding machines 122
Caress Dress 149
carpets 133, 184
cascades 114
case studies 3, 71, 201–2
cashmere 40–1
catwalks 150
celebration 193
cellulosic fibres 10–12, 18–20, 38, 63, 67, 210
Central Asia 13
chain stores 222
Chalayan, H. 198
Chanin, N. 169, 172
Chapman, J. 196, 199
charity shops 116, 120, 172, 212
checklists 166
chemicals 52, 55–6, 58–63, 65–7, 73; ethics 75, 79, 82; fashion/needs 141–2, 146; local/light design 176, 185; reuse 114, 132–3; role 242; speed issues 212; use phase 98, 101
child labour 70
childrenswear 128
China 34, 40, 44, 60, 119, 167
chlorine 19, 61
Chouinard, Y. 84
chronos 191
circles of trust 183
clean clothes 102–3, 107–8
Clean Clothes Campaign 70
clean production techniques 57
climate control 15
Climatex Lifecycle 132–3
clone products 192
closed-loop systems 132, 184, 223
clothes miles 174
co-design 222, 229
coatings 26, 58, 67, 101–3
coats 206, 214, 228
cochineal 65, 82
codes of conduct 54–5, 69, 71, 75
cold-water washing machines 97–8
collaboration 71, 127, 132, 181–3, 226, 229, 233, 235
collars 100, 120, 223
collection costs 128–9
collective bargaining 70
Comme des Garçons 156
commercial laundries 99
commodity markets 73
Common Threads Garment Recycling Programme 114, 128–9
community 154, 164–5, 168–9, 173, 176, 178
community laundries 92, 99
Companies Act 56
complex systems *see* systems-level improvements
composting 37, 114, 130, 132–3, 150, 208, 210
computer-aided design (CAD) 172
connectedness 172–3, 193, 222, 243, 245
constraints 72
consumer-care phase 24
consumption 3, 8–9, 11, 13, 16–17; ethics 55–6, 66, 72, 76, 82, 84, 88; fashion/needs 139–62; laundering 100; local/light design 165, 174, 181, 183–5; material types 20, 23–6, 40–1, 43–4; participatory design 224, 226–7, 233, 235; reuse 116, 119, 125–7, 134; role 155–9, 240–3; speed issues 189, 191, 193–4, 196, 198, 201–6, 210, 212; use phase 92, 95, 97
contracts 70, 76, 184, 198
Cooper, T. 193, 198
cooperatives 71, 80
corn-starch fibres 9, 12, 36–8, 133
Corporate Social Responsibility (CSR) 52, 54, 56, 73, 79
corporations 56, 70, 79, 181
cotton 8–15, 17, 20–1, 125, 205; alternatives 26–32; ethics 58–9, 63, 67, 73, 80; fashion/needs 156; laundering 99, 102; local/light design 167, 176, 183; material types 23–6, 34–6, 41, 44; reuse 122, 133; speed issues 190, 212; use phase 93, 95–6
Cotton Incorporated 25
Cotton Made in Africa (CmiA) 30
couture 169

Cradle to Cradle 130–3
craft skills 118, 120, 147, 155, 169; role 245; speed issues 194, 204, 206; user makers 224, 226–8, 231, 233, 235
craft of use 108–9, 144, 243
CRAiLAR process 16, 35, 176
crease resistance 60, 67
critical consumerism 156
crop rotation 26–7
crowdsourcing 230
cuffs 120
cultivated silk 36
cultivation/extraction phase 20–1
cultural capital 226, 243
cultural rhythm 191–3
cushions 114
custom services 173
customisation 172, 197, 212, 231
cut-loss 59
cut-make-trim (CMT) 68–9
cutch 65
cypermethrim 14

