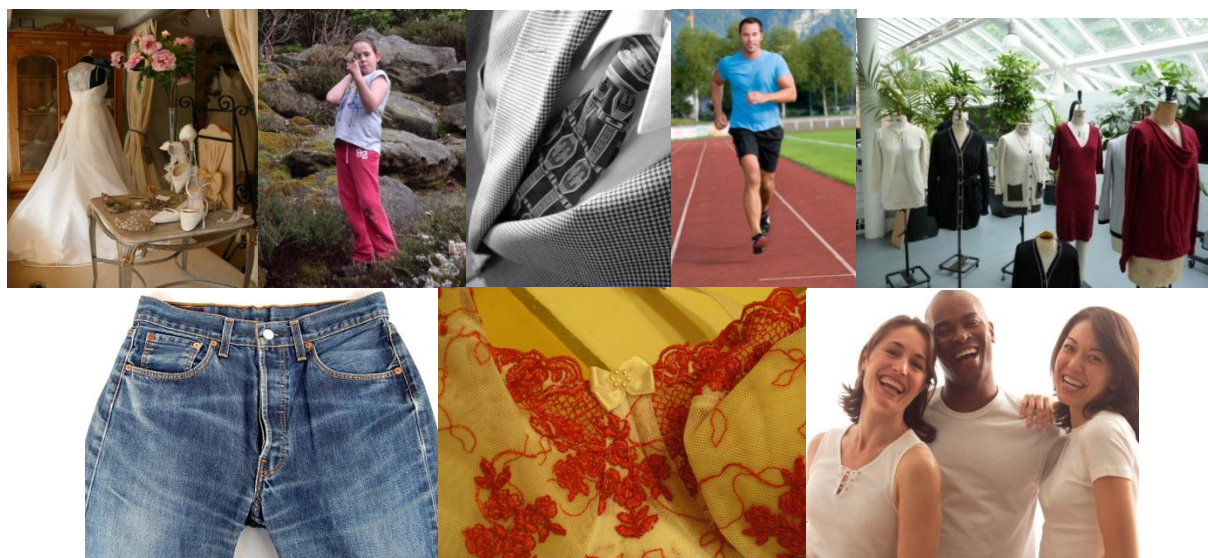


Final report

Design for Longevity

Guidance on increasing the active life of clothing



A report to support a series of Guidance Notes for product development teams offering guidance on design of clothing for longevity.

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Executive summary

Designing for durability or longevity has been identified as the single largest opportunity to reduce the carbon, water and waste footprints of clothing in the UK. Quite simply, if clothes have a longer usable life, they can be replaced less frequently – reducing the volume discarded and meaning fewer resources are consumed in manufacturing. Research by WRAP found that extending the average life of clothes by just nine months would save £5 billion in resources used to supply, launder and dispose of clothing.¹

The best opportunity within the clothing lifecycle to increase longevity is at the product design stage, where changes to design practices can have a significant impact on how long individual items remain wearable. The fundamental reason for consumers to discard clothing is that it no longer looks good – which is an issue designers can directly influence. This guidance, developed collaboratively by WRAP, NTU and a range of experts from within the clothing industry, has found four fundamental areas where changes to design practices can help ensure items look good for longer, and so extend their usable life. These are:

1. **Size and fit** – one of the primary reasons for discarding undamaged items is that they no longer fit. By designing clothes that can be easily adjusted to allow for reasonable variations in an individual's shape, designers can help increase longevity.
2. **Fabric quality** – higher quality fabrics are more likely to withstand wear and tear over a prolonged period. Clearly, the nature of that wear and tear depends on the way the item is worn; there are different expectations of childrenswear and occasionwear. But even within these different categories, fabric quality can have a significant impact on how well an item endures.
3. **Colours and styles** – while there will always be a higher turnover of fashion items, designers can help extend the longevity of many garments by using 'classic' or timeless styles and colours, that are less likely to go out of fashion.
4. **Care** – longevity is directly affected by how garments are cared for. Designers and retailers have an opportunity to influence this by ensuring consumers are given appropriate advice on care and on opportunities for re-use and recycling.

In an era of 'disposable fashion', where many retail and manufacturing business models are based on frequent, low-cost purchases, increasing longevity may seem counter-intuitive. However, as this report demonstrates, by making relatively small changes to those business models and pricing strategies, increasing garment longevity need not impact on commercial returns – especially where it is integrated with broader industry efforts to educate consumers about the environmental impact of clothing waste.

This report provides guidance for product development teams on how they can best influence consumer behaviour and facilitate extended use of garments. It looks at some overarching principles, and then applies these to eight broad categories of clothing. It identifies and distils good practice and includes top 5 solutions for extending longevity in each category, adding background and context to the more direct guidance notes for each category published alongside it.

While changes to design practices alone are only part of the picture, the report makes it clear just how much designers can influence industry and consumer practice – and what the benefits of doing so will be for designers, and their organisations.

¹ WRAP (2012) – *Valuing our clothes* www.wrap.org.uk/sites/files/wrap/VoC%20FINAL%20online%202012%2007%2011.pdf

Contents

1.0	Introduction	7
1.1	Purpose.....	7
1.2	Context	7
1.3	Existing research and guidance	8
1.4	Report structure.....	9
2.0	Methodology.....	10
2.1	Industry workshops.....	10
2.2	Establishing overall findings	12
2.3	Selection of categories.....	12
2.4	Developing the report and guidance notes	12
3.0	General Principles.....	13
3.1	Introduction	13
3.2	What limits lifetime?.....	13
3.3	Fibre and fabrics	14
3.4	Design and manufacture.....	14
3.5	Care and repair	16
3.6	Re-use and discard.....	17
4.0	Childrenswear	18
4.1	Top five solutions.....	18
4.2	Introduction	18
4.3	What limits lifetime?.....	18
4.4	Fibre and fabric.....	18
4.5	Design and manufacture.....	19
4.6	Care and repair	20
4.7	Re-use and discard.....	21
5.0	Occasionwear	22
5.1	Top five solutions.....	22
5.2	Introduction	22
5.3	What limits lifetime?.....	22
5.4	Fibre and fabric.....	23
5.5	Design and manufacture.....	24
5.6	Care and repair	25
5.7	Re-use and discard.....	26
6.0	Knitwear	27
6.1	Top five solutions.....	27
6.2	Introduction	27
6.3	What limits lifetime?.....	27
6.4	Fibre and fabric.....	28
6.5	Design and manufacture.....	28
6.6	Care and repair	29
6.7	Re-use and discard.....	30
7.0	Tailoring	31
7.1	Top five solutions.....	31
7.2	Introduction	31
7.3	What limits lifetime?.....	31
7.4	Fibre and fabric.....	32
7.5	Design and manufacture.....	33
7.6	Care and repair	34
7.7	Re-use and discard.....	34

8.0	Denim	36
8.1	Top five solutions.....	36
8.2	Introduction	36
8.3	What limits lifetime?.....	37
8.4	Fibre and fabric.....	37
8.5	Design and manufacture.....	38
8.6	Care and repair	40
8.7	Re-use and discard.....	40
9.0	Sportswear	42
9.1	Top five solutions.....	42
9.2	Introduction	42
9.3	What limits lifetime?.....	42
9.4	Fibre and fabric.....	43
9.5	Design and manufacture.....	44
9.6	Care and repair	46
9.7	Re-use and discard.....	46
10.0	Casualwear	48
10.1	Top five solutions.....	48
10.2	Introduction	48
10.3	What limits lifetime?.....	48
10.4	Fibre and fabric.....	49
10.5	Design and manufacture.....	49
10.6	Care and repair	50
10.7	Re-use and discard.....	51
11.0	Underwear	52
11.1	Top five solutions.....	52
11.2	Introduction	52
11.3	What limits lifetime?.....	52
11.4	Fibre and fabric.....	53
11.5	Design and manufacture.....	53
11.6	Care and repair	54
11.7	Re-use and discard.....	55
	Appendix: Useful Resources	56

Acknowledgements

Fran Bingham, Pentland
Elaine Brown, Elaine Brown Design
Wolfgang Buttress, Sculptor
Darren Cleary, Textile Designer
Dennis Flynn, Johnsons Cleaners
Paul Gidley, Self-employed Artist/Designer
Asato Goto, Fashion Designer
Alison Gwilt, Author, *Shaping Sustainable Fashion*
Les Jacques, Invista Apparel (Fibres)
Michael Kininmonth, Lenzing Fibres AG
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Rochana Shrestha, Avery Dennison
Shruti Singh, Speedo
Garth Ward, Aestiva Ltd
Mark Yare, SDC Enterprises Ltd

NTU staff and research students, including James Bailey, Naomi Braithwaite, Stella Claxton, Kathy Dickinson, Katie Holbrook, Sarah Lewington, Lois Pittman, Laura Raddings-Brown, Sue Smedley, Maria Stafford, Fran White.

1.0 Introduction

1.1 Purpose

This project provides guidance for product development teams on how to design clothing for longevity – the overall term used in this report and guidance notes to describe keeping a garment looking good and in use for longer.

It identifies design practices which can facilitate extended use of garments by consumers, both in 'first life' and re-use by second owners, thereby reducing overall demand for materials.

Because it is written for product development teams, both the guidance and this report assume a certain level of expertise and knowledge about clothing design and manufacture.

1.2 Context

As part of the broader goal of reducing waste, there has been a growing interest – both in terms of public policy, at both European Union² and national government level³, and commercial strategies – in increasing product lifespans. Clothing, generally categorised as a 'semi-durable', has a particularly important place in this debate.

Recent research by WRAP underlined the significant environmental impacts associated with the clothing life-cycle. These are summarised in table 1 below.

Table 1: Annual carbon, water and waste footprints of clothing in the UK⁴

	Global footprint of UK consumption of clothing	Global footprint per household	Household footprint equivalent to
Carbon	38 million tonnes CO ₂ e	1.5 tonnes of CO ₂ e emissions each year	Driving a car 6,000 miles
Water	6,300 million m ³ of water	More than 200,000 litres each year	Filling over 1,000 bathtubs to capacity
Waste	1.8 million tonnes of material	70 kg each year	Weight of over 100 pairs of jeans

That same research found that extending the life of garments by even a few months could have a major impact on the volume of resource consumed and waste generated.

Table 2: Potential footprint reductions and resource cost savings from using clothes for longer

² EU Waste Framework Directive (2008/98/EC). <http://ec.europa.eu/environment/waste/framework/>

³ Defra (2011). Government Review of Waste Policy in England 2011. www.gov.uk/government/publications/government-review-of-waste-policy-in-england-2011

⁴ WRAP (2012) *Valuing our clothes*.

<i>Scenario</i>	<i>Carbon saving</i>	<i>Water saving</i>	<i>Waste saving</i>	<i>Resource cost saving</i>
10% longer lifetime (i.e. 3 months longer)	8% (3 MtCO ₂ e)	10% (600 million m ³)	9% (150,000 tonnes)	9% (£2 billion)
33% longer lifetime (i.e. 9 months longer)	27% (10 MtCO ₂ e)	33% (2,000 million m ³)	22% (400,000 tonnes)	22% (£5 billion)

This report builds on the prior research to show how increasing garment longevity not only offers important benefits of terms of waste and resource use, but also need not necessarily impact on commercial returns, depending on the business model and pricing strategy adopted. This is explored further in Chapter 3.

The broader context for both this report and that prior research is the Sustainable Clothing Action Plan, managed by WRAP on behalf of the Department for the Environment, Food and Rural Affairs. This seeks to reduce the environmental impacts of clothing supply by identifying good practice which could be adopted across multiple organisations through collective action, and so could help deliver potential sector and/or corporate targets for reducing the impacts of clothing.

www.wrap.org.uk/content/sustainable-clothing-action-plan-1

1.3 Existing research and guidance

There are many influences upon clothing longevity that need to be understood in order to provide effective guidance on design for longevity of clothing. Design for longevity is an emerging area within the field of design research. At a general level, product lifetimes have attracted growing attention over the past decade from researchers, prompted initially by the Dutch network Eternally Yours and later by the UK-based Network on Product Life-spans. The outcomes of the Eternally Yours conferences⁵ and the Network on Product Life-spans⁶ provided important background to this project. There are also a number of widely-recognised design principles for product lifetime optimisation.⁷

For the purposes of this project, we regarded design not so much as a service industry concentrating on an end product as one able to address 'process, large scale thinking and transformative acts.'⁸ Thus, while due attention was paid to technical and aesthetic considerations of designing for longevity, the report is firmly situated within the broader context of a throwaway culture. Consideration was therefore given to commercial imperatives, socio-cultural trends and behavioural factors: most obviously, the sector's association with fashion is, of course, fundamental to understanding clothing lifetimes.

More generally, it is worth noting that insights into this relationship may have implications for other product types influenced by fashion trends: for example, the Norwegian Consumer

⁵ E. Van Hinte (ed.) (1997). *Eternally Yours: Visions on product endurance*. Rotterdam: 010 Publishers; E. Van Hinte (ed.) (2004). *Eternally Yours: Time in design. Product value sustenance*. Rotterdam: 010 Publishers.

⁶ Tim Cooper (ed.) (2010). *Longer Lasting Products*, Farnham: Gower.

⁷ Carlo Vezzoli and Ezio Manzini (2008). *Design for Environmental Sustainability*, London: Springer-Verlag.

⁸ Tony Fry (2008). *Design Futuring*, Oxford: Berg.

Research Council recently began to explore the relationship between clothing and electrical goods in its work on product life extension.⁹

1.4 Report structure

This report is one of two outputs from the project. The other is a series of guidance notes, which provide short summaries of the key findings for increasing longevity in each of eight categories of clothing. This report provides the background and context for that guidance.

- **Chapter 2** sets out how the guidance was developed.
- **Chapter 3** analyses some of the overarching issues that affect clothing design in all categories. It looks at why consumers dispose of clothing, key trends in design and manufacture, choices around fibre and fabric, how care and repair affect longevity, and the current options for re-use and discard
- **Chapters 4-11** then examine the eight categories in turn: childrenswear, occasionwear, knitwear, tailoring, denim, sportswear, casualwear and underwear.

Each of these eight chapters has subsections on the same five issues analysed in chapter 3, as well as setting the top 5 recommendations for that category. The same structure is used in the guidance notes.

Clearly there are numerous overlaps between the chapters, so while the recommendations and guidance is targeted to the category in question, designers may wish to look at related categories too.

- An **appendix** identifies some useful sources for further information and advice.

⁹ Network Conference on Product Life Extension: Knowledge Transfer between Clothing and Consumer Electronics. Accessed at: <http://www.sifo.no/product-durability/wp-content/uploads/2012/03/Conference-Program-07.03.12.pdf>

2.0 Methodology

As indicated in chapter 1, the drive to produce this guidance came from WRAP's 2012 report *Valuing Our Clothes*, which set out the potential benefits of extending clothing longevity. One of the results of this was an agreement to produce guidance for product designers, and to ensure that guidance could be as constructive and relevant as possible, WRAP engaged extensively with a wide range of parties – from retailers and manufacturers to designers themselves to trade associations, textile traders and producers, and academic experts.

This chapter explains the methodology in more detail.

