Sustainable product design for Fashion Apparel: A preliminary analysis of Indian and Swedish fashion Apparel brands

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Abstract

Although the apparel industry is considered to be among the most polluting industries there is hope with the availability of a large number of sustainable product design strategies for fashion apparel. The present paper reviews the frameworks and models related to sustainable product design of fashion apparel. Further it develops a comprehensive checklist of sustainable product design strategies for fashion apparel, and examines their applicability among Swedish and Indian apparel brands. The article presents background information on fashion apparel industry and its environmental impact and a review of frameworks and models covering sustainable design for fashion apparel. Based on the review, a checklist has been developed by the present researcher. The checklist is used to conduct an exploratory analysis of a few Swedish and Indian fashion apparel brands on sustainability product design strategies and practices. Secondary data on the apparel brands was used to examine their sustainable product design strategies. It was found that the Swedish apparel brands selected for the study use several sustainable product design strategies as compared to the Indian brands.

Keywords: Sustainable design, lifecycle analysis, Sweden vs Indian apparel

INTRODUCTION AND PURPOSE

A renowned fashion designer and recipient of an environmental award, Eileen Fischer is reported to have said, 'The clothing industry is the second largest polluter in the world ... second only to oil' (Sweeny 2015).

A piece of fashion apparel can do immense damage to the environment right from the cultivation of raw material like cotton to the production of apparel, its use and its disposal. Large amount of water is used in cultivating cotton fiber, harmful pesticides are used in farming, toxic dyes used in manufacturing, excess energy and water used in manufacturing and laundering of clothes during use and waste generated during manufacturing, and from discarded clothes which reach landfills, all these contribute negatively to the environment. Allwood, Laursen, Rodriguez,& Bocken(2006) identified a set of environmental and social problems facing the fashion industry with respect to the materials, manufacture, supply, consumption, use and disposal of fashion products.

Further more with the globalization of the fashion apparel industry and the adoption of fast fashion practices, it is not uncommon to find that an apparel would have to travel half way around the globe before it reaches the consumer. Most of the manufacturing of textile and clothing industry has moved into low-cost Asian countries over the last 25 years (Arora and Pargain 2017) making supply chains complex and unsustainable. The current global apparel market is valued at US$ 1.7 trillion and it constitutes around 2% of the world's GDP. The global apparel market size is expected to reach US$ 2.6 trillion in 2025 with a projected growth rate of 4%.(Knowledge Paper on Global Shifts in Textile Industry & India's Position TAG 2016).The apparel sector provides jobs for over 70 million people .China and India are expected to be the world's largest markets and will overtake EU and USA.

Consumer preference for fast fashion has forced fashion apparel brands to search for manufacturing efficiencies in lower cost countries, offer products at affordable prices and introduce multiple collections in a year. Fast fashion has become synonymous with a disposable culture as apparel is discarded at a fast pace by consumers who believe that the apparel has outlived its utility once it is out of fashion. This creates the problem of unsustainable consumption behavior.

The problem of over production and unsustainable consumer behavior behooves the industry. The major environmental impacts of the sector occur during raw material cultivation, production, consumption and waste produced during production and subsequently due to discarding of clothing much before its life is over by consumers. The environmental impacts are briefly discussed here:

Production

According to Chen and Burns (2006) all textile products negatively impact the environment. The fashion and textile industry is one of the world's most polluting and resource-intensive industries. Organic cotton which has found greater acceptance amongst consumers is also found to be resource intensive: more than 5,000 gallons of water is required to manufacture a T-shirt and a pair of jeans. Synthetic, man-made fibers suffer from issues with manufacturing pollution and lack of biodegradability. Across all textiles, the manufacturing and dyeing of fabrics is chemically intensive.

Consumption

Studies report rapid growth on the consumption side in many countries. The growth in consumption is attributed to the growing fast fashion trend with its increasing number of collections per year and the affordability factor.

Waste

Growing over consumption has also led to increasing waste due to disposal of garments before the end of life is complete. Consumers in different countries are reported to be discarding significant amount of clothing every year. The American consumer discards 31 kg of textile clothing each year and the UK is not very different (Büyükaslan, Jevšnik & Kalaoglu 2015)

Companies in the fashion apparel industry have become conscious and are exploring sustainable approaches to reduce their environmental and social impacts. Sustainable fashion apparel is about producing clothes in environmentally, and socio-economically sustainable manner.

Sustainable fashion as a movement began in the early 1990s due to the efforts of companies such as Patagonia and ESPRIT which adopted sustainability principles.