D

danger-cycling 124
Danyelle, J. 113
darning 120
deadlines 76
defoliants 14, 26
dematerialisation 179
Demos 224, 226
denim 108, 212
Department of the Environment 21
design 1–2, 173; activism 221–2; designer makers 71, 228–31, 245; open-source 226–8; participatory 228–31; speed issues 196–201; thinking 245; types 164–88
design for disassembly (DFD) 124–5
design for recycling (DFR) 124–5
design-for-sustainability studies 54
Designtex 132
desizing 57–9, 61
detachable collars 100
detergents 15, 36, 92, 96–8, 210
Detox 60, 75, 242
Devenney, L. M. 103
dew retting 16, 35
digital printing 66–7, 172, 181
digitization 172
dimethyl terephthalate 17
diminishing returns 143
dioxins 60
Directive on Waste from Electrical and Electronic Products (WEEE) 134
display 156
disposable garments 107, 202–3, 210
distinctiveness 173–4
diversity 7–50
DIY fashion 231
Do Shirt project 233
Dosa 82
Dosurf 233
Dow Jones Sustainability Index 56
downcycling 42, 114, 118, 128
downshifting 120
dress codes 155
dresses 103, 149, 185, 190, 208
drip irrigation 14, 32
Droog Design 233
drug resistance 67
Drury, K. 23
dry cleaning 98, 101, 185, 214
DuPont 20, 38
durability 9, 193–4, 196–201, 206
dyehouses 169
dyes/dyeing 27, 38, 40–2, 55, 57–8; ethics 60–6, 72–3, 82; fashion/needs 141; local/light design 166, 176; reuse 114, 125, 132–3

E

Eastern Europe 117
easy-care fabrics 95, 100
eBay 119
eclecticism 155
eco chic 141–2
Eco Intelligent Polyester (EIP) 133
eco-efficiency 126, 227
Ecocircle 114, 124
Ecolog system 125
EcoModo 183

economic development 69
The Economics of Ecosystems and Biodiversity (TEEB) 24
economies of scale 168, 190
education 184–5
EDUN 78
Edwardians 100
efficiency 3, 9, 20, 52, 72; laundering 102, 107; local/light design 164, 167, 173, 179–81, 183; participatory design 227; reuse 117–18, 126, 130, 133; use phase 92, 95–9
effluents 15–16, 19, 58–60, 62–3, 66, 127, 130, 214; ethics 73
Ehrenfeld, J. 3, 147, 227
El Salvador 68
elastane 38, 133
electrochemical dyeing 63
embroidery 80, 128, 169
emissions 11–12, 17–19, 21–2, 24, 37; ethics 58–9, 68; local/light design 174; material types 40, 44; reuse 114, 117, 133; speed issues 193, 208, 210, 212; use phase 97
emotional needs 144–9, 183, 196–201
empathy 93, 151, 154, 159
end-of-life phase 3, 21, 75, 116, 129, 134, 184
end-of-pipe processes 126
energy 8, 52, 56, 58–61, 63; ethics 68; fashion/needs 156; laundering 100; local/light design 166, 173, 179, 183, 185; recycling 122; reuse 114, 117, 119, 124, 126–8, 130; speed issues 201–2, 208, 210; use phase 91–3, 95, 97, 102
England 176, 196
entrepreneurs 78–9, 174
Environment Agency 51, 99
environmental impacts 10, 12–14, 16, 18–21, 24; ethics 52, 56, 58–60, 76; fashion/needs 140, 142, 145–7, 151; laundering 99, 107; local/light design 167, 183, 185; material types 26, 37, 41, 43; participatory design 224; recycling 125; reuse 117; speed issues 208, 210, 212, 214; use phase 91–5, 98–9, 109
Environmental Profit and Loss Account 24
enzyme retting 16, 35
enzymes 132, 176
escalators of consumption 155–9
Eternally Yours project 197
Ethical Trading Initiative 70
ethics 11, 27, 43, 51–89, 120; fashion/needs 149–50, 154, 156; participatory design 227
ethylene glycol 17
eudaimonia 149, 164, 230, 243
Europe 11, 43–4, 55, 61, 67; ethics 75; local/light design 169, 184; reuse 117, 119, 122
European Commission (EC) 11, 55–6, 79
European Union (EU) 21, 44, 59, 97, 133–4
eutrophication 37
Evans, S. 198
evening dresses 185
Evergreen Lease 184–5
everyday clothes 128
exchange 127, 133
experiential knowledge 151