2.1 Industry workshops

To engage industry effectively, WRAP appointed the multidisciplinary Sustainable Consumption research group at Nottingham Trent University (NTU) to run a series of workshops, each focused on a key aspect of clothing longevity. An initial scoping exercise was undertaken internally to select workshop themes and consider how to address the many varied forms of clothing within the project. Four key themes were chosen: behaviour, technical, fashion design and business.

Each workshop was led by an expert with a relevant background and attended by around 15 participants, including members of the WRAP project team and other interested parties such as researchers and subject specialists among academic staff, industry contacts from student placements, trade associations and textile societies, and representatives from Future Factory, a project based at NTU which supports sustainable design within East Midlands small and medium enterprises.

Participants at the workshops identified and explored a range of possible design actions for longevity and sought to identify priorities. Options were assessed with reference to:

- cost implications - specifically, materials and production costs;
- expected impact on longevity - including how 'certain' a specific outcome was; and
- overall environmental impact (e.g. where longevity might affect recyclability).

Examples were sought of good practice which carried no significant cost premium and no significant detriment to consumer appeal.

The format of the workshops varied. The design workshop, for example, focussed more on the personal experience of participants in terms of their own clothing preferences and practices, while the behaviour workshop required participants to identify garments worn in the preceding week in a wardrobe diary.

Outcomes of all workshops were documented for use in preparation of the guidance notes for product development teams and for this report.

The Behaviour Workshop explored issues relating to user behaviour. It drew on team members' extensive industrial experience of consumer evaluation and user perspectives, as well as our experience of qualitative research on sustainable clothing for Defra¹⁰ and quantitative research on clothing behaviour for WRAP.¹¹ The workshop paid particular attention to:

- longevity aspirations and expectations;

¹⁰ T Fisher, T Cooper, S Woodward, A Hiller and H Goworek (2008). *Public Understanding of Sustainable Clothing*, Defra.

¹¹ WRAP (2012) *Valuing our clothes*.

- attitudes to prices, including market segmentation analysis to look at how these varied in different groups of consumers;
- intensity of use, and hence cost per wear;
- use and storage, with particular reference to the high proportion of clothes that are kept but rarely worn¹²;
- user practices that may reduce product longevity (e.g. excessive washing); and
- the disposal decision (i.e. the point of disposal and whether the route chosen allows for re-use).

The Technical Workshop considered clothing technology issues, particularly those relating to fabric choice and manufacturing processes. A range of technical factors influence longevity, including fibre selection, yarn type, fabric construction, colouration and finish. Garment construction – pattern cutting, stitch type and seaming methods – also has an impact. The workshop examined:

- the current use of tests to assess the performance of fabric and garment construction during wear and laundering, and how test results are then applied within design;
- quality assurance procedures within a manufacturing environment;
- fabric choice and manufacturing process in relation to more flexible clothing design (e.g. with regard to fit);
- sizing issues and the balance between standard size for mass production and bespoke products; and
- the potential for more versatile garments such as reversible jackets, scarves that can be tied in different ways and items that can be transformed from one type to another such as a jumper into a pair of trousers.

The Fashion/Design Workshop explored the significance of fashion to clothing manufacturers and retailers, looking particularly at issues relating to style and trends, and its influence upon product lifetimes. For example, it discussed:

- vintage clothing, and garments that are produced to look worn when first purchased – and how this affects the overall lifetime of the garment;
- how re-use and retention impact on mainstream approaches to fashion – particularly ‘disposable’ fashion, which is designed and produced at low cost for short-term use;
- how design can be used to make garments more adaptable as people’s size fluctuates – for example changing the form and cut to build in flexibility, or increasing the size of seams to increase the potential to alter clothes; and
- how garments can be designed to be adapted and customised to promote their extended use and whether the ‘narrative of wear’ can be marketed as a fashion ideal, with creative pattern cutting and garment repairs worn as ‘badges of honour’.¹³

The Business Workshop explored the commercial issues around design for clothing longevity. Areas addressed included:

- implications for supply chain management;
- possible challenges to current operating models for retailers and manufacturers;
- issues around range planning / range management, consumer ‘risk’, pricing strategy, and product labelling and promotion;
- the financial implications of using better quality fabrics with reference to products targeted at different market segments within associated cost parameters;

¹² As cited in *Valuing our clothes*, research has found that “30% of clothing in the [average] wardrobe typically has been unused for at least a year.”

¹³ A Gwilt and T Rissanen (2011). *Shaping Sustainable Fashion*, Earthscan.

- what changes would be needed to make longevity critical criterion in product development and selection process by manufacturers and retailers; and
- how the concept of longevity can be incorporated into marketing.

2.2 Establishing overall findings

After all four workshops were complete, the workshop leaders met to discuss the findings and draw conclusions. Certain cross-cutting themes emerged, and these have shaped the framework of this report and accompanying guidance. They include:

- optimal lifetimes and product retention;
- the quality of fibre and fabric;
- good practice in design and manufacture (including testing);
- the potential for re-use and repurposing; and
- commercial imperatives, and the regulatory and fiscal context.

Some aspects overlapped, such as the relationship between style design (concept, image) and technical design (fit, function, production engineering).

2.3 Selection of categories

The project plan was always to create guidance specific to individual garment types and to refer to different price points. However, over 25 garment types were identified during the workshop, so a decision had to be made on whether to cover all product types or to choose a sample.

It was decided to cluster product types into eight categories, based on departmental divisions used by store groups. These are:

- childrenswear: all garments but taking account of specific requirements for children;
- occasionwear: bridal wear, dinner jackets, evening wear, party dresses and high quality suits;
- knitwear: jumpers, cardigans and dresses;
- tailoring: formal wear for regular use such as suits, jackets, skirts, trousers and coats;
- denim: primarily jeans, but also denim jackets, shirts, dresses and skirts;
- sportswear: garments worn for physical activity, whether high or low impact, excluding swimwear;
- casualwear: t- shirts, sweatshirts, leggings, trousers, shorts, skirts, blouses and shirts; and
- underwear: bras, shapewear, briefs, boxers, vests, thermals and slippers.

2.4 Developing the report and guidance notes

It was agreed to produce two related, but distinct, outputs from the work:

- guidance notes, as a series of bullet points that can be used in presentations or for ready reference during design;
- this longer report, which provides greater insight into the discussions and issues raised.

The Guidance Notes were drafted by technical specialists and informed by advice from industry contacts and other team members. Account was taken of different audiences within product development teams (e.g. designers, buyers, retailers).

3.0 General Principles

3.1 Introduction

In this chapter, we summarise some general principles to enhance the longevity of clothing. These emerged from the workshops and wider research, and can be applied across clothing in all categories. They focus on changes to design practices, but also impact on other aspects of the clothing lifecycle – such as product pricing. We also look at some of the universal issues that the clothing industry faces, and which therefore affect design, and can act as constraints.

Clearly, no matter how general these principles and issues are, they will affect various categories of clothing differently. Even within those categories, there can be important differences based on how consumers use the garments; sportswear worn as fashion items will not experience the same type of wear as if used for sports. Some of these differences are considered in more detail within the individual chapters for each category.

Similarly, while the recommendations and findings are potentially applicable to all businesses within the clothing sector, we recognise that business models and strategies – and levels of influence that product designers can exert on those – also differ considerably.

Therefore, in making our recommendations, we aim to set out a range of different options that companies can choose, each of which would be beneficial in its own right, rather than assuming that any one business will attempt to implement all recommendations.

3.2 What limits lifetime?

Clothing is discarded for many reasons. Some is discarded because the fabric appears worn (typically around the cuffs, sleeves, collar or knees), has been torn, stained or damaged in some other way, or has shrunk or become faded over time. Components such as zips or elastic may have failed or buttons been lost. More often, however, the reason is not product failure, but because the item either no longer fits due to a change in body size or is no longer wanted due to a change in the owner's style or taste, perhaps associated with fashion.

In recent years, growth in the clothing sector has been driven in the UK primarily by the value sector: 57% of the UK population regularly use value retailers.¹⁴ The concept of 'fast fashion', with fashion styles changing rapidly, has become commonplace and retailers have re-structured their supply chain to deliver more frequent range changes at competitive prices. This has created what has been termed 'throwaway fashion' because garments quickly become unfashionable and often are kept for a relatively short period, perhaps not even a season.

While this has led to faster turnover of product – and an increased volume of sales – it has not led to an overall increase in the amount of money spent on clothing. Instead, therefore, production processes have had to be shortened and costs reduced. Less time and money is typically spent designing and making the garment, it is unlikely to have been fully tested, and cheaper fabrics and processes are chosen: as a result, some garments last for just a few washes, but consumers are less concerned as they anticipate discarding the items soon anyway. For designers, this may be frustrating: their work is being treated as a throwaway item, yet for retailers under pressure to improve profits, the concept of longevity implies lower sales volumes and revenue, or higher prices.

¹⁴ *Verdict (2010). How Britain Shops.*

However, the technology and materials do exist to produce clothes that 'look good for longer'. What's more, applying such technology or using higher quality materials need not always create significant increases in production costs: economies of scale can minimise the additional material cost, and companies may experience fewer returns or complaints as a result. Nonetheless, creating clothes that last longer is likely to lead to an increase in production costs, which is something that retailers would naturally look to pass on to their customers. Usual cost models within the industry indicate that an extra £1 spend on material, for example, would mean an increase in price-point for the consumer of £4-£5. Fashion businesses can only charge what the market will pay, and it is unlikely that the market will allow producers and retailers to raise prices for garments without tangible enhancement of the product.

Therefore, perhaps the most important step to tackle this culture of disposability is to create an environment where longevity is a desirable attribute of the product. This would require a cultural shift, driven by consumer re-education, corresponding marketing promotion and, perhaps, new business models. Where longevity is seen as a significant product attribute, this can be marketed to create a competitive advantage or point of difference to maintain or improve market share and profits – and *communicating* longevity would not require any real increase in cost. However, increased longevity will not necessarily represent a sufficient enhancement to the consumer to justify paying extra if it is not a primary reason for buying the item. Any proposed solutions would need to be tailored to the target market as this will vary by age, product type and market level.

As well as changing consumer perspectives, there is also a need to rethink company strategy and business models: longevity needs to become integrated within that strategy and model, fully supported by senior executives. This would then give product designers, buyers and merchandisers clear direction and targets when building new ranges.

3.3 Fibre and fabrics

As a general principle, better quality fabrics will give longer-lasting garments and this applies to all clothing categories. However, the situation is complex and fabric quality depends on many variables, such as fibre type, yarn blends, yarn structure, fabric construction, fabric dyeing and finishing. As a consequence, fabrics with the same description (e.g. '100% cotton') can vary greatly in performance and longevity.

Take wool – often perceived as 'hard-wearing': yet while the raw material is perhaps more robust than some, the way it is processed has a significant impact on its durability, as does the way it is used and cared for. Fine knits are easily damaged; incorrect washing can lead to shrinkage.

What's more, durability may not be a relevant attribute for all end products: in some cases, 'better quality' does not mean hard-wearing but instead refers to excellent drape, lustre or softness to the touch. These qualitative attributes may mean the item is worn more frequently and kept for longer.

Therefore, selection of fibre and fabric types is based on the end product and its expected use, rather than any general principles. One way that design teams can influence the longevity of the items therefore is to identify key standards the fabric must meet – and then task buyers to source fabrics that have been tested to meet these standards (see section 3.5 below).

3.4 Design and manufacture

Garment life expectancy is affected by a range of decisions: choice of fibre and yarn; fabric construction and finishing; trimmings; garment design and make-up. Because these

decisions are typically made at the design stage, product design has been identified as pivotal to determining the longevity of the garment. Designers are able to specify many relevant characteristics of the final garment. Some of these characteristics are physical and can be tested for compliance; others, such as 'fashionability' or styling, are subjective and cannot be objectively tested. They are nonetheless crucial in determining garment longevity.

Our workshops agreed that the single most design important factor in extending a garment's life expectancy is its cut, and there are several cuts which were identified as potentially increasing lifespan. Tailored and semi-tailored pieces were highlighted as longer-lasting because they frame the form well aesthetically. Oversized knits and kimono shapes that can be worn with a belt were described as versatile and 'comfortable', therefore potentially wearable for longer. From a fashion perspective, 'classic' styles (i.e. the little black dress, tailored shirts, pencil skirt, chino-style trousers, v-neck jumpers etc.) will tend to be longer lasting, especially if core colours are used (i.e. black, white, navy, grey and red). Classic or simple styling can also aid the production quality and reduce cost, as there is an established body of technical knowledge and production expertise in these classic items.

There are of course some fixed measurements to influence size and fit, such as bust size or waist measurement. However, human shapes do not come in standard sizes, nor do consumers all have the same preferences in terms of comfort and how fitted a garment should look. One way to circumvent this and maximise longevity is to design clothes to include some capabilities that facilitate size adjustment to allow for reasonable variations in an individual's shape (and preferences). This could involve the use of strategic fastenings, for example, to increase/decrease size/length on side seams or hems.

Garment construction is also key aspect of garment longevity. There are dozens of stitch types and many choices of sewing threads and other methods of construction, such as fusing and welding, in addition to different machine types and settings. Each is suited to specific fabrics and garment categories and so need to be selected in agreement with the garment manufacturer and detailed in the garment specification. Seemingly small factors, such as trimmings or components, can also have an impact on overall longevity, both in terms of quality of the component and how it is attached to the garment. Clearly, these choices need to be aligned to expected usage of the garment. Expectations and standards relating to longevity in clothing are not clearly defined or understood and will vary by product category or retailer.

A good way to find out the suitability of a fabric in relation to its end use is through the use of wearer trials pre-production. This method can assess a range of issues that can directly affect the longevity of the garment such as:

- how well it withstands washing;
- susceptibility to staining;
- durability of fabric; and
- understanding of care instructions.

By conducting such trials over a reasonable time period, manufacturers can identify any issues and take appropriate steps to resolve them – such as changing fabric quality. A number of industry standard tests now exist for fabrics and garments, covering physical testing, colour-fastness, chemical testing and flammability. The latter two relate to safety and legal requirements and are not referred to below unless they impact upon the longevity of the garment.

Physical tests include:

- seam rupture;
- tear strength;

- burst strength;
- pilling, abrasion;
- elasticity; and
- seam slippage.

Colour-fastness is assessed on a grey scale of 1 (poor) to 5 (excellent) and a criterion might be '4-5 after 20 washes'. Tests include:

- subjecting garments to domestic laundering, commercial laundering & dry-cleaning;
- rubbing (wet and dry);
- chlorinated & sea water;
- phenolic yellowing; and
- testing for print durability.

Not all tests are appropriate for all garments, and longevity quality levels will be dependent on product type plus expected use (to determine, for instance, how many cycles in an abrasion test are required). There is no absolute single standard for all products. Many standards relate to the process and equipment, while the assessment criteria can be subjective, as well as depending on the product and its expected use. For example, a ball gown would be expected to be commercially cleaned occasionally, whereas a swimsuit needs to be colourfast to a variety of water conditions with multiple uses. Standards may be British (BSI), European (CEN) or international (ISO), and even retailer-specific (Marks & Spencer led the development of clothing technology standards).

