Timo Rissanen

From 15% to 0: Investigating the creation of fashion without the creation of fabric waste

Abstract

While there are historical precedents for a no-waste approach in the creation of clothing, with the predominant contemporary methods of fashion making the amount of fabric waste is approximately 15 percent of the total fabric used. Modes of recycling and reusing the waste exist but these can be problematic. This paper demonstrates how the waste has been eliminated in the past, and investigates the potential of waste elimination within contemporary fashion industry. The responsibility of fabric waste creation is mostly placed on manufacturing rather than the fashion designer. This paper proposes that a more responsible fashion design methodology can be formulated within existing technology, by exploring more holistic ways of optimising areas of expertise within design and manufacture. Hierarchical divisions of labour within the fashion industry can create limitations for innovation in sustainable fashion design strategies. The aims are to demonstrate that sustainable manufacturing practice is an opportunity for innovative fashion design, and to make feasible suggestions for modifying existing practices.

Introduction

Between the initial conception by the fashion designer and the shop rack, a mass-produced garment passes several steps. The patternmaker makes a pattern (on paper or computer) based on the designer's sketch; the pattern guides the cutter in cutting fabric. Before the cutting of multiple garments in production, the marker-maker creates a marker (on paper or computer), which contains all the pieces of all the sizes to be cut – the marker is a cutting map for production. Most often responsibility for fabric waste creation at the cutting stage is placed on the marker-maker, and the primary objective is to reduce fabric cost. (Abernathy, Dunlop et al. 1999: 136)

Bernard Rudofsky (1947: 137-54) was among the first to formulate a critique of contemporary fashion-making in the context of historical methods. He criticised the wasteful Western way of cutting fabric, comparing it with examples of efficient cut in traditional forms of dress. A more recent author, Naomi Tarrant (1994: 10) explains how pre-Industrial societies treated fabric as a precious resource. Through the history of dress she highlights several instances of cutting in which waste minimisation is inherent.

Evidence shows that the developments in cutting in Europe have been influenced by developments in fabric weaving technology. When fibre was scarce and spinning and weaving were slow, fabric was precious. It was cut as little as possible and waste creation was avoided during the cutting process. Tarrant (1994: 8) states that before the Classical period in Europe, two types of loom were used for weaving. The ground and warp-weighted looms were not ideal for weaving long lengths of fabric and both looms were relatively slow. Around 1000 AD the horizontal loom was introduced to Europe from China; the weaving of longer lengths of fabric became much faster than before. Regular changes in dress in Europe appeared from the fourteenth century onwards (Tarrant 1994: 48). During the Industrial Revolution the weaving industry was mechanised approximately a century before the fashion industry, allowing plentiful 'raw' material for the industry sped up by the sewing machine from 1850s onwards (Forty 1986: 73, 94).

Fashion creation methods
With fabric waste creation as the distinguishing factor, I have identified five methods of fashion creation. Traditional methods include Cut & Sew, Fully Fashioned and Jigsaw Puzzle, while methods informed by environmental concerns include Cradle to Cradle and A-POC. Each is described, and the advantages and disadvantages of each method are discussed. I acknowledge that other methods exist at an experimental stage. For example, a group of artists in Western Australia are experimenting with growing clothes out of living tissue (Phillips 2004: 40). Such creative experiments should be encouraged; this paper, however, only examines methods of designing and making clothes that are possible through existing technologies.

Traditional methods
1. Cut & Sew: 'Cut & Sew' is used on woven, knitted and non-woven fabrics. It is the predominant way of designing and making clothes, and the majority of the fashion industry is most familiar with this method. The fashion designer sketches a garment and the patternmaker makes a pattern for it. The garment is cut and the machinist sews the pieces together.

2. Fully Fashioned: *Knits:* The shaped pieces of a knitted garment are knitted from yarn individually and then joined. Domestic hand knitting is a familiar example; a front, back and sleeves are knitted individually and then sewed together to make a jumper. A more advanced type, seamless knitting of three-dimensional garments, has been technologically available since 1995 (Choi and Powell 2005: 1). Socks have been knitted this way even longer.
Wovens and non-wovens: Mechanised weaving only allows the weaving of rectangular lengths of fabric. Through hand-weaving shaped woven pieces can be created: the half-oval Roman toga is an example – the shape is woven, rather than cut (Tarrant 1994: 10). No mechanised weaving technology has been developed for fully-fashioned garments. As for non-woven fabrics, hand-felting allows the making of shaped pieces but again, no mechanised technology is widely available.