F

fabric processing 56–8, 60
Fair Trade 7, 9, 27, 32, 73, 80, 147
fashion 139–62, 173, 185, 189–90, 206, 222–6
Fashion Victims 68
Fashioning an Ethical Industry 68
fast fashion 189–90, 204
fast species 206
Fastskin FSII 165
feedback 72, 75–9, 127
femininity 142
fertilisers 13, 15–16, 26, 30, 41, 133
fibre review 3, 12–13, 19–26, 56–8
fibre-to-fibre recycling system 114
fibrillation 40
fiftyRX3 project 113
finesse 194, 196
finishes 67–8, 132, 183
fixing agents 65

flax 9, 14, 16, 34–5
fleeces 114
flexibilisation 68
flourishing 3, 149–50, 159, 164, 245
football 69
Fordism 149
formal dress 156, 185
fossil fuels 36, 174
Franklin Associates 24, 94, 201
freedom of association 58, 70
freshening up 107, 210, 212
FTSE4Good 56
Fuad-Luke, A. 197
fungicides 13, 29
furnishings 9, 114, 184, 197–8, 201
fustic 82
future generations 207, 224

G

Gablik, S. 154, 229
gala events 185
Gap 55
garment hire 185
gender bias 142
genetic modification (GM) 29–30, 41
Genuine Progress Indicator 179
Germany 116, 125, 133
Global Compact Principles 32
Global Organic Textile Standard (GOTS) 27, 60
Global Recycle Standard 122
globalisation 167–9, 174, 240
goals 72, 75, 84, 109, 126–7; fashion/needs 139, 141, 147, 154; local/light design 184; participatory design 227, 230; reuse 133; role 241
gowns 208
Greeks 191
green chemistry 60
green design 151
Green Earth Cleaning 98
green goods 156
green jazz 228
green manufacturing 25
greenhouse gases 17, 22, 24, 37, 133
Greenpeace 60, 75, 242
Gronow, J. 143
gross domestic product (GDP) 179
groundwater 13, 117
growth regulators 26
guidelines 57
Gupta, A. 173

H

H&M 60, 75, 134, 212
Hamdi, N. 159
hand-picked cotton 14, 32
health 14, 21, 32, 41, 56; ethics 63, 67; fashion/needs 146; laundering 108; participatory design 230; speed issues 214; use phase 98, 101–3
heavy metals 16–17, 60, 63, 65, 208
heavyweight fabrics 176
Hebrides 176
hegemony 222, 242
hemp 9, 14, 16, 23, 27; ethics 61; local/light design 176; role 34–5, 44
Henry VIII 176
herbicides 13, 16, 29–30, 41
Hewson, A. 78
hexagonal assemblies 180
Hieatt, C. 154
Hieatt, D. 154
Higg Index 54
hire goods 156, 185
Holroyd, A.T. 183
home clothes 128
Honey Bee Network 173
honeycomb assemblies 180
Honoré, C. 196
hormone disruption 60
household textiles 11
howies 154
human rights 32, 56, 69
humidity 133
hydrocarbons 18
hygiene 99, 103, 108