Garment and fabric testing – further information

The ASBCI has some technical excellent publications such as *Tried and Tested*, *Caring for your Clothes* and *Make or Break*.¹⁵ In addition, testing houses are good sources of expert advice, particularly those with global operations such as Bureau Veritas, HSTTS, Intertek and SGS.

3.5 Care and repair

The lifespan of clothing is influenced by how it is used and maintained. Garments are susceptible to abrasion, stains and soiling to varying degrees depending on the circumstances of use, and certain types of clothing will need to be cleaned more frequently than others. However, the frequency with which a garment is washed will affect its lifetime, and laundering at the wrong temperature is liable to shorten its life.

Recent evidence suggests that many people do not sort their washing – hence increase the risk of colours running, or of washing more delicate fabrics at the wrong temperature. People also wash their clothes frequently, out of habit rather than necessity. Many consumers are unaware of material properties, and therefore do not care for their clothes as effectively as they could: for example, they don't know whether the best way to care for a garment is to hang it up or fold it, dry it flat or on a hanger, use the loops provided or hang it by the shoulders.

When it comes to dry-clean only items, the most commonly reported problem was component failure, rather than the fabrics breaking down or being detrimentally affected by solvents. The lifespan of such items could therefore be increased by ensuring such components (e.g. buttons, zips) can withstand the dry cleaning process.

¹⁵ www.asbci.co.uk

Improving care information within products and packaging is clearly therefore a way to increase longevity. But in addition, wider educational measures could help, such as encouraging people to wash their clothes only when necessary, and where possible at 30 degrees.

Clothing repair skills have been lost in recent years and people often lack confidence in their ability to mend or alter clothes.¹⁶ Most can sew buttons on, but fewer are able to alter a hem or darn a hole. Younger people in particular are less likely to have these skills. As a result, many people simply store or discard items in disrepair or in need of alteration. However, there is growing evidence of interest in learning how to repair clothing. Surveys show that more people want these opportunities, and a number of community initiatives have emerged such as thezipyard.com¹⁷ and Cordial and Grace¹⁸. At national level, TV shows such as The Great British Sewing Bee can also help promote clothing repair and alteration as a valuable and enjoyable activity.

3.6 Re-use and discard

The process by which clothing is discarded is often not straightforward. Research has estimated that around 62%¹⁹ of discarded clothing in the UK is collected for re-use and recycling whether through charity shops or friends and family, sold online via eBay or collected by textile merchants or charities.

However, around 350,000 tonnes of clothes go to landfill each year, even though the materials have commercial value, either as re-usable garments, or when recycled into wiping cloths, felts and other non-clothing uses.

Evidence suggests that many items of clothing are stored for a year or more after they are last worn before they are discarded. Although this technically prolongs clothing lifespans, the main reason for the gap is that people leave them in their wardrobe, and forget about them. This can mean that by the time the owner discards them, items are no longer fashionable and so less likely to be resold. Though the lifespan may be longer, this is not resource-efficient. If owners felt better able to repair or alter them, then these items might be more likely to be reworn.

¹⁶ Fisher et al. (2008). *op cit*.

¹⁷ www.thezipyard.com

¹⁸ www.cordial-and-grace.co.uk

¹⁹ WRAP (2012) *Valuing our clothes: the evidence base*.

4.0 Childrenswear

This category covers clothing for children from babies to teenagers. It therefore includes all garments, but takes account of specific requirements for children. Specific subcategories include school wear, nightwear, party clothes and fancy dress, as well as everyday clothes such as trousers, skirts, t-shirts, coats and knitwear.

4.1 Top five solutions

- Designing-in a growth allowance.
- Selecting fabrics and components that are proven to offer durability and colourfastness.
- Applying fabric finishes to reduce the likelihood of staining.
- Designing garments for multi-functionality (such as reversible coats).
- Reinforcing weak areas, or areas liable to extra stress such as elbows and knees.

4.2 Introduction

Children fundamentally require comfortable clothes that will enable them to move freely. It is normally expected that children – particularly younger children – will outgrow their clothes before they have become worn out. This not only creates a strong opportunity for re-use – something that most parents are keen to encourage – but also means that design and manufacturing approaches generally seek to produce childrenswear that does last longer than clothing in other categories. Nonetheless, there are significant opportunities to increase the lifespan of childrens' garments still further.

4.3 What limits lifetime?

The most common reason for disposing of childrenswear is that the child has outgrown the garment. Children are expected to grow 6-7cm per year, which affects sizing and fit. When the clothes no longer fit properly, they are typically either thrown away or passed on to siblings, children of friends or family or to charities. Options for alteration are not typically considered, or are not possible.

Another reason for disposal is component failure. This is more likely when clothes have not been quality tested.

Childrenswear often requires frequent laundering; this can reduce their longevity as repeated launderings weaken and fade the fabric, giving it a worn appearance. Shrinkage will occur when the garment has been washed at too high a temperature. The absence of clear and detailed advice on care labels (or it being ignored by consumers) may be a contributory factor.

As children get older, 'fast fashion' at relatively low prices often becomes attractive. Many teenagers who are developing fashion awareness like to have new clothes regularly but have limited budgets.

4.4 Fibre and fabric

Children wear their garments in distinctive ways that have an effect on the durability requirements of product. Because their lifestyles are often active – indoors and outdoors – clothes can become worn quicker than their adult equivalents, for example on the knee in the case of toddlers, and especially subject to stains and soiling. Products may therefore need to be more robust than some adult wear, and choice of fabric is clearly key to this. The quality of raw materials is pivotal: fabrics need to be selected to reflect the anticipated end-use of the garment. For example, elastomeric yarns can be used within fabrics that stretch. This will then help the fabric to recover from stretching and minimise loss of shape.

Wearer trials and risk assessments can be invaluable. In general, it is good practice too to use quality assurance testing for children's clothing, for safety reasons.

Designers may need to increase their level of knowledge in order to understand technical guidance on fabric, garment construction and safety requirements (flammability, chemical substances) and size. This could require forming closer working relationships with fabric and garment technologists, fabric suppliers and testing houses.

Creating and using quality manuals

Many large manufacturers of childrenswear have created their own quality manuals that set out specific requirements for the construction and testing of childrens' clothing. This not only provides useful information for designers, but also evidences good practice, as safety and legal requirements dictate that quality is not compromised in favour of allowing inferior garments to be delivered into store. These manuals typically contain testing requirements for fabrics and components; it is therefore important to refer to them when manufacturing garments and to introduce regular quality inspections at different stages of production.

4.5 Design and manufacture

When it comes to childrenswear, it is important to remember there are two distinct audiences: parents and children. These two audiences typically have very different priorities (although these change as children get older). Children may be only interested in the appearance or comfort of a garment; parents, on the other hand, are concerned with wider properties. They want, and expect, children's clothes to be practical and hard-wearing.

These different priorities are fundamental to design issues around children's clothing – and can provide important insights for designers. For example, it could lead to selecting fabric qualities and trims in order to maximise longevity, or developing garments with reinforced elbows and knees, particularly for infants. Other useful additions include designing patches into the garment or attaching spare patches for home mending to the swing ticket. If the garment has been designed with buttons, then it makes sense to provide spare buttons at point of purchase.

Construction too is important. There is a general assumption that the standard of make-up will be good when constructing childrenswear. Manufacturers may therefore want to test fabric and component quality and then provide assurance to potential buyers. Parents also expect that clothes have been designed and manufactured with child safety in mind, and that legal requirements have been adhered to.²⁰ For example, regulations include restrictions on draw cords usage, button security, trim attachment, flammability and toxicity.²¹ (Further information can be obtained from the Trading Standards Institute, the organisation responsible for the enforcement of safety regulations.)

Another priority, for parents in particular, is sizing, because of the speed at which children grow. To prolong use, designers can look at ways to build-in elements that can help garments last longer, such as increasing stretch by using elastic in waistbands and use of generous hem allowances. Another important fact is that in general, children's heads are large in proportion to their bodies. This can be addressed by designing necklines to include buttons or other devices that can make the neck opening larger.

²⁰ *General Product Safety Regulations, 2005*

²¹ www.tradingstandards.gov.uk

Other useful approaches include developing multi-functional garments, that can be worn in different ways to broaden the styling options, and increase the potential amount of wear. These are suitable for younger children, as well as teenagers, and potential examples include:

- reversible coats;
- t-shirts that could be worn as pyjamas; and
- long loose shirts that could be worn as a dress or tucked into trousers.

For fashion-conscious teenagers, these sort of options can be invaluable. As well as the well-known fact that teenage fashions change quickly, encouraging rapid disposal of garments deemed out of fashion, social media is adding further pressure. A recent NTU workshop identified that some teenage girls will feel that if a picture is posted on a social media site of them wearing a particular outfit or item, they then cannot wear that item again for at least a month.²²

Possible ways to overcome this include providing suggestions on how make greater use of garments in their wardrobe – for example, by providing styling advice, offered at point of purchase through new technologies such as smartphone apps or online.

There is also scope to include design features that may make garments more attractive for young people to wear, such as:

- pockets for iPods, phones and fold-away hoods;
- skirts/dresses that can be fixed at varying lengths; and
- collars that transform into hoods.

4.6 Care and repair

Garments worn by children may become soiled and stained more often than normal and therefore require frequent laundering, which will be detrimental to longevity if they appear faded and look worn more quickly. This not only highlights the need for good quality fabric but also reinforces the impact of laundry practices on longevity. By encourage their children to wear clothes for longer, or more frequently, to minimise the number of times a garment is washed, parents can help extend its lifetime. This may be achieved by simple measures such as the use of protective items such as aprons.

As caring for childrenswear differs from adult clothing, advice on good practice to consumers is especially important. There is high consumer demand for childrens' clothes that can be laundered regularly, quickly and easily; however, by encouraging consumers to wash clothes less frequently and always in adherence to garment care instructions, it will be possible to improve longevity. Manufacturers have a role to play here in educating parents, and children, to encourage behaviour change. One simple example is attaching child-friendly care advice to the garment, including suggestions for how children – even at a young age – can look after their clothes by hanging and folding them: whilst children are young it is a good time to impress good practices on them.

As with all clothes, the decline of sewing skills means that rather than altering a garment when it no longer fits, or mending a hole or tear, people are more likely to throw it away. However, many small repairs can be easily made, and reintroducing and re-emphasising skills such as sewing on buttons, letting down hems or darning will prolong the amount of time childrenswear is kept. These skills can be learned by both parents and children alike: an ideal opportunity to embed these good practices is whilst children are of school age.

²² NTU Behaviour Workshop, 8th March, 2012

There are a number of simple ways that the industry can help with this:

- swing tickets attached to garments could recommend sewing loose buttons and small tears in seams;
- basic repair kits including threads or yarn, buttons and instructions, could be provided as standard, or promoted at checkouts, to enable minor repairs;
- factsheets could be offered in-store, online or in packaging, and instructions and guidance written in child-friendly ways; and
- more inventive suggestions on how to customise childrenswear garments could be provided, along with off-cuts of fabric and threads.

4.7 Re-use and discard

It is normal practice that outgrown childrenswear is passed on to younger siblings or friends. Handing down garments provides customers with better value for money – the same item is worn by two or more children. This message, if communicated effectively, ought to encourage the purchase of well-made, high-quality childrenswear items.

But as well as focusing on the potential for re-use as a reason to buy higher quality items, there are also other opportunities for reuse of childrenswear that can be developed.

- Suppliers could consider 'buy back and resale' schemes, or hiring of rarely worn items such as party dresses or fancy dress.
- Consumers can be encouraged to engage in sharing, swapping and repurposing (as well as passing on items to family or friends).
- Schools can promote the re-use of school uniforms – something some already do.

As consumers typically expect to be able to re-use childrenswear – either with younger siblings or by passing it on to others – it makes commercial sense for childrenswear to be designed to facilitate this. For example, when it comes to school uniforms, design for re-use might involve the selection of classic colours and styling, as introducing fashion colours will mean that items risk becoming dated and unfashionable before a second or prolonged use.

As well as business models to encourage re-use, there is also a significant opportunity to educate young consumers about the need to reduce waste and resource use, and their ability to make a difference with regard to discarding clothes. By giving them information and guidance about how to care for the garments, a longer lifespan can be encouraged; similarly, children may be more willing to pass on garments when outgrown or no longer wanted, or to wear second-hand clothes. Educational visits to waste management facilities or clothing production sites can help this, while upcycling and sewing workshops can help teach sewing skills to enable customisation.

Garment design can also affect the ease with which clothes are recycled. Using a single fabric facilitates recycling, but where multiple fabrics and components are used, there is scope for designers to make it easy to disassemble these, without compromising the robustness of the product.

5.0 Occasionwear

Occasionwear refers to clothes that are worn for special events and occasions. It includes bridal wear, dinner jackets, evening wear, party dresses and high quality suits.

5.1 Top five solutions

- Using classic styles, innovatively, to help transcend fashion fads.
- Ensuring high quality fabrics are used when designing garments.
- Designing garments that are multi-functional, to give the customer the option to wear different parts of the outfit with other clothes.
- Facilitating alteration through adjustable waistbands, generous seams or additional buttons.
- Selecting materials and components that can withstand the chemicals used in the dry-cleaning process.

5.2 Introduction

Occasionwear refers to garments that are worn to special events such as birthday and engagement parties, weddings, christenings, balls or days at the races.

Occasionwear is an exceptional category of clothing. It is worn infrequently; indeed, items are often stored and unworn over long periods. It therefore makes sense to design them to last – especially given that these garments often command a premium price: this in turn means consumers expect longevity as an indicator of value for money.

This suggests a need for classic design considerations rather than fad design, with flexibility for modifications. However, the price point also affords the opportunity for detailed makeup, the use of luxurious fabrics, surface decoration and embellishment and opulent trims: manufacturers of occasionwear are often highly skilled. Typically, occasionwear undergoes commercial laundering rather than regular washing.

One additional consideration is the possibility of designing clothes in a way that can increase their use even if, as a consequence of more frequent wear, their lifetime is shortened.

Manufacturers chosen to produce the garments need to have appropriate skills levels to match the sophisticated quality desired to be engineered into occasionwear.

5.3 What limits lifetime?

Even though occasionwear is typically worn less frequently than other categories, there are a number of factors which can limit the lifespan of garments and see them disposed of before they are worn out. In some cases, the very fact that they are rarely worn can encourage consumers to throw them out, rather than keep them. More commonly, the gap between occasions means that consumers have gained or lost weight between wear: consequently, garments do not fit properly or are uncomfortable to wear.

There are also design factors that influence longevity. Occasionwear that follows current fashion trends can quickly become dated; some occasionwear garments have a highly distinctive design, which means consumers are reluctant to wear them more than once over a short period as others will notice it's the same item.

Garments made from delicate fabrics often do not withstand rigorous wear. They may be easily torn or snagged, or spoilt by spillages of food or wine. Once damaged, they are no longer worn and are likely to be disposed of if care and repair is not easy, cheap and convenient.

5.4 Fibre and fabric

Occasionwear, more than most other categories, makes extensive use of luxury fibres, elegant fabric designs and advanced textile technologies and treatments.