3. Jigsaw Puzzle: This is a version of 'Cut & Sew'; the method of construction (sewing) is the same. The pattern pieces interlock on a length of fabric like the pieces of a jigsaw puzzle. No waste is therefore created and the need for a marker is eliminated as the garment pieces only fit together in one way. This was a common method until the Industrial Revolution in Europe.

Methods informed by environmental concerns
4. Cradle to Cradle (McDonough and Braungart 2002): The process of designing and making is the same as 'Cut & Sew' or 'Fully Fashioned' but fabric waste is considered to be a part of a closed loop of material flow. In McDonough and Braungart's philosophy, waste equals food; the 'waste' is either reused or composted.

5. A-POC (A Piece Of Cloth, Issey Miyake and Dai Fujiwara): A-POC is a knitted or a woven tube of fabric, with the two sides of the tube connected in areas to create cavities within the tube. Following these joined areas the consumer cuts the garments of his/her choice. In knits sewing is eliminated completely – a yarn enters a machine and a tube containing several different garments comes out. Some woven A-POC garments require minimal sewing (Kries and von Vegesack 2001: 63).

Fabric waste: manage or eliminate?
Most development on efficiency of fabric use has been done in 'Cut & Sew'. The marker-maker uses a computer to fit the pattern pieces on a length of fabric as efficiently as possible. The unpredictability of pattern shapes is the primary obstacle to eliminating fabric waste. Even with up-to-date computer technology, in adult outerwear fabric wastage varies from 10 to 20 percent (Feyerabend 2004: 4). Cooklin (1997: 9) estimates the average waste to be 15 percent of total fabric used, while Abernathy, Dunlop et al. (1999: 136) put the figure at around 10 percent for pants and jeans, but higher for blouses, jackets and underwear. Garment style (number and shapes of pattern pieces), the number of sizes in one marker and the skills of the marker-maker determine the amount of waste.

The fabric waste (off-cuts) can be recycled as fibre or re-used as scraps to weave rugs or make wallets, etc. The recycling of mixed fibres (for example, 95% cotton, 5% elastomeric) can be problematic, as no feasible methods of separating the fibres after spinning or weaving exist. Recycling, or downcycling fibre mixes results in a material inferior to the original – the felt used by removalists is an example. Colour poses further problems: when different coloured fabrics or fibres are recycled together, the end colour can rarely be pre-determined, and re-bleaching and dyeing may be necessary. On the other hand, the practicability of sorting off-cuts into different fibres and colours is questionable within the industry. Gertsakis and Lewis (2003: 7) argue convincingly that waste reduction is always preferable to recycling or disposal, and in the case of fabrics this is especially evident. Furthermore, recycling can impact negatively on the environment through transportation (fuel, emissions) and reprocessing (in particular, water, energy and chemical consumption).

Off-cuts can be used to make wallets and other small items, but two problems arise. Firstly, the item should be cut together with the garment, as it is difficult to handle and store off-cuts. At the cutting stage, dozens or hundreds of layers of off-cuts may be together, and it is best to cut the item then to ensure lower cost. Secondly, some fabrics suit a fairly limited number of small, useful items. Delicate chiffon off-cuts may be turned into fabric flowers but a broad range of products made from chiffon seems doubtful. I do not deny that there may be instances where an additional product may be the ideal way to deal with off-cut waste. However, in the overall picture of sustainability, arguably it is better to avoid waste than to fill the planet with things made from it.

In its truest form, fully-fashioned knits involve no cutting, and therefore create no fabric waste. However, setting up the knitting machine for each new style can be costly, and a lot of knitwear is a combination of 'Fully Fashioned' and 'Cut & Sew'. Rectangular panels are knitted from which the garment pieces are cut (Cut & Sew), but the panel may have a hem knitted into it (Fully Fashioned). The more advanced technology of seamless knitting warrants further research in the sustainable design context: cutting and sewing are eliminated as the knitting machine creates finished garments from yarn.