I

ideational forces 242
identity 140–1, 143, 145–6, 155–6, 174, 178, 245

ideology 193, 196, 221, 224
Illich, I. 224
Illuminati II 32
immune system 61
impacts 2–3
incentives 72
India 29–30, 36, 80, 82, 173
Indian Institute of Management 173
indigo 65, 82
industrial cycles 132
industrial ecology 127–30
Industrial Revolution 53, 168
information flows 72, 79
infrastructure 13–14, 17, 30, 174
inkjet printing 66–7
innovation 53–6, 59, 73; fashion/needs 93, 95–7, 155; laundering 103; local/light design 165–6, 173–4, 180; participatory design 226–7; recycling 122; reuse 114, 120, 124, 130, 133; role 242; speed issues 191, 203; use phase 109
insecticides 13–15, 29
integrated pest management (IPM) 29
Integrated Pollution Prevention and Control (IPPC) 55–6
interconnected material cycles 127–8
interdisciplinarity 245
Interface 84, 184
intergenerationality 3
interventions 71–2
IPPC 75, 79
ironing 93, 97
irrigation 13–14, 16, 30, 32
islands of slowness 203
Isle of Mull 34, 176
Isle of Mull Weavers 34
Italy 203

J

Jack, T. 108
jackets 114, 120, 196
Japan 80, 114, 165
jeans 91, 103, 108, 172, 190, 212
Jégou, F. 172, 203
job security 51
jumble sales 212
jumpers 103
Junky Styling 120
just-in-time manufacturing 185, 189
jute 16, 35

K

kairos 191
Kawakubo, R. 156
Keep and Share 183, 196
kenaf 16, 35
khadi fabrics 82
Kim, C. 82
knit fibres 128, 150
knits 100, 120, 180, 183, 196
knitting 58–9, 169
knowledge types 151, 173

L

labelling 97, 122, 133, 156, 198, 212, 214
labour abuses 51, 55, 68–9
Labour Behind the Label 68–9, 75
labour costs 59, 68
labour standards 52, 56, 58, 68–70, 76, 82
Lands' End 172
lanolin 15
lateral thinking 180
laundering 9, 24–5, 40, 63, 91–3; fashion/needs 141; local/light design 179–80, 184–5; speed issues 191, 201–2, 206, 210, 212; use phase 95–9, 107–8
Le, J. 103
lead times 75–6, 169, 190, 204
leadership 84
leasing 185–6
leather 24, 178
legislation 53–6, 75
Lenzing 20, 40
Lesotho 68, 78
Levi Strauss 27, 56, 60, 91
lifecycle assessment (LCA) 20, 24–5, 43, 93–5, 99, 102, 201
Lifetimes project 206–7
light design principles 164–88
lightweight fabrics 129, 176, 179–80
limited editions 168

linen 16, 63, 73, 103
linings 196, 223
Linux 172, 226, 230
liquor ratios 62, 65
living strategies 172
load sizes 101
local colours 65
local design principles 164–88
local product development 3
Local Wisdom project 173, 178, 243
localism 167–74
logistics 167, 190
logos 156
Look Behind the Label 73
LoooLo Textiles 114
loops 114
low-chemical cotton 9, 14, 29–30, 32, 44
low-impact fibres 73
low-liquor dyeing 65
low-water-use cotton 30–2
lubricants 58–9
lyocell 9, 12, 19–20, 23, 38–41, 44

M

3M 67, 101
McDonald's 203
McDonough, W. 132, 168
McQuillan, H. 130
madder 65
MADE-BY initiative 22, 79, 156
manufacturing industry 2, 8, 12, 16–21; ethics 51–4, 56, 68; fashion/needs 154; local/light design 167–9, 172–3; material types 24–5, 34, 38; participatory design 222–3, 226; reuse 122, 124, 126–7, 133–4; role 240, 242–3; speed issues 189; systems-level improvements 71–85; use phase 94–5
Manzini, E. 172, 203
marijuana 23
market forces 10–11, 14, 23, 27, 29–30; ethics 54–5, 75; fashion/needs 143–4; material types 34, 40, 42, 44; reuse 119; role 243; user makers 224
Marks and Spencer (M&S) 32, 34, 60, 63, 73, 75, 100, 134
masculinity 142
material stocks/flows 72–5
material types 2, 7–50
maternity clothes 185
Mattelmäki, T. 197
Max-Neef, M. 143, 145–8
Meadows, D. 71–2, 85
media 55
MEND*RS 120
mending 120, 214
menswear 128
mental illness 140
Merino sheep 14
Mestral, G. de 165
metadesign 222
Microban 67, 102
Microsoft 230
mindfulness 172
mindsets 72, 84–5
minority fibres 9
miticides 29
modes/models of production 71–85, 142, 226
modular design 100
modularity 102, 156, 173, 214
monitoring 69–70
monocultures 8, 125, 169
mordants 65
Morphotex 165–6
moths 178, 214
Muji 122, 228
mulberry trees 15
multi-stakeholder initiatives 70