Key fibres that the designer might select include silk, fine wools, viscose and cashmere. Fabrics associated with occasionwear include velvet, satin, taffeta, jacquard, chiffon, crepe, georgette, organza, organdie, laces and tulles. Woven, weft and warp knitted fabrics are all used, while non-wovens represent a small but growing part of the market. Whole garment knitting and jacquard power weaving technologies are facilitating the creation of new textile structures that integrate two and three-dimensional characteristics within the same surface.²³ Digital embroidery, laser cutting and engraving technology are being applied to create highly technical but desirable fabrics for *haute couture* and influencing the occasionwear market, which relies on innovation and 'unexpected' novel effects.²⁴

This growing range of options means that selecting fibres and yarns is no longer a simple choice between natural or synthetic, as engineered fibres and hybrid yarns become more readily available to the high fashion market.²⁵

However, these delicate fabrics are more susceptible to damage during production and wear, as are the fittings, finishings and components used.

- Velvet is a pile fabric so can be affected by pile loss over a longer period: testing can help assess susceptibility to pile loss, and designers may want to set a maximum amount of pile that the fabric can lose.
- Garments made from silk fibre and woven fabrics such as georgette or satin are delicate and known to tear during garment make-up or when worn. Satin in particular can be subject to snagging, with pulls occurring on the surface of the fabric. This is a natural occurrence with satin, caused by the long floats of yarn associated with this type of weave. However, the tightness of the weave, the fibre type, yarn twist and float length can have a bearing on how likely the fabric is to snag. Designers may therefore want to stipulate some of these issues.
- Additional finishing, such as embroidering or trims such as sequins and motifs, is integral to the appearance of many occasionwear garments – and if it is damaged or becomes worn, consumers may throw the entire garment away or return it to the retailer. Therefore, it is important to pay as much attention to sourcing these finishes, trims and components to prolong the item's lifespan. Testing can help assess how well these finishes and components can withstand laundering. Potential issues can then be flagged in garment care advice: for example, some buttons may need to be removed before dry cleaning.
- Occasionwear often contains interlinings. It is important that the correct interlining is used during testing or pilot runs, so that the tests provide a true picture. Garments from the pilot run can then be tested in different way, such as following laundry instructions, to ensure that no delamination of the interlining occurs.

²³ This was notably explored by Issey Miyake in his A-POC and 132 45 collections.

²⁴ R Huddleston and P Whittaker (2010). Jakob Schlaepfer: A case study in laser innovation and the unexpected, *Craft Research*, 1 (1), pp. 125-132.

²⁵ M. O'Mahony (2011). *Designing Future Textiles: New developments in textile structures and surface treatments*. In: A. Briggs-Goode and K. Townsend (eds), (2011). *Textile Design: Principles, advances and applications*, Cambridge: Woodhead, pp. 354-366.

One option often considered for these fabrics is the use of anti-soil finishes to protect against staining. Before applying such finishes, designers may want to consult fabric suppliers as some such finishes can affect the strength of the fabric, or the way it feels.

5.5 Design and manufacture

When it comes to designing and marketing occasionwear, different rules apply compared to everyday wear. Consumers seeking garments for special events often want to stand out in terms of style, which leads them to look to *haute couture* for inspiration, resulting in the purchase of ready-to-wear or high street interpretations – which they then may not plan to wear again. Some items (in particular, garments such as wedding dresses or ball gowns) may be retained for sentimental value rather than with any particular intent to wear them again.²⁶

Others will want an item that will last a long time and be kept 'for best' – but this can mean consumers feel overdressed when wearing it and so the number of occasions it is used for is very small.

There are therefore two distinct approaches to increasing longevity of occasionwear through design:

1. focusing on quality, so that these often expensive items do last and continue to look good for longer; and
2. finding ways to encourage consumers to wear items more frequently and so get more use out of them before discard.

The former involves fabric or fibre choice and care – considered in separate sections – but also manufacturing processes. One area where longevity can easily be increased is in the seam and stitch types used for occasionwear, to minimise the likelihood of problems such as puckering, damage to the fabric or holes at seams. Specific practices such as under-pressing garments during make-up need to be carried out carefully, so that the surface of the fabric is not damaged by pressure which can result in glazing on high sheen fabrics or flattening the nap on pile fabrics. It may also be useful to include loops for hanging items correctly during storage, to guard against loss of shape.

In terms of increasing wear, there are a number of options available to designers.

- Classic styles and colours (black, navy, white, grey, cream) help transcend fashion fads and mean an item is more likely to be re-worn when fashions change. This is particularly true for items viewed as 'investment' pieces by consumers.
- Cutting fabric on the bias, or including pleats, draping or a flared or fuller skirt on an evening dress can make for a more flattering fit.
- Garments can be designed to be worn in more than one way – or have detachable parts so that the design can be simplified or worn on less formal occasions. Suits can be mixed and matched with other items of clothing, as can layered pieces: a lightweight bias cut crepe dress sold with an embroidered tulle overtop could be worn separately with other garments.
- Garments can be sold with accessories that help transform their look. For instance, a dress could include or suggest an accessory in the form of a piece of opulent costume jewellery, silk scarf or intricate belt.²⁷

²⁶ J Chapman (2005). *Emotionally Durable Design*, London: Earthscan.

²⁷ A good example is an A/W Vivienne Westwood dress (£445) styled with an Anlomania leather belt (£90), which transformed the dress from 'formal evening' to 'fashionable daywear'.

- Allowing for fluctuations in weight gain or loss will encourage the consumer to keep the garment for longer. To address this, garments can be designed to allow easy alteration – through adjustable waistbands, generous seams or additional buttons – though clearly this cannot be done in a way that is detrimental to the overall look of the garment.

There are a range of tools and design approaches that have the potential to influence longevity. Garment design has latterly been strongly influenced by CAD technology through the closer integration of 2D textile and 3D pattern cutting technologies. This has resulted in designers being able to engineer surface design effects, allowing the body of the wearer to be optically contoured – essentially making clothing more flattering. This approach could be further explored by high street brands producing occasionwear.

The Eastern aesthetic evident in the work of Japanese designers such as Issey Miyake, Rae Kawakubo and Yohji Yamamoto highlights other styles – such as origami-inspired designs – that could be used to improve fit, while the Northern European influence of the Antwerp 6²⁸ is also important through its deconstructed approaches to garment design and pattern cutting.

Finally, when it comes to occasionwear, there are clear opportunities to promote sustainable or eco-fashion: this is an area where consumers are often looking for something different, and eco-fashion may tick that box, with customers willing to pay higher prices.²⁹

5.6 Care and repair

As it is infrequently worn, occasionwear is not subject to the stresses and strains of products worn day to day. Garments are laundered less frequently, and may need to be handwashed or professionally dry cleaned because of the delicate nature of fabrics used.

However, these same delicate fabrics mean extra care is required in cleaning, storage and during wear to ensure that garments continue to look good. Therefore care advice is particularly important, especially as many consumers do not own multiple items of this sort. Advice on care labels or swing tickets may need to include recommendations to:

- wash coordinating products together, and remove accessories before washing;
- dry clean only when necessary, rather than after each wear – using airing instead as a means of freshening garments. It may also be important to remind consumers that both parts of a suit should be cleaned together, and that accessories may need to be removed before dry cleaning;
- avoid rubbing stains, as this can damage the fabric, and not to use solvents for spot cleaning as they can cause discolouration;
- take special care to avoid pulls – particularly for garments made from woven Jacquard or satin – both during wear and storage; and
- store carefully, using high quality wooden or padded hangers where possible and using any loops or other features provided.

Clearly, care instructions need to reflect the item itself and any specific issues that have been identified during testing and wearer trials. Separate or additional care advice may also be needed for any detachable components.

²⁸ K. Townsend and G. Goulding (2011). *The interrelationship of 2D and 3D in textile and fashion design*. In: A. Briggs-Goode and K. Townsend (eds.), *op. cit.*, pp. 288-322.

²⁹ S. Brown (2010). *Eco Fashion*, London: Laurence King, A. Gwilt and T. Rissanen (2011). *op. cit.*

Repair of occasionwear is a complex area; the nature of the fabrics and the way the items are made up may mean that repairs and alterations need to be undertaken professionally with specialist skills and machinery. There is a potential business opportunity therefore for retailers and manufacturers to either develop specialist aftercare services or identify companies to recommend to customers.

For minor repairs, such as sewing back on buttons, spare buttons and matching thread can be provided as applicable.

5.7 Re-use and discard

As discussed above, occasionwear is sometimes bought as a keepsake, rather than seen as an item for ongoing wear. But despite this, there are numerous opportunities for re-use, including through 'vintage' fashion and alternative business models to individual sale. What's more, the specialist fabrics used in some occasionwear are sometimes valuable and can be repurposed.

Garments designed in classic styles and colours are more likely to be re-used, particularly where the design allows for modification, either for comfort or to modernise/customise an item.

Recent evidence has found a strong consumer interest in opportunities to hire occasionwear or formal wear – something that is currently available in the menswear and vintage markets, but less so for womenswear. The same research also identified interest in a 'buy back and resale' model, in which customers could return nearly new occasionwear to retailers for resale, receiving monetary rewards or store vouchers. This would offer consumers an opportunity to afford occasionwear they may not otherwise purchase, and the research found a significant number of people who would want to return used occasionwear items and/or willing to purchase used items.³⁰

Beyond these occasionwear-specific models, there are of course other opportunities for re-use and recycling, such as resale through Ebay or other online channels, donations to charities and swap or swishing events. Retailers can provide advice on these through their own websites, as well as suggestions to use recycling facilities rather than simply throwing clothes away.

This is particularly important for occasionwear items: evening dresses, to take one example, often use a large amount of fabric, which therefore increases the possibility of repurposing it once the garment can no longer be worn. Using a single fabric facilitates recycling, but where multiple fabrics and components are used, there is scope for designers to make it easy to disassemble these, without compromising the robustness of the product.

³⁰ WRAP (2012) *op cit.*

6.0 Knitwear

This section covers knitted outerwear, including jumpers, cardigans, and dresses produced and manufactured by weft knitting.³¹

6.1 Top five solutions

- Using quality yarn and fibres to improve the strength and colourfastness of knitted garments.
- Ensuring care and laundry advice is clear and simple.
- Taking steps to preserve the quality of knitted fabric (including colourfastness) and garment manufacture throughout production.
- Providing guidance for use and design in re-use and encourage consumers to downcycle old garments.
- Focusing on classic design and loose shapes.

6.2 Introduction

Knitted garments offer comfort and warmth. As result, the feel of the fabric can strongly influence purchasing decisions. However, knitwear is also highly susceptible to damage and distortion, through pulls on the material, poor quality construction and incorrect laundry processes.

Knitwear is typically seen as either a staple wardrobe item or an investment piece, linked to a high level of craftsmanship. Longevity is more likely in the latter case. This is because it is a category where craftsmanship and knowledge of the entire product lifecycle is important to producing garments that last. The more consumers understand this and are encouraged to differentiate, the more likely they are to make quality a key consideration in purchase.

A range of factors, from fibres themselves to yarn spinning processes, different yarn count references and technical manufacturing procedures, all influence how well a product lasts. Designers may need to become familiar with machine gauges and knitted fabric structure and understand 3D form and garment construction, and to work closely with yarn suppliers and spinners as well as knitting technicians and with garment technologists who will be able to assist and provide technical guidance.

Even then, there is still the risk that poor quality production processes can affect the lifespan of the end products: as well as setting standards at the outset, in terms of raw materials and fabric tensions/qualities, designers may want to be involved in selecting manufacturers and recommend regular quality control checks during production. Areas such as aftercare are also important, both to extend first life and encourage re-use.

6.3 What limits lifetime?

Knitted fabrics are formed from interlinked loops. As a result, they are more liable than other types of fabric to distortion, shrinkage and shape loss through wearing and washing. Knitwear also suffers from pilling or felting. All of these factors result in garments becoming unwearable – either because they no longer fit properly or no longer look good.

These issues are particularly prevalent in garments made using lower quality materials and components or poor manufacturing processes. They are also exacerbated by consumers' lack of understanding of laundry requirements and aftercare. Washing at too high temperatures can lead to shrinkage and felting, which occurs when the scales on wool-rich fibres (natural wool, cashmere, alpaca, etc.) get tangled. Pilling, caused by abrasion on the fabric surface,

³¹ Weft knitting is the process by which yarn is fed crosswise to the length of the fabric and loops are formed in sequence across the width of the fabric.

can result from continuous wear and over-washing. Hanging garments for storage can lead to shape distortion.

Finally, like other garments, knitwear can become outdated when fashions change.

6.4 Fibre and fabric

Given the problems identified above, it's clear that fabric choice can have a significant impact on how likely a knitwear garment is to last longer. Knitting is one of the oldest ways of making clothes, and the textiles industry has over the years found a number of solutions to common problems. For example:

- elastomeric yarns in knitted structures can enhance the recovery of stretch fabrics, particularly at cuff and hem ribs;
- acrylic yarns, though less luxurious in terms of feel, can produce long lasting garments and are inexpensive and hard wearing – so are particularly suitable for lower-cost garments and knitwear likely to experience heavy use, such as childrenswear;
- fibre dyeing can sometimes be used in preference to yarn dyeing for assurance of colourfastness when using some types of fibre (i.e. wool or cotton);
- pre-shrinking treatments may be applied to the fabric as a finishing process; and
- pilling can be prevented or minimised by selecting yarns with longer fibres, and avoiding blended fibres.

This is in addition to the general principle that higher quality fabrics will continue to look good for longer. Fibres such as cashmere, mohair and merino wool can command a premium price because consumers expect them to last longer: they are deemed to offer good value. All of these issues can be defined by designers, setting standards from the outset in terms of ensuring raw materials and components are to the quality required by selecting appropriate fabrics and establishing fabric tensions/qualities, including wales and courses.

When the standards have been established, testing at various stages of production can help ensure the quality of the garments is maintained. Relevant tests include shrinkage and colourfastness, and suitable stages for testing are:

- pre-production;
- knitting (fabric only);
- mid-production (when garments have been assembled, for cross checking); and
- final production (garments selected at random from finished production prior to delivery).

Limiting choice to increase control

Once a particular set of yarns has been chosen and tested, designers and buyers alike can gain benefit from staying with that same set for knitwear designs over several seasons. From the design point of view, it can increase over fabric quality: knitting technicians will become familiar with the yarn properties, so will need to make fewer adjustments to machine settings, leading to more reliable production. From the buyer's perspective, meanwhile, this may provide an opportunity to negotiate better price deals.

6.5 Design and manufacture

Designing knitwear for longevity is, as suggested above, a question of attention to the smallest details as well as overall shape and style. In broad terms, the styles and silhouettes deemed most likely to encourage longevity and re-use include classic colours and marl effects, high-quality fine and chunky plain and ribbed knits, and traditional stitch patterns such as Fair Isle and Arran popularised by vintage trends.

Looser fits may encourage the consumer to retain the garment for longer as they allow for fluctuations in body shape. They can also be labelled as either single size or dual-sized; garments knitted with a fabric structure that can stretch, however, are expected to be

labelled as single size. However, the sizing and fit of knitwear is complex due to variations in the stretch of garments theoretically the same size: this occurs because of differences yarn types, stitch patterns, structures and machine gauges. It is therefore worth considering designing-in adjustable features so that garments can fit a wider range of shapes and sizes, or looking at possibilities to make garments multi-functional so they can be worn in different ways – such as dresses that could also be worn as jumpers, or vice versa.