William McDonough was among the early advocates of designing waste out in 'The Hannover Principles' (1992: 5). In the case of fabric waste, 'Cradle to Cradle' places the main responsibility in textile design; the fabric must be designed for its closed loop. In the strictest adherence to the philosophy, synthetic fibres are "technical nutrients" which are reused in "technical cycles", while natural fibres are nutrients for "biological cycles" (104). Since 1995 DesignTex has sold fabrics developed by McDonough and Michael

Braungart in collaboration with the Swiss textile mill Röhner (105-9). Scraps can be safely used as mulch or compost, as all harmful chemicals are eliminated at the fabric development stage. Synthetic fibres should be designed in a way that allows waste to be used without downgrading the fibre; this is still under-explored. The clothing company Patagonia is investigating the possibility of collecting and recycling their polyester jackets at the end of use by the consumer (Patagonia 2005). Mixes of natural and synthetic fibres, where one fibre belongs in a technical, the other in a natural cycle, are more problematic.

One could argue that McDonough and Braungart encourage a culture of disposability ("Throwing something away can be fun", 109). Compost is proposed as a solution to many problems of waste, such as packaging. Fabric manufacture uses large amounts of energy, water and time, even if the raw material (fibre) is in a continuous cycle. Promoting the disposability of any product with an extremely short life span, compostable or not, is questionable.

Issey Miyake claims A-POC to recycle thread (Kries and von Vegesack 2001: 68), but how it achieves this is not clear. While the revolutionary nature of 'A-POC' is not in doubt, the methods of making A-POC are technologically unattainable to most manufacturers (Scanlon 2004). Additionally, the responsibilities of waste creation and management are passed from the designer and manufacturer to the consumer (Sato 1999: 125).

A brief history of 'Jigsaw Puzzle'

In terms of fabric waste creation, the himation, chiton and peplos of ancient Greece, and the sari of India are perhaps the most ideal. Each is a rectangle of fabric with no cutting, draped on the body. The sari yields several variations (Lynton 1995: 14-6), as does ancient Greek dress (Rudofsky 1947: 137). Many examples of traditional dress exhibit an affinity with 'Jigsaw Puzzle'. The best known is perhaps the cut of a Japanese kimono; the garment pieces are engineered to the fabric width and length. No fabric waste is created in the cutting process, as Tarrant (1994: 36), Kennedy (1990: 6) and Liddell (1989: 223) demonstrate. Surplus fabric in front neck is pleated inside the collar for structure, rather than cut (Dobson 2004: 54). Similarly, the curve of the sleeve at bottom is achieved by easing the excess seam allowance on the inside.

Tilke (1956) presents several 'Jigsaw Puzzle' garments from around the world. The men's breeches from Turkey (Plate 19: Garment 1) are a basic example. The crotch is made from four gores, which interlock on a given width of fabric. The legs are essentially two large rectangles. A t-shaped blouse worn by the seamen and fishermen of Bornholm, Denmark, (Plate 38: Garment 24) is cut for maximum efficiency. Also from Denmark, a woman's blouse (Plate 38: Garments 1, 2, 9 & 10) is cut from one piece. The bodice wraps to the centre back and attaches to a yoke seam, from which the sleeves jut out. Plate 89 includes two examples of Chinese trousers (Garments 6 & 7, 9 & 10) demonstrating the displacement of basic rectangular shapes against each other. This results in the fabric hanging off-grain in an asymmetrical garment.

Shep and Cariou (1999: xxiv) demonstrate the cut of a men's shirt from 1837, which echoes the shape of the Danish blouse described above. The entire shirt is cut from rectangles that form an interlocking grid on a particular length of fabric, thus producing no waste. However, from the diagrams shown it is very difficult to determine how the pieces correspond to a finished shirt. The authors also include two square-cut shirts from the ‘Keystone Shirt System’ from 1895 (121; 123). By the late nineteenth century most men’s shirts were already similar to contemporary men’s shirts in cut, but these examples were work wear and frugality would have influenced the cut. An eighteenth century men’s shirt illustrated by Hart (1987: 153) is a simpler version of the same principle.