N

nanotechnology 102–3
nappies 99
narcotics 176
natural dyes 65
natural fibres 7, 11–17, 26, 34, 40; ethics 61, 80; fashion/needs 141–2; laundering 99; material types 42; recycling 125
natural rhythm 191–3

Naturally Advanced Technologies 16
naturally-coloured fibres 41
Naturtex Partners 41
needs 3, 139–62, 167, 172, 183; participatory design 224; speed issues 196, 206
needs-based models 149
negademand 180–1
negative feedback loops 72, 75–6
Netherlands 91
networking 227
New Economics foundation 174
NGOs 75
Nike 55, 60, 70
Nine Lives project 128
No Logo 56
No Wash tops 103, 107
Nobel Prize 4, 147
non-governmental organizations (NGOs) 55–6, 69–70
non-woven fabrics 100
norms 108
Notkin, J. 176
novelty 156–7
numbers 72–3
nylon 12, 15, 17–18, 20, 25; ethics 63, 67, 73; laundering 100, 102; local/light design 166; material types 38, 43; recycling 124

O

obsolescence 116, 140, 200
Offer, A. 143, 146, 205
office wear 185
Offside! 69
oil 9, 12, 14, 17, 23, 43
on-demand production 59
One campaign 78
open-source design 2, 172, 226–8
organic fabrics/fibres 7, 9, 60, 114, 147; cotton 9, 14, 23–4, 26–9, 32, 41, 44, 73, 80, 156; fashion/needs 155–6; silk 16; soybeans 41; wool 15, 32–4, 82
organochlorines 67, 102
organophosphates 13–15, 32
outcomes 92, 200, 228
outdoor garments 125
outputs 75, 127
overdosing 98
overdyeing 128
overprinting 120
Oxfam 69, 75
oxidative route 59

P

packaging 72
pad-batch dyeing 63
Pakistan 133
Paper Dolls collection 156
paradigms 72, 84–5
Páramo 180
parasites 14
part loads 101
participatory design 2–3, 154, 222, 228–31
partnership model 229
party tops 206, 208
passive fashion 222–6
Patagonia 23, 84, 102, 114, 128–9
patching 120, 212
patents 165
pathogens 108
pattern cutting 130, 180
patterns of use 201–3
peace silk 36
Peak Oil 23, 193
pentachlorophenols (PCPs) 59
People Tree 80
Pepper, D. 167
perchloroethylene (perc) 67, 98
perfluorination 101
perfluorocarbons 67
permaculture 127, 150
personalisation 197, 228
Peru 41
pesticides 9, 11, 13–15, 133, 212; fashion/needs 146; material types 21, 24, 26, 30, 32, 42; speed issues 214
PET 38
petrochemicals 9, 16–17, 23, 37, 40, 98
petroleum 133
Philippines 68
physical needs 145