At the more detailed level, designers can also enhance longevity of knitwear by focusing on factors such as seams, trims and components. Linking trims provides security and strength and increases the luxury of the appearance. Buttons and buttonholes can be areas of weakness, but tests exist to assess these – such as the EU childrenswear pull test standards which provides a useful bench mark.

Seam breakage is a risk if quality is not maintained in production: to minimise this risk, cup seaming is recommended for fully fashioned knitwear as it produces a secure seam without cutting the fabric. Overlocking is a cheaper option, but to reduce the risk of breakage of cut and sew knitwear, four-thread overlocking is generally required, as well as adhering to standard guidance for minimum stitches per inch: for a 10-gauge fabric, this would be 10–12 stitches per inch.

An alternative approach is to design garments that do not require seaming. These are known variously as no waste, interactive or complete garment designs, and are knitted with integral body and sleeve and require only the attachment of a neck trim. Benefits include innovative styles, individual and bespoke fit, increased comfort for the wearer due to lack of seams, equal distribution of fabric stress on the fabric and increased styling options, each of which enhance garment longevity.

Whatever design decisions are made, well-considered construction is also essential to prolonging the lifetime of a knitwear garment. Designers can influence this through the development of garment specification sheets that set out the precise details and standards required. These can then be developed further by the technologist, and referred to at all stages of manufacture, with regular quality control checks ensuring they are adhered to.

Specification sheets typically contain information such as:

- make-up method sequence;
- machine types to be used for sewing;
- thread for stitching type and colour;
- stitches per inch required;
- wales and courses on the fabric;
- details of any trims and how to attach them e.g. buttons; and
- size requirements.

6.6 Care and repair

As highlighted above, knitwear is often damaged by washing, drying or storage practices. Therefore one of the key steps to increase longevity is to improve consumer knowledge about how to care for knitwear, and in particular what **not** to do.

Care labels already provide information such as instructions to hand wash or reshape while damp. However, not all consumers understand what is meant by these terms, so more detailed advice – for example in swing tickets or on a website – could help. Other relevant advice may include:

- reducing the number of times a garment is washed – airing in between wears;
- using specific laundry detergent for knitwear;
- laying knitwear flat, rather than using hangers for storage;

- using moth balls; and
- recommending the use of a specialist pilling removal tool.

A broader message is that knitwear garments need special care, and that consumers need to 'keep caring'.

Small holes in knitwear or lost buttons can be repaired relatively easily. To encourage this, garments could be sold with home repair kits included; such kits would consist of correct-coloured yarn and thread, spare buttons and other components, as well as instructions, or a link to online information.

For major repairs, specialist skills and machinery may be required. There is a potential business opportunity therefore for retailers and manufacturers to either develop specialist aftercare services or identify companies to recommend to customers. Links can also be introduced to community-based initiatives that enable users to develop repair skills.

6.7 Re-use and discard

Knitwear is commonly resold or re-used, even when it has become slightly misshapen or shrunk: it can still fit another wearer, and its qualities of warmth and comfort are preserved.

Therefore, wherever possible, consumers can be encouraged to donate unwanted knitwear to charity, or even give it to friends or family; garments that no longer look good can still be used for outdoor activities such as gardening.

There is also potential demand for higher quality knitwear for resale or re-use³² because of its attributes and thus possible business opportunities to develop 'buy back and resale' schemes.

Retailers can facilitate this by providing advice and guidance for consumers on their websites, or on garment labels, encouraging consumers to seek options for re-use. Worn-out knitwear can be recycled, and components such as buttons and zips recovered for re-use.

Using a single fabric facilitates recycling, but where multiple fabrics and components are used, there is scope for designers to make it easy to disassemble these, without compromising the robustness of the product.

³² A case study of the benefits of reusing woollen jumpers is available. See WRAP (2011). *Benefits of Re-use Case Study: Clothing*.

7.0 Tailoring

Tailoring refers to formal for regular use, such as suits, jackets, skirts, trousers and coats. Clearly, it is related to occasionwear: the difference between the two can arguably be attributed to how consumers use (and intend to use) the garments: in this category, the focus is on items to be worn daily or many times in a week. However, tailoring designers may want to read the chapter on occasionwear as well.

7.1 Top five solutions

- Using high quality outer fabric and ensuring lining and interlining are compatible.
- Applying classic styles, cut and colours, and building-in features to allow easy adjustment size and shape alteration.
- Including clear guidance and advice on the care label.
- Where possible utilising detachable elements, such as collars or linings, which can be replaced when worn.
- Providing a specialist aftercare service, as well as mending and repair advice.

7.2 Introduction

Tailoring is a product category where longevity is valued. Consumers expect suits and tailored coats to last a long time and withstand frequent wear. Because tailored clothes are worn as smart or formal items, they are less affected by fashion trends, with a strong emphasis on classic styles and colours. They are expected to retain their shape well and be less susceptible to fraying, staining and other damage.

The fact that many tailored garments meet these requirements can be seen not only in the long lifespan of many suits, in the strong second-hand market for tailoring – and the fact that Savile Row suits have traditionally been passed down from generation to generation.

Of course, the bespoke garments crafted by Savile Row tailors are only part of the tailoring market, which also includes made-to-measure and the mass produced garments sold on the high street. The price range of tailored garments varies accordingly, but the perception remains that higher price points imply longer-lasting items. The extra investment normally ensures higher quality fabrics and construction. Tailored garments generally consist of different fabric and fibres: for example, the outer cloth could be 100% wool flannel with 100% silk lining and cotton interlining.

When produced by specialist tailors, these fabrics – and individual parts - will be stitched together by hand (and possibly machine), with a strong focus on shape and structure, using interlinings, stiffenings and shoulder pads. The interlinings will be basted (i.e. stitched temporarily by hand) to the body fabric to ensure shape and structure is achieved.

However, this is a time-consuming process and so not cost-effective for mass production, where the use of iron-on interlinings has replaced the hand basted bespoke method. Here, interlining fabrics are produced with a fusible adhesive on one side: this is then applied to the fabric by heat with the adhesive melting to the outer cloth.

This is just one of many possible examples of the differences in construction at different price points.

7.3 What limits lifetime?

As noted above, tailored are generally less susceptible to fashion trends than other types of clothing, though slight changes in trends and cuts can reduce wear. Instead, garments tend

to be discarded either when they no longer fit, or when they no longer look smart. There are a number of reasons why this can occur, including:

- wear and tear around particularly vulnerable areas, such as collars, cuffs and hems;
- failure of individual components like buttons or zips; and
- distortion, creasing or shrinkage. This happens because of differences in the properties of fabrics used for interfacing and linings, compared to the outer cloth. When the garment is washed or cleaned – following instructions based on the properties of the outer cloth – the interfacing may become damaged. Lower quality fabrics are more likely to suffer from this.

The other limiting factor is that sometimes suits are unworn for long periods, during which the owner's body shape – particularly their waistline – may change. This can mean that after storage, the garments either no longer fit, or no longer look as smart as required.

7.4 Fibre and fabric

Choice of fibre and fabrics has a major influence of the longevity of tailored garments. As in other categories, the general principle holds true that higher quality fabrics will typically last longer. However, designers and buyers for all markets have price points and margin targets to meet, so different decisions have to be made.

Wool fibres or other natural fibres (such as merino wool) or a silk or linen blend are generally considered to be a good choice of fabric for longevity, as opposed to synthetics. Natural fibres resist dirt and breathe well compared to synthetic fabrics, which often retain body odour. Where it is not commercially feasible to produce garments in 100% natural fibres, wool mixes generally offer the best quality for the price. Polyester blends will help with abrasion resistance and shape retention. Pure silk is not recommended. For woven fabrics, key criteria include a high tear strength and low seam slippage, and overall fabrics that resist dirt and require less washing or dry cleaning are a better choice wherever possible, as the laundering process adds to the wear of the garment.

Much can be learnt about designing tailored garments for longevity from the good practice developed by Savile Row tailors, who for the most part select only fabrics of natural fibres. In a typical Savile Row suit, the outer cloth will be 100% wool in a traditional weave (e.g. Prince of Wales or Herringbone). 100% silk fabrics will be used for the lining of the garment, with natural fibres for the interlining. The garment will be stitched using a 100% cotton sewing thread. The choice of these fabrics is one element of ensuring longevity is achieved.

There are a range of tests available to help assess resistance to staining and cleaning processes. Because longevity is expected, it is important to ensure garments do meet required standards. For example:

- garments to be dry cleaned need to be tested for colourfastness against dry cleaning solvents such as perchloroethylene or 'green earth' solvents is required, and for dimensional stability to machine dry cleaning;
- garments that are designed to be machine-washed need to be tested for colourfastness in domestic and commercial washing machines. Best practice is to test items when washed at 10 degrees higher than the wash temperature stated on the care label; and
- all fabrics, whether dry cleaned or machine or hand washed, need to be tested for colourfastness to perspiration and dry rubbing.

However, even before testing – and arguably, as part of the design and buying process – it makes sense to check fabric tolerances with test houses. This can save wasted time and effort in the development of unsuitable garments. While individual properties are typically well known, there are often unexpected issues around materials used in combination, such as interlinings and linings. Adhesives used in interlinings, for example, can be susceptible to

failure if they have repeated exposure to solvents and cleaning agents. Key properties for fabrics chosen as interlinings therefore include:

- air permeability;
- form stability;
- crease resistance;
- stability to washing and dry cleaning; and
- dimensional stability.

7.5 Design and manufacture

Because tailoring is expected to have a longer lifespan, designers need to work with this in mind. Cut and colour are crucial, and in general it is recommended that classic cuts and colours are used to both prolong lifespan and increase frequency of wear.

The cut of a tailored garment is generally perceived to be the most significant feature. Clearly, a bespoke tailored garment should guarantee a good fit: the skilled tailor will ensure the garment is made to measure, and will fit the garment through various stages of construction, adjusting and amending as required. More generally, good fit can be created through classic tailoring styles that are then translated into a reliable set of tried and tested pattern blocks to enable mass production. These blocks need to be checked regularly and adjusted in accordance with customer feedback to ensure garments are meeting customers' sizing requirements.

In terms of colour, classic or neutral colours (black, charcoal, navy, brown, and camel) have greater longevity compared to fashion or seasonal colours. Trend colours can be introduced as highlights, such as piping, or contrast stitching or linings. An example of this is demonstrated by the designer Paul Smith, who has developed ranges of traditional tailored garments with a contemporary twist.

A further key principle is to design items that can be easily adjusted and altered over time. There are various aspects to this, ranging from features to enable easy adjustment if a consumer's waistline changes, to enabling parts such as pockets, collar or linings to be easily detached and replaced when they become worn.

Bespoke tailored garments are almost always designed to allow for adjustment in size. They typically include allowances on waist seams, the centre back seam on a jacket or coat, and through the body darts: sleeves also have built-in allowance, with only one being functional so sleeve length can be lengthened or shortened as necessary. But adjustable elements can also be readily designed-in to mass produced garments – such as wide seam allowances on the back rise seam of trousers, centre back seam on jackets and coats, a choice of waist fastening widths on the waistbands of skirts and trousers, and the inclusion of elastic in half or full waistbands.

In terms of production, again it is important to bear in mind the expectation of longevity. By following some of the practices of skilled tailors, the lifespan of mass produced garments can be increased without incurring substantial costs. For example, most tailored garments have linings to protect the seams support and shape the top cloth. Interlinings and the top cloth must be aligned in the same direction of the grain to avoid distortion.

When a lining is used, it is acceptable to leave seams on a garment unfinished; for garments without linings, all cut seams need to be finished to avoid fraying, either by overlocking or applying a binding along the raw edge.

In general, tailored garments are best constructed using a lockstitch machine and a strong thread (ideally 120–130 strength). Needle size will depend on the fabric: a size such as Nm70 is generally appropriate for lightweight fabric (lining), while a size like Nm100 may be needed for heavyweight (outer fabric). This will prevent seam puckering, as well as distortion of warp and weft threads in the fabric caused by needle penetration as the fabric is stitched. It is recommended to top stitch seams wherever possible, not only for design effect but to ensure seam security.

The quality of trims and other components is also important in longevity. In recent years, the quality of components has declined as a means of reducing cost, but this has led to problems such as buttons not remaining on garments during laundering. A useful rule of thumb is that buttons, zips and other components need to be compatible with the recommended care instructions for the whole garment.

7.6 Care and repair

Because tailored garments are often purchased as investment pieces, with longevity in mind, consumers are potentially more receptive to messages around the correct care for the garments and options such as fitting, alteration and repair services.

For example, tailored garments made from wool generally need to be dry clean only – and many consumers are already aware of that (though this must be clearly stated on the care label to avoid any unnecessary damage). However, fewer consumers are aware of the potential to spot or steam clean wool garments to remove minor stains. Therefore, care guidance can explain how to do this and what the benefits are. It can also point out that restricting the frequency of dry cleaning helps to prevent fibres from breaking down.

Where garments are suitable for machine washing – such as tailored items made from some synthetic fabrics and mixed blends – this is often highlighted as a key benefit at point of sale. Care instructions need to be clear about machine settings and recommended drying practices. There is also potential to provide guidance on storage of tailoring to minimise creasing.

In terms of repairs, again consumers are likely to be receptive to tips on basic mending tasks such as replacing buttons and re-stitching seams. To encourage this, garments could be sold with home repair kits included; such kits would consist of correct-coloured thread, spare buttons and other components, as well as instructions, or a link to online information.

For more complex repairs or alterations, which require specialist skills or machinery, there are potential business opportunities: retailers can provide services themselves or recommend partners.

7.7 Re-use and discard

Because tailored garments do last for a long time, there is a strong second-hand market for them, through charity or vintage shops – and retailers can help raise awareness of this by providing advice on the labels and their websites about options for re-use.

Designers can encourage re-use by following the principles outlined above – of using classic styles and colours, so garments do not fall out of fashion, and allowing easy adjustment.

There are also potential business opportunities to develop 'buy back and resale' or hire services for tailoring, following the lead of occasionwear sector, where many retailers provide hire services for menswear in wedding suits or evening dress.

Worn-out garments can be recycled, and components such as buttons and zips recovered for re-use. Using a single fabric facilitates recycling, but where multiple fabrics and components are used, there is scope for designers to make it easy to disassemble these, without compromising the robustness of the product.

8.0 Denim

This section is primarily focused on jeans but also covers denim jackets, shirts, dresses and skirts.

8.1 Top five solutions

- Using ozone bleaching, laser engraving and resin finishes to create the desired effects with a lower environmental impact.
- Enhancing fabric strength and surface quality by applying sustainable dyeing, bleaching and surface treatments.
- Applying traditional, robust manufacturing methods and mass customization strategies to products.
- Educating consumers about the unique characteristics of denim and how to care for it and repair, re-use or repurpose it.
- Creating emotional attachment through ethical sourcing and production, no waste and craft design approaches.