Arnold (1977(1966): 3) discusses fourteenth century dresses from Greenland which use interlocking gores on a full width of fabric to create fullness in the skirt with minimal waste. She also details ways in which off-cut ‘waste’ was often used as part of the interlining of a garment, similar in principle to the kimono collar described earlier. Rothstein (1984: 17) describes a seventeenth century knitted jacket made of rectangles. Like the curve of the kimono sleeve, neck and underarm shaping are achieved by turning under sections of fabric.

‘Jigsaw Puzzle’ in the 20th century

The Italian futurist Thayaht (Ernesto Michahelles) launched the *tuta*, or overalls in 1919 (Stern 2004: 43). The entire body is cut in one piece, with the cut-out wedge between the legs used for front facings. Gussets under the arms and at the crotch allow better movement. Notably Thayaht worked for Parisian couturier Madeleine Vionnet in the early twenties. Betty Kirke (1998) demonstrates several garments by Vionnet, which exhibit an affinity with fabric width. A Vionnet dress from 1919-20 is essentially four squares of fabric, with minimal shaping (Kirke 1998: 54-5). Twisting the front shoulder against the back before joining eliminates armhole and neck gape.

Bernard Rudofsky (1947: 137-48) was highly critical of the European way of cutting fabric to make clothes, and applied his knowledge of traditional forms of dress into the Bernardo Separates range in 1950 (Bocco Guarneri 2003: 294). The clothes were adjustable and one-size-fits-all, made from rectangular pieces of fabric. Rudofsky aimed to minimise waste as well as sewing, to keep the clothes financially accessible to most. In 1944 Rudofsky included garments by Claire McCardell as examples of no-waste fashion design in the exhibition ‘Are Clothes Modern?’ (Rudofsky 1947: 201). The pattern diagrams seem to have been simplified, and do not include all the pieces.

A present day practitioner, Zandra Rhodes, often allows the printed fabric determine the pattern shapes of a garment. For Rhodes patternmaking is an integral aspect of the fashion design process. The cut of a blouse from 1979 (Anon. 2005: 34-5), while not entirely eliminating waste, demonstrates this approach clearly. The sleeve and peplum pieces interlock fully, while the bodice length is determined by the space left over by the aforementioned pieces.

Most recently in New York, Yeohlee Teng has adopted fabric waste minimisation as a key element of her design practice since 1981 (Major and Teng 2003: 14). The pattern of a cape (155) described as cut “with no waste” (18) shows that roughly ten per cent of the fabric is wasted. However, the patterns of two complex sarongs from 2001 demonstrate full utilisation of the fabric, as does that of a coat from 1997 (171). In its cut the coat is similar to the Danish blouse from Tilke (1956: Plate 38): folds replace side seams to create the body, and sleeves jut out of one piece of fabric. The illustrated coat pattern (like all the pattern diagrams in the book by Major and Teng) does not include facings, interlinings or linings, which a rigorous approach to eliminating waste would demand.

The potential of Jigsaw Puzzle for contemporary fashion making
The reintroduction of a 'Jigsaw Puzzle' methodology into contemporary fashion making can create new opportunities for creative fashion design thinking. Initially, fabric may seem a limiting factor for 'Jigsaw Puzzle'. Only one selvage (fabric edge lengthwise) can be lined up precisely at the cutting stage (Chuter 1995: 129). Sacrificing a centimetre or two along one edge solves the problem but is not perhaps ideal. A better solution is designing garments that allow slight variation in parts. Evidence of increasing 'mass-customisation' within fashion production exists, with specific implications for design, marker-making and cutting (Abernathy, Dunlop et al. 1999: 145-50). Although the objective is to offer 'custom fit' in a mass-produced garment, extending the idea to 'custom look' seems plausible. David Pye (1995(1968): 59-60) notes how the reign of standardised products since the Industrial Revolution has sidelined imperfection and serendipity in design, but a 'Jigsaw Puzzle' methodology could offer avenues for their exploration in fashion design.