pilot projects 63, 70
Plan A initiative 32, 34, 73
plant-based fibres 11–12, 18, 132, 142
PlantFiber 38
plastics 43
pluralism 82
poisons *see* toxins
politics 150, 230–3
pollution 8–9, 11, 13–17, 117, 130; ethics 51, 55, 58–63, 72; fashion/needs 141; laundering 107; local/light design 167, 176, 179; material types 19–20, 24, 27; participatory design 224; speed issues 214; use phase 92, 98
polyamide 17
polyester 8–12, 15–17, 20–1, 23–4, 36; ethics 63, 66–7, 73; laundering 100, 102; local/light design 166, 179; material types 38, 42–3, 63, 66–7; recycling 125; reuse 114, 122, 124, 128, 133; speed issues 201, 208; use phase 92, 94–6
polylactic acid (PLA) 12, 17, 23, 36–8, 44
polymers 12, 17–18, 118, 122
polypropylene 20
polyvinyl alcohol (PVA) 59
Portugal 169
positive feedback loops 72, 76–9
poverty 51, 69, 78, 108, 119, 146–7, 190
power structures 143, 154, 167, 169, 204, 223, 231, 242–3
practical knowledge 151
pre-owned clothing 116
presentational knowledge 151
price fluctuations 73
printing 58, 60–2, 66–7, 80, 172, 181
privatisation 30
Pro-Ams 224, 226
process focus 96–9
product focus 96, 99–102
product lifecycles 9, 11
production costs 172
production phase 3, 9, 21, 52–4, 56–9, 93
production systems 99–102
profit 84, 126, 168, 181, 185, 190, 204, 243
propositional knowledge 151
prosumers 224
protocols 15–16, 19
prudence 205–6
psychology/psychological needs 140, 145–6, 155, 194
public relations (PR) 95
public sector 149
Puma 24, 60
punishments 72
purchase rates 189
pyrethoids 13–14, 32

Q

qualitative studies 19–21
quantitative studies 19–20
quilting 169
quotas 78

R

rag collectors 116
rain-fed cotton 14, 30, 32, 35
raincoats 228
ramie 133
rapidly-renewable resources 7, 12
re-dyeing 42
REACH programme 55, 75
recessions 169
reciprocity 150
reconditioned garments 116, 118, 120
recycled fibres 7, 9, 17, 23, 41–3, 72–3
recycling 113–36, 166, 180, 184, 203, 208, 233
Recyclon 124
red-carpet events 185
Reform project 231–3
regionalism 9, 30
renewable fibres 7, 9, 11, 23
renewable resources 12, 36–8, 40
repairs 26, 118, 120, 140, 173–4, 181, 185, 196
repolymerization 43
reproductive system 61, 98
research and development (R&D) 73, 125
resourcefulness 154, 159, 165, 193, 222, 243
resources 3, 9, 20, 52, 56; ethics 62, 66,

72–3; exchange 113–36; fashion/needs 140, 145, 155–7; laundering 99, 103; local/light design 164, 166–8, 173, 179–80, 183–4; participatory design 224, 233; profiles 93–5; recycling 125; reuse 118–20, 127, 129; role 242–3; speed issues 192–4, 196, 201–4, 206; use phase 108
respectability 108
retting 16, 34–5, 176
reuse 26, 59, 63, 65, 95; laundering 107; local/light design 169, 174, 180; role 98–9, 113–36; speed issues 198
reverse consumerism 233
reversible fabrics 180
rhythm 191–3, 201–3, 206
Rigby, E. 107
risk assessment 51
Rissanen, T. 130
Rohner Textil 132
rolling replacements 155
Royal Navy 176
3Rs 117
rubber 24
rules 72, 80–2
Ryan, C. 183