8.2 Introduction

Denim is naturally associated with longevity, being worn longer than other fabrics due to its hard-wearing physical properties and naturally ageing characteristics. Fashions have dictated that well-worn denim is still deemed to look good – based on a narrative of wear which means discolouration and even damage that would be unacceptable in other garments is welcomed. The concept of denim as a ‘second skin’ through close or good fit and its ability to mould to the shape of the body of an individual through laundering and wearing practices leads to a unique emotional attachment, recognised as a behavioural driver for enhancing garment longevity.³³

A perfect example lies in one of the most famous denim garments, Levi’s 501 jeans. They have evolved from their initial development as workwear in California by Levi Strauss in the 1850s, through use by gold prospectors and cowhands in the 1930s and as uniform issue for the armed forces in the Second World War³⁴, to become a long-standing fashion item. The five-pocket design in ‘3x1’ twill fabric, mass-produced using robust construction methods, remains an important benchmark for the denim industry.

However, the same example highlights how even within the denim sector, high quality raw materials and specialist construction methods facilitate extended garment use and re-use.

Denim garments can be found in all sectors of the market, including bespoke and made-to-measure through to mass-produced garments sold through supermarkets. The price range of denim garments varies according to the status of the designer and brand, but unlike other garment categories, price does not always directly correlate with consumer expectations of wear.

Today, the prime challenge for the industry is how to produce denim more sustainably. This chapter therefore examines not only physical durability, but also how retailers can source, produce and market denim in ways that will further enhance user attachment to garments.³⁵

³³ J Chapman (2005) *op cit*.

³⁴ Zhang Huiguang and Luo Lv. (2007). *Delirious Denim*, London: Southbank Publishing, London.

³⁵ H Schifferstein and E Zwartkuis-Pelgrim (2008). *Consumer-product attachment: measurement and design implications*, *International Journal of Design*, 2 (3), pp.1-14

8.3 What limits lifetime?

Despite being generally hard-wearing, the fabric and component quality of mass produced denim has deteriorated in recent years due to the demand for cheap clothing and easy care laundering. This has resulted in more garments being disposed of due to fading and thinning of fabrics.

One cause of this is washing at high temperatures in biological detergents, which can result in advanced dye loss and abrasion. Although some consumers use this approach to 'naturally age' saturated indigo coloured denim, today's sophisticated pre-washing treatments mean that this is now rarely necessary: instead over-laundering can make garments look too worn.

Washing can also lead to garments losing quality of handle and shape, becoming baggy at the knees or seat so no longer fitting well. This is much more prevalent in denim for the younger, high street market, bought in a wider variety of fabrics manufactured from blends of natural and synthetic/elastomeric fibres and colours: these appear less attractive when faded than traditional indigo.

Twill denim structures can break down or fray at key garment stress points, such as knees, elbows, hems and collars. This is a result of regular wear, but has again been exacerbated by the use of lower quality fabric – as have issues such as belt loops breaking, pockets coming away from garments and the tearing or fraying of pocket linings. These small faults can lead to disposal: the general decline in mending skills means that fewer consumers choose to repair them. Component failure, such as damage to zips, pocket rivets, fly and cuff buttons and fastenings, is also a cause for disposal.

8.4 Fibre and fabric

Denim's durability as a textile structure is based on its warp-faced twill construction, in which a white weft or filling yarn passes under two or more, dyed warp fibres. The ideal (unwashed) weight for men's jeans is deemed to be 12-14oz, but the handle and drape of the fabric and durability and comfort of the garment can be enhanced by the inclusion of cellulosic fibres such as lyocell in association with the use of open end or ring spun yarns.

Traditionally dyed blue with natural indigo, denim is now generally coloured using chemical dyes in various shades of blue, (sulphuric) black and grey, although it can be manufactured in any shade, including metallic. Indigo denim remains the most significant jeans fabric: however, it is notoriously unfriendly environmentally, using vast quantities of water in the production process.

Designers now intervene with the natural process of wear that is denim's USP by applying high and low-tech treatments to accelerate the creation of specific effects, such as stonewashing. These include hand sanders and laser cutting and engraving. Resin fabric finishes can be applied to prevent colour loss and abrasion. Newer treatments such as finishing of garments using enzymes and use of more sustainable bleaching treatments such as 'dry ozone'³⁶ reduce the amount of water and concentrated chemicals needed; they also avoid the adverse affects on fabric structure that can be caused by stonewashing or sandblasting, and are preferable in terms of health and safety.

There are a number of tests that can be undertaken to ensure denim meets the standards required, including dry and wet rub, abrasion resistance, tensile strength, tear strength and seam slippage. It is important to test not only the initial fabric but also finished garments,

³⁶ <http://www.greentechcorp.net/our-technology/dry-ozone-for-denim/>

and consider retesting or batch checking, as individual batches may vary in aesthetics and strength in terms of fabrics and construction. Wearer trials can also be of use.

Unlike many other categories, denim can be marketed and sold on an ethical basis, with certain market segments interested in how the fabric is sourced – which in itself becomes part of the narrative of wear for the consumer.

Hiut Denim is a good example of this. It uses woven fabrics in 12oz Turkish or 14oz Kuroki denim and emphasises the provenance of the product: sourcing of organic fibre, dyeing using natural indigo and manufacture by experienced artisans. This also them to market their jeans as individually crafted, and commanding a premium price as an 'investment' product. However, Hiut also incorporates new technology: each item has a unique identification number or 'history tag'³⁷ that can be used by the wearer online through social networking to track the life of the jeans. The feature also enables second hand buyers to track the first life of the garment – and implies that the garment will last a long time.

Another company, Nudie, emphasises use of fair trade denim woven on Japanese hand looms, natural indigo plant dyes and cellulosic washing and bleaching treatments. It claims that the company doesn't 'just offer jeans, but a way of thinking and a commitment to repair, re-use and reduce.'³⁸

There are also opportunities to introduce zero waste approaches to fashion design and pattern cutting for denim. While visibly repaired garments in other categories are deemed to be less valuable, features like patches can add to the value of denim, and incorporate fabric ordinarily wasted, both as a design feature and to increase physical durability.

8.5 Design and manufacture

Like many other categories, the cut and fit of denim garments are integral to longevity. Although not usually cut as close to the body as tailored garments, nor afforded the creative scope of occasionwear, denim garments – particularly jeans and jackets – are expected to frame and surface the human form aesthetically. There are two fundamental approaches designers can take to achieving this:

- using classic cuts and styles – which in the case of denim includes a wide range of different styles from loose fit to bootcut to skinny, with trends evolving frequently; and
- providing bespoke or individual jeans.

Examples of this latter approach include Levi's, with its Curve ID service which provides made-to-measure jeans in a variety of shapes; Marks and Spencer, which offers a made-to-measure jeans service, reflecting consumer interest in good, personalised fitting garments and – to a lesser extent – brands such as Not Your Daughters Jeans and Mother, who focus on providing different flattering fits for different body shapes.

Within the former category, there is still significant scope for variation and innovation. Lee Cooper's collaborations with Vivienne Westwood underpin the importance of innovative cutting and how this can consolidate or rejuvenate interest, brand loyalty and product longevity. Gerbaud is recognised for innovative cut and Diesel is one of the most pro-active companies in terms of using innovative surface treatments created using advanced technological systems.³⁹

³⁷ www.hiutdenim.co.uk

³⁸ www.nudiejeans.com

³⁹ *These have included the effects of 'destruction, damage, filth and mould' (Huiguang 2007: 329)*

When it comes to choosing colours, the majority of denim is still sold in varying shades of blue, though as discussed above the use of natural indigo has now been largely replaced by chemical dyes. This increases the range of colours available for designers. However, there are well-established buying patterns around colours: dark indigo and black are most popular for autumn/winter, while lighter jeans – including bleached and stonewashed varieties or 'ice' blue and grey shades – are more popular for spring/summer.

Alternative colours to the core blues and black tend to reflect latest trends: they may also use lower-quality construction processes as they are not expected to last as long. One useful approach for retailers therefore is to use coloured denim pieces as seasonal highlights that, if possible, work with staple denim ranges. In this way on-trend items can be purchased to consolidate a new look, as opposed to creating a new wardrobe. Top Shop provides a good example of how this works by providing a broad range of styles in indigo, blacks and grey under its Moto label, which it then supplements with on-trend coloured versions in a limited, highly fashionable cut.

There are well-established manufacturing processes for denim – such as stitching using a lap or flat fell seam, widely referred to as a 'jeans seam'. Yet there are variations within this: for example, the multi-thread chain stitch 401 is generally used for plain seams, but is particularly useful for skinny or close-fitting jeans as it produces extensible seams that do not pucker (a common occurrence when stitching around curves), and in jeans made with elastomeric yarn, as it provides greater elasticity within the seam. To avoid fraying at hems and other edges, overlocking stitches such as 504 (three thread) or 512 (four thread) can be used, with strong threads (ideally 120-130 strength). As a general rule, top-stitching enhances the security of seams on denim as well as providing an attractive design effect.

To address the possibility of breakdown of the denim fabric through abrasion or repetitive wear to key points on the garment, there are various methods of reinforcement available, such as:

- strategic patching on the inside of the garment (like Levi's 511 Slim 2009) or outside as a feature;
- using higher quality materials, such as heavy 'ecru' cotton twill pocket linings;
- incorporating woven interlinings;
- adopting workwear manufacturing standards, particularly around reinforcing seams and pockets: corners of pockets are generally reinforced with metal rivets, but as these are difficult to replace it is recommended that they are also secured with bar-tacking or by applying a patch of durable fabric, for example leather or PVC;
- limiting the use of highly abrasive and harmful chemical treatments, and choosing instead less harmful bleaching methods such as 'dry ozone', which uses reduced amounts of water; and
- using engineered surface design treatments such as laser engraving around key 'prone to wear' areas such as knees, elbows and collars.

To minimise the risk of components coming off, buttons are recommended as opposed to popper fastenings; the latter require a special tool to attach them, so replacement is more difficult.

Once standards are determined for manufacture, it is useful to produce a quality manual for ready reference across all parts of the process.

8.6 Care and repair

Washing and wearing affect the handle and appearance of denim: the effects of abrasion and fading of the dyed warp threads gradually reveal more of the undyed, 'white' weft of the cloth.

A range of factors affect the speed at which a garment becomes more worn, including the function of the garment, the frequency of wear, laundry processes and the context it is worn in. As consumers often have preferences about how 'worn' they like their denim to be in terms of shade, texture and fabric hand, it is in the retailer's best interest to assist them to achieve this. Detailed garment labelling, that specifies how a particularly designed, dyed and finished garment is likely to be affected by different care practices, can help. As well as the basic information – that denim garments are best washed inside out, at low temperature and with minimal detergent – labelling could advise consumers that, to preserve the desired worn effect, it is best not to wash garments too frequently: instead, they can be refreshed via steam ironing or airing, or dry-cleaned.

As acknowledged above, wear marks and holes in denim items are often kept as 'badges of honour', but there is also an interest in repairing garments – particularly amongst women. Men are less likely to repair garments themselves, but said they often sought assistance from partners or female family members to repair particular denim pieces to which they had formed a strong emotional attachment, and would use a mending service if provided by a retailer. Potential repairs include patching, using parts of older similar garments that are no longer worn, and replacement of elements such as collars and pockets using deconstructed garments.

To encourage this, garments could be sold with home repair kits included; such kits would consist of patches, matching thread and spare buttons, as well as instructions, or a link to online information.

For more complex repairs or alterations – discussed more in the next section – which require specialist skills or machinery, there are potential business opportunities: retailers can provide services themselves or recommend partners.

8.7 Re-use and discard

Denim's longevity opens up a lot of opportunities for re-use. Garments can also be passed on as second-hand – to friends and family or through donation to charity shops. There are also opportunities to resell garments online or through vintage outlets. Retailers can help raise awareness of this by providing advice on the labels and their websites about options for re-use.

The hard-wearing material can also be altered or re-styled as fashions change, or if parts of an item become unwearable. As well as simple customisation for different tastes – adding patches or embellishments to a second-hand denim item – it is possible to:

- reconfigure items such as jeans into skirts and dresses, or jackets into waistcoats;
- shorten jeans when hems have frayed to create cropped styles or shorts;
- create a more fitted silhouette by re-seaming to reduce leg width; and
- create a fuller or looser silhouette by adding inserts on side seams to increase leg width.

Websites such as Denim Blog provide tips for styling jeans in different ways, expanding the possibilities of wear.⁴⁰

⁴⁰ <http://www.denimblog.com/>

There is potential for retailers to create significant value through such extended product use, in particular by offering specialist alteration services. To facilitate this kind of re-use, designers may benefit from further training around technical and sustainable textile advancements, production and testing methods, fabric sourcing, garment construction and safety requirements. For example, sustainably dyed, surfaced and finished denim may last longer than other commercially produced garments.

Worn-out garments can be recycled, and components such as buttons and zips recovered for re-use. Using a single fabric facilitates recycling, but where multiple fabrics and components are used, there is scope for designers to make it easy to disassemble these, without compromising the robustness of the product.

9.0 Sportswear

Sportswear includes garments used for physical activity from low impact (jogging, yoga, golf, walking) to high impact (tennis, running, football and gym activities). Swimwear is not directly addressed.

9.1 Top five solutions

- Using durable material, with reinforced seams and areas where rubbing or chafing occurs.
- Providing care instructions that encourage airing clothes or washing promptly after use.
- Encouraging longer attachment to items through the use of wearable technology or personalisation.
- Adding soil-resistant or antibacterial finishes to reduce problems from body perspiration and odour.
- Selecting warp-knitted fabrics with open fabric structures (e.g. nets and mesh) to help the transport of moisture.

9.2 Introduction

Sportswear is distinctive in that it may be bought with a very specific use in mind: a particular sport or activity. Therefore, purchasers expect that garments are suited to that activity, both in terms of fit and, increasingly, technical performance. Performance criteria for sportswear include abrasion resistance, absorbency, colour fastness, comfort, dimensional stability, elasticity, elastic recovery, flexibility, piling, wicking and translucence. Consumers are generally willing to pay a premium price for these performance elements – but expect performance wear to last longer as a result.

Sportswear is an area where technology is advancing fast, in terms of fabric, finish and construction to wick away moisture, provide compression or offer protection from impact. Some garments now even incorporate features such as timing chips.

An element of trust around the performance of the item and the advanced technology is crucial – one reason why around 70% of sportswear bought in the UK comes is produced by well-known brands⁴¹ that consumers trust. However, this also highlights the other key aspect of sportswear: that is a fashion choice, and sports brands are deemed to be highly fashionable. Indeed, most sportswear purchases are made not for sporting reasons but to be worn as mainstream casual attire⁴² – over a third of people in the UK take part in no regular sport or exercise activity, but many still wear sportswear.

This suggests that a multifaceted approach needs to be taken to achieve longevity – focusing on ways to increase the lifespan of both garments that are worn for sporting activities and those worn as casualwear.

Given this, designers may want to read the following chapter, which provides guidance specifically on casualwear, in addition to this chapter.

9.3 What limits lifetime?

The reasons for discarding sportswear depend on the reason for purchase. A garment bought for fashion or casual purposes is likely to be discarded, or possibly downgraded, when it is no longer fashionable. It may also be discarded due to staining, loss of shape or wear and tear.