In most fashion design companies, the fashion design process occurs through a fixed and rigid hierarchy. The fashion designer is at the top of hierarchy, followed by the patternmaker, cutter and machinist. There are countless variations; in large companies there may be more people in the chain and in small businesses there may be less. To sum up, the hierarchical division of labour has its roots in practices established by Charles Frederick Worth in the late nineteenth century (de Marly 1980: 22) and in Frederick Winslow Taylor's 'Scientific Management' (Taylor 1913: 39-40). Both Breward (2003: 34), and Kawamura (2005: 65) discuss the institutionalised mythology surrounding the fashion designer and how the myth facilitates the promotion of fashion. Sladen (1995: 104-5) details how the Utility Scheme in the UK during World War II strengthened the hierarchical organisation of the fashion manufacturing industry, while McRobbie (1998: 57-8) describes how fashion design education has played a part in elevating the fashion designer above the production process. McRobbie also discusses the numerous problems this hierarchical separation causes for both designers and manufacturers (59-60).

The adoption of a 'Jigsaw Puzzle' methodology could encourage a reorganisation of the hierarchy. Patternmaking is integral to the design process, rather than a stage that follows it. Instead of a vertical hierarchy between the fashion designer and patternmaker, 'Jigsaw Puzzle' facilitates a horizontal differentiation (Jones 2004: 102), an approach demonstrated by Issey Miyake, Yeohlee Teng and Zandra Rhodes. Eckert and Stacey (2003) call knitwear design "a complex interaction between aesthetic and technical design", while Seitamaa-Hakkarainen and Hakkarainen (2001: 48) note how weaving design incorporates visual ("composition space") and technical ("construction space") designing. Similarly, 'Jigsaw Puzzle' requires simultaneous consideration of technical and aesthetic elements during the design process; the impact of the fashion designer's patternmaking skills and knowledge on the method requires further research.

Grading is "the process of systematically increasing and decreasing the size of the a master pattern to create a range of sizes" (Moore, Mullet et al. 2001: xv). Several authors note the problematic nature of grading within current manufacturing practices (Price and Zamkoff 1996: 2; Moore, Mullet et al. 2001: 8; Handford 2003: viii). Because of interlocking pieces, conventional grading methods may be bypassed with 'Jigsaw Puzzle': each size is designed. Yeohlee Teng has tackled grading by designing one-size-fits-all clothes, while Zandra Rhodes bypasses some traditional rules of grading. For example, the sleeve on the bodice discussed earlier does not grade, to allow for the sleeve pieces to interlock in all sizes. The potential of a 'Jigsaw Puzzle' methodology in overcoming existing problems warrants investigation.

With a 'Jigsaw Puzzle' methodology, the fashion design process may become more considered. Instead of producing a large number of sketches relatively fast, the designer needs to incorporate patternmaking into the design process of each garment. A large proportion of a sample range is culled before mass-production. According to Waddell (2004: 40), "most design houses estimate at least 20% wastage at this stage", and that the culling is done due to technical or financial feasibility, or for aesthetic reasons. The deleted styles (sample garments) represent a considerable amount of work by the design team, a cost to the company and a significant waste of physical resources.

Each of the five methods of fashion making described earlier requires further research regarding responsible design practice. Most likely all will remain in use by practitioners: they are complementary. 'Jigsaw Puzzle' has not been formally researched and adapted to practice, yet it could have specific significance in the case of fabrics that, due to their composition, are difficult to reuse or recycle. Problems arise with natural/synthetic fibre mixes, yet in terms of sustainability they should not be immediately discounted. For example, polyester is often blended with cotton for better durability and colourfastness, thus potentially extending product life considerably. McDonough and Braungart (2002: 116) propose for the cotton to be composted to allow the collection of the polyester for reuse. Only a lengthy product life would justify such complex, and possibly costly, procedure.

Conclusions

Fashion designers often regard fabric as their raw material but fabric really is a finished product in its own right. Tarrant (1994: 10) sums up: "Cloth is expensive to make in time and in raw materials." Fabric ought to be considered a precious resource once again. Not only are some synthetic fibres made from finite sources, some natural renewable fibres are harmful to the environment due to their cultivation methods. Furthermore, considerable amounts of chemicals and water are used in the treatment of raw fibres, and energy consumed in spinning, weaving and knitting. The fabrics are also often treated with various finishing chemicals, as well as dyed, sometimes using harmful substances to achieve particular colours.