S

safety 56, 75
Salvation Army 172
scale 163–5, 167–9, 173, 179, 190–1, 203, 242–3
Scandinavia 194
scarcity of materials 23
Scotchguard 67, 101
Scotland 176
scouring 14–15, 56–9, 61, 176, 214
scrap fabrics 130
screen printing 66
seamstresses 172
seed industries 30
self-organization 72, 82
Sen, A. 4, 147, 207
sequestering agents 61
service economy 156, 183–6
sewing guides 128
sewing thread 133, 172
sexual harassment 146
Sharan Craft Centre 79
shared use 165, 181–3, 243–5
shareholders 56
sheets 120
Sherburne, A. 42
Shetlands 176
shirts 100, 133, 233, 245
Shodh Yatra 173
Shove, E. 155
shrugs 183
shwopping 75, 134
side effects 67
silk 15–16, 36, 40, 44, 82, 101, 103
silkworms 15, 36
silver 101–2
Simon, H. 4
single-frame approaches 9
sizing agents 58–9
skepticism 185
skirts 128
Slater, K. 23
slow culture 196, 203–4
slow design 3, 159, 201, 203–6, 214
Slow Food movement 203–4
slow species 206
smart technologies 25
Smits, S. 197–8
Social Accountability International 70
social impacts 8, 10, 12, 17, 26; ethics 52, 56, 68, 76; fashion/needs 142, 145–7, 151; local/light design 183; material types 43; use phase 92
social media 149
socks 133
soil erosion 24, 34
soil particulates 30
soil salinisation 16
solvents 66, 98
Sorona 38
sourcing policies 73
soybean fibres 12, 23, 40–1, 44
Spain 169
specialist fabrics 67–8

speed issues 3, 189–220, 243
Speth, J.G. 227–8
spinning 58–9, 169
sportswear 114, 154, 180
spot cleaning 210
Sri Lanka 68
stabilisers 58, 61
Stahel, W. 201
stain resistance 26, 67, 101
stakeholders 70, 79, 174, 228–9
standard body shapes 223
standards 72–3
staple fibres 36, 125
starches 59
statistics 117, 122, 189, 199
status 98, 108, 140, 223
steam explosions 35
stenters 68
stitching 156
stockpiling 199
storage 59, 199, 210, 214
string vests 180
sub-Saharan Africa 117
substitute fibres 12, 14, 16–19
suits 101, 120, 185
super bugs 67, 102
Super Satisfiers 148
supply chains 9, 22, 24, 30, 54–6; ethics 60, 68–9, 71, 73, 79, 85; fashion/needs 140, 156; local/light design 166, 168; participatory design 228; reuse 127; use phase 102
surfactants 98
sustainability 5–6, 11–12, 137–8, 239–45; ethics 51–90; locality 163–88; material types 7–50; needs 139–62; reuse 113–36; speed issues 189–20; use phase 91–112; user makers 221–38
Sustainable Apparel Coalition 54
Sustainable Cotton Project 29
swimwear 165
Switzerland 132
symbiosis 127
symbols 144, 169, 186, 206
synthetic dyes 65
synthetic fibres 11–12, 15, 18, 20, 23; ethics 66, 73; laundering 99; local/light design 176, 179–80; reuse 132; role 36, 42; use phase 94
systems focus 3, 52–3, 71–85, 96, 102–3; fashion/needs 147; improvements 163–5, 180–1; role 242; transformed 184; use phase 92

T

T-shirts 78, 80, 82, 93, 122; fashion/needs 154; local/light design 166–7, 180; participatory design 233; reuse 133
tailoring 169, 172, 214
Takahashi, J. 156
Take Back legislation 133
target setting 72
technology 53–4, 56, 59, 63, 65–6; ethics 68, 79; fashion/needs 156; laundering 107; local/light design 169, 172–3, 176; participatory design 224; recycling 122, 125; reuse 114, 124, 129, 133; role 242; speed issues 204–5; use phase 97
Teijin 38, 114, 124, 165
tempo giusto 196, 204
terephthalic acid (TA) 17
terms of engagement 56
tetrahydrocannabinol (THC) 34
Thackara, J. 168, 203, 230
thermapresses 66
Thorpe, A. 103, 146, 194
ties 101
time issues 191, 204, 206
Toffler, A. 224
Top Man 120
Top Shop 212
tops 128, 190, 206, 208
towels 133, 183
toxins 13, 27, 52, 55, 58; ethics 60, 63; fashion/needs 146; reuse 114, 133; speed issues 212
traceability 122, 156
tracking 79
trade associations 94, 98
trade unions 51, 68–70, 75

tradition 169, 173, 178
TRAID Remade 117, 120
trans-disciplinarity 92
transfer printing 38, 66
transition strategies 126
transparency 55, 71, 79, 168
transport 21, 26, 59, 107, 167, 169, 174, 179
trends 228
trichloroethylene 15
triclosan 102
Trigema 133
trousers 120, 206, 212
tuberculosis 108
tumble drying 26, 95, 100
tweed 176
typhoid 108