⁴¹ *FASHION TRAK (2003). Branded Sports Clothing.*

⁴² *MINTEL (2011). Sports Clothing and Footwear.*

These latter reasons also apply to sportswear worn for specific activities, but depending on the nature of the activity, this may well occur sooner. For example, items subject to sweat perspiration are sometimes discarded immediately: marathon runners have been known to throw t-shirts away mid-race.

Staining and wear and tear may be a result of substandard raw materials, or fabrics not having been tested in the correct environment – then proving unable to cope with the abrasion, stretch or moisture levels associated with the sporting activity. In other cases, it can be due to consumers' lack of understanding of laundry requirements, which then cause odour, mildew and/or mould, and degradation of the fabric.

Alternatively garments may be discarded when the 'smart' element of the material, such as waterproofing, no longer functions effectively.

Sportswear garments are not often repaired and if the material (or an accessory) fails will generally be thrown away.

9.4 Fibre and fabric

Fabric choice for sportswear needs to reflect the intended sporting use and level of activity: indoor or outdoor, high-impact or low-impact, how warm the wearer is likely to become, etc. As well as technical considerations, comfort is key to minimise chafing and rubbing; the handle and texture of fabrics can even affect sporting performance – wearers can lose concentration due to chafing, or 'up their game' if they feel more professional. In turn, this can affect the length of time a garment is kept and used: garments may be deemed 'lucky' or seen as an integral to a successful performance.

The fibres most commonly used for sportswear are wool, which traps air, and synthetic fibres which mimic the properties of down: these include synthetic wadding, textured yarns, hollow fibres, micro fibres, fibre pile and polar fleece. Cotton is often good for use in sportswear as it is strong and durable. However, it creases easily and is absorbent, so soaks up water – becoming heavy in the rain. Because it does not stretch, it cannot be used if the fabric needs to be elastic.

In terms of synthetic fibres, polyester, including recycled polyester, is well suited to performance sportswear. It is strong, durable and abrasion resistant; non-absorbent so does not soak up sweat, while being rain-resistant. It has reasonable insulating properties, keeping heat in, and it is easily cared for and stored. It doesn't crease, is resistant to acids such as sweat, and will not rot if left damp. One negative aspect is that it collects static, which may be a concern if the fabric is rubbing.

Nylon (polyamide) and elastane are also often used in sportswear. They are very elastic and so stretch and recover well. Like polyester, they are crease-resistant, durable and non-absorbent. They can also be effectively combined with other fibres to offer a stretchy, form-fitting quality. However, nylon is not an effective insulation so is not recommended for outdoor sports where temperatures are low and the wearer needs to keep warm.

Ongoing research continues to develop new fabrics for sportswear which offer additional technical or performance features. UK company Finisterre has developed new fabrics for outdoor sports with increased durability and breathability based on the study of fur

physiology,⁴³ while Armadillo uses a fine Merino jersey for high-performance wear, which it now supplies to the British Army.

To increase resistance to both the elements and wear, sportswear fabrics may be tightly woven, while warp knitted fabrics – such as nets or mesh – can help transport moisture. Some garments use mesh in areas particularly prone to sweat, such as underarms. Other technical options include coating and laminating, to allow vapour transmission while barring larger droplets. Anti-bacterial products and soil-resistant finishes can be applied to fabric to stop bacteria growing on clothes leading to odour, which may affect longevity.

Nanotechnology, while controversial,⁴⁴ is of particular interest for sportswear – theoretically enabling increased resistance to dirt and odours, as well as other performance benefits. Amicor™ for example, is a group of fibres used in socks to prevent odour.⁴⁵ Properties which can repel water and help reduce stress on the body, including joints, could in the future be added to clothing.⁴⁶ By adding smart nanomaterials, the fabric may keep its purpose for longer.

Given their expected environment and usage, it is particularly important that sportswear garments are tested for colourfastness to perspiration and dry rubbing. Fibre dying, in preference to yarn dying, is likely to help with colourfastness.

9.5 Design and manufacture

Effective sportswear design requires a balance between fashion trends – reflecting its popularity as casualwear – and performance properties. The latter may involve incorporating technical fabrics, using the latest joining methods and making allowance for technology such as phones, media players or sporting performance tracking devices. These are discussed further below.

One area where fashion can particularly influence sportswear is in choice of colours. However, while a seasonal colour may get more worn in the short term, classic or neutral colours (black, white, grey, charcoal, navy and brown) have greater longevity. Designers may look to balance the two, using trend colours as highlights, in the form of panels, stripes, piping or contrast stitching or linings that could be replaced on higher investment pieces (such as jackets) when the garment looks dated.

High visibility is where colour choice and performance considerations meet: if visibility needs to be increased as a safety element, it is best done so in a way that maintains a classic look. A similar principle applies to steps to reinforce parts of the garment most subjected to rubbing or chafing, or the addition of extra lining to reduce the risk of abrasion – all of which can help increase the comfort of the item when used for sporting activities.

One way to increase the frequency of wear for a sportswear item is to embrace multi-functionality. For example, walking trousers can be produced with zips around the leg area that enable the bottom part to become detached, meeting a dual purpose: shorts for hot

⁴³ S Kettley (2011). *The Design of Technical Textiles*. In: A Briggs-Goode and K Townsend (eds) (2011) *Textile Design: Principles, advances and applications*, Cambridge, UK: Woodhead Publishing.

⁴⁴ P Sharret and D Adam (2012). *Nanotechnology* [online]. London: Guardian. Available at <http://image.guardian.co.uk/sys-files/Guardian/documents/2012/03/29/NanotechP2-3ToGCv4.pdf> [accessed 18/05/2012]

⁴⁵ www.amicorpure.co.uk/sites/amicor/home/marketing/the_brand.asp.htm

⁴⁶ Troy M Benn and Paul Westerhoff (2008) Nanoparticle silver released into water from commercially available sock fabrics *Environmental Science and Technology*, 42 (11), pp.4133-4139.

weather and long trousers for cold. Replaceable bottom half trousers could be provided, creating interchangeable garments.

In some ways, this is the opposite of other key developments in sportswear design – complete garment technology and stitch-free welding, both of which can assist with sportswear garment longevity. Complete garment technology enables the production of seamless garments, where the stretch of the fabric is equally distributed (as opposed to seamed garments, which on stretch fabrics in particular bear considerable strain and can easily split). Innovative high performance fibres can be knitted using this technology, including polyamide micro fibres which can produce breathable, quick drying and durable clothes.

Stitch-free welding is a way of joining fabric together by fusing the pieces of fabric by heat, high frequency radiation or bonded adhesive film. As no thread is used to join the garment, it is liable to require fewer repairs.

Where these technologies are not used, it is considered best practice to use flat fell seams in sportswear, using perhaps 406 two needle multi thread chain or 602 covering chain to ensure the stitch will stretch with the fabric. This adds strength to a garment that will be worn with performance in mind, and to top stitch seams wherever possible, not only for design effect but to ensure seam security. For some sports, waterproof seams may be required.

There are a number of different design practices that can increase longevity of sportswear items by seeking to increase user attachment to the garment. When a consumer has a sentimental attachment to a garment, they are more likely to keep, wear and look after it as they know that it cannot be easily replaced.

One means is shortening supply and creating a limited edition product, such as Stella McCartney Team GB kit.⁴⁷ Another is allowing the consumer to personalise a garment (e.g. through colours or added extras, such as displaying their name on it). Where items are to be given as gifts, design elements could be included on the inside of the garment to allow the giver to write a message. Such personalisation may hinder re-use, but sportswear is often not resold due to the nature of its use.

A third option is around technology. By creating a link between technology and the garment, the item may become more integrated into the wearer's life and this may increase longevity. At a simple level, this could entail designing garments to include secure pockets for technology (e.g. phones, media players, tracking devices) – and ensuring that these are sufficiently flexible so that the garment is not locked into a particular cycle of electronic technology.

At a more advanced level, there is a growing use of technology in sportswear to support body monitoring and performance tracking.⁴⁸ Where this is effective, the item becomes more than just a garment: it's a training aid – and so likely to be used more and kept for longer.⁴⁹ Adidas is actively embracing the use of wearable sensors that can provide accurate measurements of body movements for performance improvement as well as for injury

⁴⁷ J E Ha-Brookshire and N N Hodges (2009). *Socially Responsible Consumer Behaviour? Clothing and Textiles Research Journal*, 27 (3), 179-196.

⁴⁸ Nike plus is an example of this within footwear.

⁴⁹ L Dunne (2010). *Smart Clothing in Practice: Key Design Barriers to Commercialization*. *Fashion Practice*, 2 (1), pp 41-66.

prevention – for example, by monitoring physiological signals to enable early identification of heat stress or dehydration.

The European Union ConText research project examined weaving, printing, lamination and embroidery practices to identify the most promising techniques to monitor electrophysiological activity from the body in as unobtrusive way as possible. The research has significant potential ramifications for designing longevity into sportswear through its focus on incorporating contactless sensors into textiles through state-of-the-art product manufacturing processes such as laser cutting, ultrasonic welding and computer-guided sewing.⁵⁰

9.6 Care and repair

Sportswear will be subject to soiling, staining and perspiration more than other garments, which means extra care is required to keep a garment looking good and lasting longer.

There are a number of simple care recommendations that can help, including:

- highlighting the importance of prompt laundering after physical activity, rather than leaving wet or sweaty garments in a sports bag, which may encourage the progressive breakdown of fabrics, including mildew in cotton-based garments;
- recommending airing garments where possible to reduce the need for laundering and thus prolong life;
- discouraging the use of tumble drying due to its aggressive effect on textiles; and
- recommending that garments with motifs need to be ironed on the reverse to avoid damaging the motifs.

More specific care instructions may be needed for performance fabrics and wearable technology.

Repairs to sportswear garments can be difficult, particularly to performance fabrics. However, there are still plenty of aspects that can be repaired, such as sewing on buttons or other components. Where this is possible, garments could be sold with home repair kits included; such kits would consist of patches, matching thread and spare buttons, as well as instructions, or a link to online information.

For higher-value items, such as coats, there may be business opportunities around repair or alteration services. For example, Barbour provides a re-waxing service for the life of a garment and will replace worn linings.⁵¹

9.7 Re-use and discard

In general, sportswear garments are less likely to be resold due to perspiration and proximity to skin. When items are still in good condition – for example, sportswear that children have grown out of – there may be opportunities for resale. Schools and sports clubs may also offer channels for re-use. Garments that are worn out and no longer suitable for the main sporting activity they were designed for may still be suitable as casualwear, or for activities such as gardening or walking.

Retailers can provide advice on labels or through their websites on possible opportunities for re-use, and encourage consumers to give items to charity.

⁵⁰ S Kettley (2011). *The Design of Technical Textiles*. In: A Briggs-Goode and K Townsend (eds) (2011). *Textile Design: Principles, advances and applications*, Cambridge, UK: Woodhead Publishing.

⁵¹ www.barbour.com/repairs-reproofing

Many consumers are relatively unaware of the possibility of recycling clothing, so may assume that items that cannot be re-used must simply be thrown away. Retailers can also therefore help raise awareness of specialist recyclers, particularly for sportswear. Using a single fabric facilitates recycling, but where multiple fabrics and components are used, there is scope for designers to make it easy to disassemble these, without compromising the robustness of the product.

10.0 Casualwear

Garment types in this category include t-shirts, sweatshirts, leggings, trousers, shorts, skirts, blouses and shirts.

10.1 Top five solutions

- Selecting high-quality fabric and testing rigorously for performance, including colourfastness and pilling.
- Providing clear and simple care and laundry instructions.
- Designing-in adjustable features to accommodate fluctuations in body shape.
- Where appropriate, designing garments with detachable parts which can be replaced when they become soiled or worn.
- Providing styling guidance for the consumer to encourage longer use and potential re-use.

10.2 Introduction

Casualwear is one of the largest product areas of the market – in terms of both the range of different types of garments and the sheer volume sold and worn. A study, published in 2006, suggested that the average consumer buys around eight t-shirts per year.⁵² Given the ongoing rise of 'fast fashion', which predominates in this sector, it is likely that this figure is now higher. Garments such as t-shirts and basic sweatshirts can be manufactured quickly, and therefore lend themselves to being developed as low-cost items that will be disposed of in a short time when the fashion trend has moved on. While they are in fashion, they are likely to be worn – and washed – frequently.

Of course, the consequence of this is that not only are large volumes of casualwear sold, but large volumes are disposed of. Even if they don't fall out of fashion, items are often of poor quality, rather than being made to last. These low-cost garments are also available to purchase in all manner of locations, from high street clothing retailers to supermarkets, as well as the growing online market. This can lead to an increased frequency of purchase without thought or regard to need.

From the waste and resource perspective, therefore, casualwear is a major challenge – not least because the 'disposable' attitude is now being extended to more expensive, high-fashion garments, which are also thrown out as soon as trends move on. Even where these are produced to better standards, they are unlikely to be re-used as they are so associated with a particular fashion or style.

As this chapter shows, this need not be the case. There are plenty of well-established methods for producing higher quality casualwear garments that last longer and are less affected by the latest trends. However, while this guidance fundamentally addresses the issue from the design perspective, it is clear that the bigger challenge is around proving the commercial case for investing more in production, and charging more for these higher-quality garments. A business model could be developed around producing garments that last longer – particularly for casualwear garments that follow classic or timeless styles – and marketing this additional longevity as a key benefit to consumers, who would in turn be willing to pay more if longevity was assured. Providing that assurance is the responsibility of the designer.

10.3 What limits lifetime?

The focus on low cost and trend-driven fashion over quality and style of products has reduced the longevity of casualwear in recent years. Essentially, casualwear is rarely designed with longevity in mind, focusing instead on latest styles. Garments quickly become

⁵² J Allwood, S Laursen, C Malvido de Rodriguez and N Bocken (2006). *Well Dressed*, University of Cambridge.

dated and are then disposed of – with consumers being able to pick up cheap replacement items easily.

Price pressures have led to use of relatively poor quality fabric that is liable to result in garments quickly becoming misshapen, shrunk or faded with regular washing. The demand for rapid delivery means that fastest production methods are used, with speed prioritised over durability.

Where garments do last longer, however – particularly among less fashion-conscious consumers – another issue is that they are not readily adjusted as owners' size or shape fluctuates. Few casualwear items use features that are common in other categories, such as elastic at the waist, adjustable button fastenings or adequate seam allowances.

10.4 Fibre and fabric

The first, fundamental step to producing casualwear that lasts longer is to improve the quality of fabrics used. As in other categories, a higher quality of fabric generally means increased longevity. It also typically feels nicer both to the touch and during wear – hence is more desirable for consumers. Fibres such as wool, nylon and polyester are recognised as being hard-wearing and so can be a good choice; weaker fibres are best used within blends (e.g. linen with polyester). A range of industry-standard tests can be used to ensure that fabrics meet the durability standards required, such as fabric weight per unit area, knit/weave density and tear strength rating.

It is then important to make decisions about materials to minimise the likelihood of damage both in regular wear and during washing. For example, where garments are needed to stretch – such as fitted t-shirts – elastomeric yarns can help with recovery properties to protect shape. Trims at neck hems and cuffs are areas of potential weakness – either through fraying or becoming loose and misshapen. The use of knitted rib trims can minimise this risk, particularly where yarns with longer fibres are chosen. When using fabrics susceptible to shrinkage, like cotton or wool, pre-shrinking treatments can be applied as part of the finishing process.