It is uncommon in current fashion design practice for the designer to be concerned with the efficiency of fabric usage. The responsibility is instead with the marker-maker and cutter, and to a lesser degree the patternmaker. The marker-maker can only work within parameters set by the patternmaker, and indirectly by the designer. Designer responsibility in the fashion design context provides opportunities for investigation, and for new modes of practice.

Unsustainable levels of clothing production and consumption in the developed world form a larger problem requiring attention, especially as the negative economic, social and environmental effects tend to fall more on developing countries where an ever-increasing proportion of clothing is produced. Van Kopplen and Vaughan (2003: 3) define sustainable fashion design as "immersing creatively in every part of the extensive process that creates the garment from the raw material to the method of sales and merchandising". Waste elimination is but one small contribution towards sustainable fashion design, but one that could nevertheless have a huge impact on the amount of fabric waste created by the fashion industry.

References

Abernathy, F. H., J. T. Dunlop, et al. (1999). A stitch in time. Lean retailing and the transformation of manufacturing - Lessons from the apparel and textile industries. New York & Oxford, Oxford University Press.

Anonymous (2005). Zandra Rhodes: a lifelong love affair with textiles [Exhibition catalogue]. Woodbridge, Antique Collectors' Club.

Arnold, J. (1977(1966)). Patterns of fashion 2. Englishwomen's dresses and their construction c. 1860-1940. London, Macmillan.

Bocco Guarneri, A. (2003). Bernard Rudofsky. A humane designer. Wien & New York, Springer-Verlag.

Breward, C. (2003). Fashion. Oxford, Oxford University Press.

Choi, W. and N. P. Powell (2005). "Three dimensional seamless garment knitting on v-bed flat knitting machines." Journal of Textile and Apparel, Technology and Management **4**(3): 1-33.

Chuter, A. J. (1995). Introduction to clothing production management. Second edition. Oxford, London, Edinburgh, Cambridge & Carlton, Blackwell Science.

Cooklin, G. (1997). Garment technology for fashion designers. Oxford, Blackwell Science.

de Marly, D. (1980). The history of haute couture 1850-1950. London, B T Batsford.

Dobson, J. (2004). Making kimono and Japanese clothes. London, B T Batsford.

Eckert, C. and M. Stacey (2003) Sources of inspiration in industrial practice. The case of knitwear design The Journal of Design Research http://jdr.tudelft.nl/articles/issue2003.01/Art2.html accessed 03/09/2005

Feyerabend, R. (2004) Textiles Briefing Paper http://www.mrs-hampshire.org.uk/Workshop%204/Textiles.pdf accessed 06/09/2005

Forty, A. (1986). Objects of desire. Design and society since 1750. London, Thames and Hudson.

Gertsakis, J. and H. Lewis (2003) Sustainability and the waste management hierarchy - A discussion paper EcoRecycle Victoria www.cfd.rmit.edu.au/content/download/189/1390/file/Sustainability%20and%20the%20Waste%20Hierarchy.pdf accessed 21/09/05

Handford, J. (2003). Professional pattern grading for women's, men's, and children's apparel. New York, Fairchild Publications, Inc.

Hart, A. (1987). The clothing accounts of George Thomson 1738-48. Barbara Johnson's album of fashions and fabrics. N. Rothstein. London, Thames and Hudson**:** 149-153.

Jones, G. R. (2004). Organizational theory, design, and change. Text and cases. Fourth edition. Upper Saddle River NJ, Pearson Prentice Hall.

Kawamura, Y. (2005). Fashion-ology. An introduction to fashion studies. Oxford & New York, Berg.

Kennedy, A. (1990). Japanese costume. History and tradition. Paris, Editions Adam Biro.

Kirke, B. (1998). Madeleine Vionnet. San Francisco, Chronicle Books.

Kries, M. and A. von Vegesack (2001). A-POC making. Issey Miyake & Dai Fujiwara. Berlin, Vitra Design Museum.