U

U2 78
ultraviolet (UV) curing 66
underarm ventilation 103
Undercover label 156
underwear 91, 103, 107, 133, 206, 210, 228
Uniqlo 60
unisize garments 183, 196, 228
United Kingdom (UK) 11, 14, 18, 21, 25; ethics 51, 56, 67, 69, 73, 75–6; laundering 100–1; local/light design 168, 176, 178; material types 34; participatory design 222, 224; reuse 119, 134; speed issues 190, 199; use phase 97, 99; waste 116–17
United Nations (UN) 32
United States (US) 25, 29, 40, 44, 59; ethics 80, 82; local/light design 167, 169, 172, 184; participatory design 230; reuse 133; waste 116
unwashed clothes 103
upcycling 118
Updatable 233–5
upholstery 132, 197
use phase 3, 20–1, 24, 63, 91–114; local/light design 184; shared 243–5; speed issues 196–203, 206, 212
user makers 221–38
usership 144, 201

V

value-free fashion 141–2, 151
value-laden fashion 142–4, 151
variety 156
Vaude 125
vegetable cashmere 40
vegetable fibres 65
vegetarian silk 36
Velcro 156, 165
verification 69–70
vests 180
VF Corporation 154
Victor Innovatex 133
Victorians 100
vintage fabrics 172
vintage garments 119–20
virgin fibres 128
viscose 18–21, 25, 63
volatile organic compounds (VOCs) 58, 66–7
volume-budget model 190
Von Busch, O. 198, 229, 231–2

W

waffle assemblies 180
waistbands 223
Wales 154
Walker, S. 151, 168, 230
War on War 68
Warde, A. 155
wardrobe inventories 206
washing balls 98
washing machines 92, 97, 99, 102, 108, 156
waste 15, 21, 24, 26, 38; ethics 52, 56, 58–60, 72–3; local/light design 165, 167, 169, 173, 179, 181; management strategies 117–26; material types 40–3; reuse 114, 116–17, 122, 130, 133–4; speed issues 193; use phase 92
water 9, 11–21, 24–6, 30–2, 34–5; ethics 51–2, 55, 58–63, 65–6, 72, 75;

fashion/needs 141; local/light design 167, 185; material types 38, 40–2; repellency 60, 67; reuse 117, 133; role 242; speed issues 190, 193, 208, 210, 212, 214; use phase 97–8, 102
5 Ways project 103, 128, 148, 178, 233
wearable electronics 156–7
weaving 58–9, 169
websites 79, 119
wedding dresses 185, 208
weld 65
Well Dressed? 25
West 119, 144, 190, 221
West Africa 30
white fibres 125
whole systems *see* systems focus
whole-garment knits 59
Wikipedia 172, 226
wild silk 16, 36, 44, 82
wipe-clean surfaces 103
women 69, 128, 169, 185
Wong, M. 184
wood 18–19, 34, 38, 40
wool 9, 14–15, 18–22, 32–4, 41; ethics 60, 67, 73, 82; grease sludge 15; laundering 102–3; local/light design 176; material types 44; reuse 127–8, 130, 133; speed issues 214; use phase 95
Wooltech 15
working conditions 69–70, 75, 82, 191
World Cup 69
World Health Organization (WHO) 13
world views 3
World War II 40
woven fabrics 100, 114, 176, 180
WRAP 193
wraps 183

Y

yarns 59, 61–2, 117, 120, 122, 124, 128, 133
YouTube 226, 230

Z

Zara 169
zero-waste pattern-cutting 130