Fading and loss of colour is a major reason for discard. Again, this can be tested for, in terms of colourfastness against laundering, rubbing and exposure to light. As in other categories, it is best practice to incorporate testing at different stages of production – not just on the raw materials. Wearer trials are also valuable.

A further way to increase longevity is to use fabric finishes that address moisture, stains and odours for t-shirts, sweatshirts, blouses and shirts. This is a particular benefit that could be used in marketing the garments.

10.5 Design and manufacture

When designing casualwear for longevity, the latest trends are best avoided. Instead, classic shapes will result in consumers wearing such garments for longer. Classic or neutral colours (black, charcoal, white, navy) have been identified as having greater longevity when compared to fashion or seasonal colours. As with other types of clothing, however, there are opportunities to introduce trend colours as highlights. Marl yarns can also be longer-lasting as they tend not to fade.

A key consideration with regard to increasing clothing longevity is adjustability in size, as weight fluctuations may result in garments no longer fitting properly or comfortably. This is especially relevant to casualwear due to the importance of comfort. Loose fitting garments will encourage the consumer to retain garments for longer as they allow for changes in body shape. For example, classic cut t-shirts can be designed with a generous width and length to

allow for body change – without compromising the overall shape. A single jersey wrap dress can fit a range of sizes by featuring well-concealed adjustability in the fastening. Adjustable waists on trousers and skirts are possible through use of adjustable button spacings on the waistband, elasticated waistbands either half or all of the waistband, smocking or pleating, or draw cords.

Another possibility to consider is creating multi-functional garments – versatile products that can be worn in different ways, such as a strapless dress that could convert to a long sleeved top. Other items can be designed to facilitate re-styling, so they create very different looks – such as longer length t-shirts that could be worn tucked into trousers, loose with a belt or as a minidress over leggings. A more radical approach is to produce casualwear with detachable parts such as collars or cuffs which can be replaced when soiled or worn.

No-waste, interactive and complete garment designs are emerging concepts in stretch casualwear. These new design/production methods not only offer the potential for innovative styles and bespoke fits, but also increased comfort for the wearer due to the lack of seams and greater longevity, as stress on the fabric is distributed equally throughout the garment, rather than having weak points at seams.

When it comes to more traditional garment construction, there is a wealth of best practice to draw on to help increase longevity. Methods particularly suited to casualwear include:

- serging or over-edging fabrics prone to fraying;
- using 4 thread overlocking for knitted and stretch fabrics to provide added security of seams;
- using flat seaming for stretch fabrics, especially at hems and cuffs; and
- using lockstitch with a strong polyester sewing thread for woven fabrics.

Designers can influence the construction process through the development of garment specification sheets that set out the precise details and standards required. These can then be developed further by the technologist, and referred to at all stages of manufacture, with regular quality control checks ensuring they are adhered to. Specification sheets typically contain information about:

- make-up method sequence;
- machine types to be used for sewing;
- thread for stitching type and colour;
- details of any trims and how to attach them e.g. buttons; and
- size requirements of the garment.

It is also important to ensure that all components conform to quality standards and are checked during production. For example, the EU childrenswear pull test standards can be used as a benchmark to check the strength of attachment for button hole and button sew.

10.6 Care and repair

The culture of disposability around casualwear has also led to a relaxed attitude to garment care: when consumers don't expect or even require items to last for long, they are likely to be less concerned about following advice in terms of laundering and storage.

However, even with lower-cost garments, changes to care practices can increase the lifespan of casualwear and deliver wider environmental benefits, in terms of reducing resource use. Retailers can help drive this with clear information on care labels and swing tickets, as well as through websites and point-of-purchase information.

As well as advice on care, consumers are often receptive to warnings about the potential impact of not following care instructions – such as the risk of shrinkage if garments are washed at too high a temperature, or the risk of white t-shirts becoming discoloured if washed with dark items. Stretch garments in particular require extra care when laundering due to the construction; particular concerns include shrinkage, loss of shape, snagging, pilling and felting. Pilling can result from continuous wear and excess washing.

Further relevant suggestions for reducing the likelihood of poor performance resulting from laundering include:

- reducing the number of times a garment is washed – freshening items up by airing, as opposed to washing, where possible;
- sorting laundry into colours and fibre types before washing, to minimise the risk of discolouration or colour run;
- avoiding tumble-drying;
- steam-cleaning wool fabrics;
- considering hand washing or gentle machine washing;
- removing stains with a liquid detergent rather than washing the whole garment; and
- using moth balls when storing.

Again, the lower cost of casualwear items means that damaged garments are often disposed of, rather than repaired. However, many consumers have particular favourite casualwear garments, that fit particularly well, are especially comfortable or look good; it may be possible to encourage them to make simple repairs. To influence this, garments could be sold with home repair kits include matching thread and spare buttons, as well as instructions, or a link to online information.

10.7 Re-use and discard

While some casualwear garments are damaged and therefore not suitable for re-use, many are discarded when still wearable. There are therefore plenty of opportunities for garments to be resold, passed on to friends or family, donated to charity or taken to events such as swishing. Retailers can help raise awareness of this by providing advice on the labels and their websites about options for re-use.

Older garments may be used for non-public purposes (e.g. gardening) and ultimately recycled: this is something that many consumers are relatively unaware of, and simply assume that items that cannot be re-used must simply be thrown away. Retailers can also therefore help raise awareness of specialist recyclers.

Using a single fabric facilitates recycling, but where multiple fabrics and components are used, there is scope for designers to make it easy to disassemble these, without compromising the robustness of the product.

11.0 Underwear

Underwear refers to garments such as bras, shapewear, briefs, boxers, vests, thermals and slips.

11.1 Top five solutions

- Using more durable fabrics, trims and construction methods.
- Removing seams where possible, and recognising that comfort is crucially important for prolonged daily wear.
- Scheduling in time for multiple fittings during the design process to ensure that underwear fits well and supports where necessary.
- Providing expert advice on fit on product packaging and at point of sale.
- Designing underwear to be easy to launder.

11.2 Introduction

For underwear, the most important factors in encouraging longevity are comfort and fit. The longer these can be retained, the longer consumers are likely to keep an item – whether it is a highly-engineered multi-component garment, such as a bra or shapewear piece, or a simpler garment, such as briefs or a vest.

The prime challenge for designers, working at all price points, is therefore to produce garments that maintain their form and fit, provide sufficient support and remain comfortable over the long term, despite regular wear and washing. This requires not only careful construction and fabric selection, but also attention to detail in terms of fitting, both during design and at point of sale. Other important considerations include the ability to withstand frequent laundering, maintaining not only shape but also colour.

Given the nature of underwear, opportunities for re-use are limited; however, recycling is a possibility.

11.3 What limits lifetime?

Underwear is generally discarded when it is no longer comfortable, or no longer fits properly. In some cases, this is a problem from the point of purchase onwards, particularly in the womenswear market, where many consumers buy bras that they find uncomfortable. This can be a result of either (or perhaps both) insufficient fitting during the design and product development stage, and inadequate advice at point of purchase. Such items are often discarded after relatively little use.

Similarly, garments with that rub or feel rough against the skin or that have seams that are visible through outerwear are likely to be worn less frequently or disposed of early.

At the other end of the spectrum, frequent wear and washing can lead to reasons for discard. Cotton vests using fabric that is not stable (e.g. finished incorrectly) are likely to shrink or become misshapen, particularly if washed at too high a temperature, rendering them uncomfortable to wear and therefore liable to be discarded. When garments do not recover well from stretching, they are also likely to be disposed of: for instance, if the waistband elastic in a pair of briefs becomes slack then consumers will throw them away, although the fabric they are made from may still be serviceable.

As it is not usually seen, appearance may generally be less of a reason for disposal than poor comfort or functionality. Nonetheless, discolouration or fading may be an issue – particularly for whites or other light coloured pieces. This can be particularly obvious if garments are part of a co-ordinating set, such as bra and briefs, but one garment is washed more frequently than another.

11.4 Fibre and fabric

A wide range of fibre types are used in underwear manufacture, including cotton, viscose, silk, polyester, polyamide and blends. Fabrics can be knitted, woven or lace, with narrow fabrics for trim, straps and waist elastic.

All offer not only different aesthetic qualities – look, feel, etc. – but also different performance attributes. Some fibres and yarn types stretch better than others or are more resilient to washing. Therefore fabric choice needs to reflect the expected end use of the garment: a sports bra, for example, has very different requirements from an everyday bra, in terms of stretch and recovery, moisture management and handle. Some products have very specific requirements such as thermal underwear, for which the product is expected to keep the wearer warm but be designed in such a way that perspiration can be wicked away from the body.

There is a well-established body of knowledge about fabric and fibre suitability for underwear, and how to gain the best results.

- The use of micro fibres and fabrics containing elastane can be useful in underwear. When designing bras containing moulded cups, for example, high-stretch materials and fabrics containing elastane can help maintain shape.
- Knitted fabrics may need to be relaxed to enable accurate sizing for spreading, cutting and sewing.
- If garments are to be manufactured using man-made fibres that are prone to cling, anti-static finishes may be of use – though it is important to check with fabric suppliers to ensure they will not damage the fabric.

If making underwear garments out of more than one fabric type, it is important to ensure that the fabric properties are well-matched, and so do not respond differently to laundry. For example, combining a very rigid fabric, such as a plain woven printed polyester, with a piece of single jersey knit may look aesthetically pleasing when seen on a hanger, but the two fabrics would shrink differently during washing – potentially leading to puckered seams or even affecting the fit, causing the user to throw it away.

Similar considerations apply to components such as elastics, hook and eyes, wires, bows and diamante: it is generally deemed good practice to test trims and components as well as fabrics during production. For example, samples of moulded cups can be subjected to wash tests simulating laundering in order to ensure that garments such as bras are not prone to delamination due to variations in settings of pressure, temperature and time when moulding.

A further important consideration to help increase longevity is reducing the occurrence of phenolic yellowing when producing t-shirt bras with white moulded cups including polyamide. Fabric suppliers can confirm whether the fabric to be used in moulded cups has been processed in a way to avoid yellowing.

11.5 Design and manufacture

In designing underwear it is important to consider style, colour, fit, comfort and how easy it will be to launder. Highly specialised products such as bras and shapewear bring together the creative skills of the design team, the craftsmanship of the manufacturing unit and the engineering skills of the technologist. They are made up of many components which bring about highly distinctive quality attributes. For certain products, such as soft bras, style and colour are key drivers, but comfort and fit are more important when considering sports bra support.

The close-fitting nature of underwear makes it imperative that garments fit well. The fit process when developing underwear is therefore crucial in order to ensure that items, particularly bras and foundation garments, are comfortable and supportive. There are two separate stages to this:

1. fitting during design – testing the fit with different-sized models before production. It may be worth allowing time for several fittings at different stages of the design and manufacture process, particularly for new styles; and
2. fitting at the point of purchase – if consumers are given the correct advice before buying, they are more likely to wear the item for longer. Though this is something designers have minimal direct influence over, accurate advice from shop staff can help build loyalty and encourage repeat purchases.

Ensuring the best seam and stitch type is very important when making underwear. Seam types affect the aesthetics, strength, durability and comfort in wear, as well as convenience in assembly in relation to machinery available and, of course, cost⁵³. The tolerances on seam allowances will be very small; therefore there is little margin of error when making up garments. It may be worth considering sewing trials with machines unthreaded to inform decisions about needle type, presser foot and feed dog to avoid fabric damage during manufacture.

Approaches such as seam-free design can be beneficial, as they make items less bulky and more comfortable. Laser or raw cut edges offer similar benefits, especially for multi-component garments. Further, it is important that any metal trims are nickel-free in order to avoid skin irritation which could mean that garments are returned to store or thrown away.

Other ways to increase longevity and frequency of use include the possibility of using some underwear garments as outerwear – something that would clearly need to be considered at the design stage – and the production of multi-way bras, which offer the opportunity for variation in terms of straps (with or without), designs, materials and even width.

In addition, bras can be designed to accommodate an additional back hook and eye trim, which can be sold separately. This helps with increasing the comfort of the garment if the consumer's size or shape fluctuates and again encourages increased wear.

11.6 Care and repair

Underwear generally requires relatively frequent laundering, either by machine or hand washing. Ironing is not generally needed, and it is unlikely that many pieces will be dry cleaned, although for more expensive pieces this is an option that could be promoted. Because of the need for frequent washing, it is important to test pilot garments to ensure that discoloration is minimised and the correct care advice can be given. In general, relevant advice may include:

- the use of a specialist lingerie bag for delicate items;
- a recommendation to wash co-ordinating products such as bra and briefs together to ensure they age at the same rate;
- the need to wash darker colours together to minimise colour run;
- the importance of closing fastenings before washing to reduce the chance of them being caught on other parts; and
- the need to use specialist detergents for silk garments.

⁵³ H Carr and B Latham (2008). *Carr and Latham's Technology of Clothing Manufacture*. Blackwell Publishing, pp.52-53.

If underwear garments are well constructed the need for such garments to be repaired will be minimised. It is unlikely that consumers would repair underwear unless the garment is a special occasion piece; however, it may be worth offering the option for such garments to be returned to store for minor repairs.

One care consideration, pre-sale, is the use of BHT-free⁵⁴ plastic bags when packaging products for shipment. This is because there is a clear link between the use of BHT and yellowing of white or pale garments. In general too, the exposure of underwear to oxides associated with nitrogen pollution needs to be avoided.

11.7 Re-use and discard

Underwear is a personal garment for which opportunities for re-use are limited. Garments that are in very good condition may be re-used, but in most cases the priority will be to ensure that the garment is recycled rather than discarded as waste. This is something that many consumers are relatively unaware of, and simply assume that items that cannot be re-used must simply be thrown away. Retailers can also therefore help raise awareness of specialist recyclers.

Using a single fabric facilitates recycling, but where multiple fabrics and components are used, there is scope for designers to make it easy to disassemble these, without compromising the robustness of the product.

⁵⁴ Butylated Hydroxytoluene(BHT) is an antioxidant used in some packaging. It can cause white fabrics to yellow. See <http://www.fibre2fashion.com/industry-article/13/1267/yellowing-of-textiles-on-storage1.asp>

Appendix: Useful Resources

British Standards Institution: www.bsigroup.com/ (stitch classification: www.bsigroup.co.uk/DualSearch/?q=stitch+classification)

EU legislation on textiles: <http://trade.ec.europa.eu/sigl/products.html>

GINETEX care symbols: www.ginetex.net/labelling/care-labelling/care-symbols/

International Organization for Standardization: www.iso.org/iso/home.html

International Association for Research and Testing in the Field of Textile (Oeko Tex): www.oeko-tex.com/OekoTex100_PUBLIC/index_portal.asp?cls=02

Shape GB (guidance on sizing): www.shapegb.org/home

Trading Standards Institute: www.tradingstandards.gov.uk

UK Fashion and Textile Association: www.ukft.org (rules and regulations: www.ukft.org/rulesandregulations/rulesandregulations.php?mid=5andmdid=20andscid=0)

www.wrap.org.uk/clothing

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