Liddell, J. (1989). The story of the kimono. E. P. Dutton, New York.

Lynton, L. (1995). The sari. Styles - patterns - history -techniques. London, Thames and Hudson.

Major, J. S. and Y. Teng, Eds. (2003). Yeohlee: work. Material architecture. Mulgrave, Peleus Press.
McDonough, W. (1992) The Hannover principles. Design for sustainability William McDonough Architects http://www.mcdonough.com/principles.pdf accessed 9/9/2005
McDonough, W. and M. Braungart (2002). Cradle to cradle. Remaking the way we make things. New York, North Point Press.
McRobbie, A. (1998). British fashion design. Ragtrade or image industry? London & New York, Routledge.
Moore, C. L., K. K. Mullet, et al. (2001). Concepts of pattern grading. Techniques for manual and computer grading. New York, Fairchild Publications, Inc.
Patagonia (2005) Patagonia company history Patagonia Inc http://www.patagonia.com/culture/patagonia_history.shtml?seepromo=home accessed 21/09/05
Phillips, G. (2004) Clothes you can buy off lab dish The Sunday Telegraph December 19, 2004 40
Price, J. and B. Zamkoff (1996). Grading techniques for fashion design. New York, Fairchild Publications.
Pye, D. (1995(1968)). The nature and art of workmanship. Revised edition. London, The Herbert Press.
Rothstein, N., Ed. (1984). Four hundred years of fashion. London, Victoria & Albert Museum.
Rudofsky, B. (1947). Are clothes modern? Chicago, Paul Theobald.
Sato, K. (1999). Issey Miyake: Making things. Zurich, Scalo.
Scanlon, J. (2004) Seamless Wired Magazine http://wired-vig.wired.com/wired/archive/12.04/miyake.html?pg=1&topic=&topic_set= accessed 12 April 2005
Seitamaa-Hakkarainen, P. and K. Hakkarainen (2001). "Composition and construction in experts' and novices' weaving design." Design Studies **22**: 44-66.
Shep, R. L. and G. Cariou (1999). Shirts and men's haberdashery 1840s to 1920s. A tribute to Betty Williams. Mendocino, R. L. Shep.
Sladen, C. (1995). The conscription of fashion. Utility cloth, clothing and footwear 1941-1952. Aldershot, Scolar Press.
Stern, R. (2004). Against fashion. Clothing as art, 1850-1930. Cambridge & London, The MIT Press.
Tarrant, N. (1994). The development of costume. London, Routledge.
Taylor, F. W. (1913). The principles of scientific management. New York, Harper & Brothers.
Tilke, M. (1956). Costume patterns and design. A survey of costume patterns and designs of all periods and nations from antiquity to modern times. London, A. Zwemmer Ltd.
Van Kopplen, A. and L. Vaughan (2003) Engaging in fashion 5th European Academy of Design Conference http://www.ub.es/5ead/PDF/w/VaughanKopplen.pdf accessed 21/09/05
Waddell, G. (2004). How fashion works. Couture, ready-to-wear & mass production. Oxford, Blackwell Science.

Bio:
Timo Rissanen completed Bachelor of Design in Fashion and Textile Design at the University of Technology, Sydney (UTS), in 1999. In 2000 Timo represented Australia at Mittelmoda in Gorizia, Italy. From 2002 to 2004 he owned and designed for a menswear label, Usvsu, which in March 2003 won the New South Wales division of the Mercedes Benz Start-Up Program. In May 2003 Usvsu showed in the New Generation Show at Mercedes Australian Fashion Week. While the label is currently on a hiatus, by 2004 it was stocked in major Australian cities, as well as in Italy and Russia. As well as working as a freelance patternmaker since 1999, Timo has lectured and tutored in fashion design at UTS since March 2003 and he is currently completing a PhD in fashion design there.

Timo Rissanen
PhD Candidate
Faculty of Design, Architecture & Building
University of Technology, Sydney
Building 6, 702-730 Harris Street, Ultimo
PO Box 123 Broadway NSW 2007 Australia
Tel. +61 412 331 044
Email: timo.rissanen@uts.edu.au