Of particular interest to this study is the sustainable product design strategies and practices adopted by the Swedish and the Indian Apparel Industry. The industry in Sweden is sizeable with a turnover of approximately SE K 237 billion in 2013 and employs almost as many people as the timber and paper industry. Textiles represent the fourth most environmentally damaging area of consumption in the EU (housing, transport and food top the list) prompting the Nordic countries to come together on a common platform to tackle reduction in textile and apparel waste(Palm, Elander, Watson, Kiørboe, Lyng, & Gíslason. 2014). The Indian textile and clothing on the other hand accounts for 25 % of the country's exports and has been growing. The Indian yarn and textile has been classified as red based on the pollution index computed by the Ministry of Environment, Forest and Climate Change (2016).

In the 2015 Country Sustainability Rankings study (Wilde 2016) Sweden earned the highest ranking. Since Sweden has a lead in terms of adopting sustainability and embedding it into their ways of operating the present researcher chose to compare the fashion apparel industry of the two countries namely India and Sweden .With increasing emphasis on sustainability, Indian apparel industry could face huge challenges in the near future and possibly be threatened as a result. The total textile and apparel exports of India stood at US\$ 40 Bn. in 2015. Apparel is the largest exported category in India's exports with a dominant share of 43%.Howeveras compared to the share of the largest exporter i.e China (40%), India's share is a mere 5% in the global trade(Textile industry and Market growth in India 2017)

Apparel produced and marketed by clothing manufacturers fall into three main categories: a couture garment is made to order and of a high-quality with attention to detail and finish. Ready-to-wear, or prêt-à-porter, clothes have characteristics which are a mix of haute couture and mass with care taken in the choice and cut of the fabric and made in small quantities to guarantee exclusivity and are expensive. The mass market caters for a wide range of customers, use cheaper fabrics, simpler production methods and are sold cheaply. A designer in couture or pret has a greater control over selection of fabric and the remaining phases of production and hence this article takes the view that if fashion apparel designer does not take the design

stage seriously it will be difficult to retrieve from unsustainable choices made thereafter(Gwilt 2012).

The article presents background information on fashion apparel industry and its environmental impact and a review of frameworks and models covering sustainable product design strategies for fashion apparel. Further a new checklist was developed by the present researcher for purpose of conducting exploratory analyses of Swedish and Indian fashion apparel brands. The checklist helps assess companies on their strategies and practices. The analysis then provides input to a discussion of potential design strategies. A set of limitations is identified and conclusions made.

The objectives of the study include:

- To develop a checklist of sustainable product design strategies for fashion apparel based on a literature review of frameworks and models.
- To conduct an exploratory analysis of sustainable product design strategies and practices of apparel fashion brands from Sweden and India in case of pret/ready to wear and mass market brands by using the checklist developed by the present researcher.

LITERATURE REVIEW-SUSTAINABLE FASHION DESIGN MODELS

The following is a review of the frameworks and models covering strategies used in sustainable fashion design for apparel. Design is considered an important part of any environmentally conscious approach as it is known to influence 80 % of product costs and 80 % of its environmental impact.

Research on models and frameworks on sustainable fashion design strategies have been in existence since the 1990s with the subject receiving greater importance today. Some of the research frameworks present a list of sustainable strategies, some researchers have organized these into broad categories with sub strategies listed, and others have used the lifecycle analysis stages to list the strategies.

The European Commission has defined principles of environmental design based on life cycle thinking (Commission of the European Communities 2003).

Sandy Black (Gwilt, 2012) offers guidelines for a sustainable fashion designer covering design for the entire garment's life cycle including use and disposal. She has as identified several sustainable fashion design strategies that are considered useful in the fashion industry with emphasis on sustainable consumption. However these are not categorized into a meaningful schema.

Niinimaki and Hassi (2011) cover a list of strategies over the life cycle of fashion products which can help extend the product life span: long life guarantee, product attachment ,multiple life cycles, slow fashion, customization ,halfway products ,modular structure ,co-creation, local production ,design services, unique design, services for longer or intensive utilization.

Niinimaki and Haasi has a list of well-considered strategies focused on extending the life span of fashion apparel and as a

part of the study consumer opinions and preferences were also sought.

Fletcher (2013) covers the stages of the lifecycle and explores design approaches like service design, localism, speed and user involvement

Kozloski, Bardecki and Searcy (2012) provide a framework linking life-cycle assessment and stakeholder analyses. Some considerations for the designer to address are covered. Most of the considerations are similar to those offered by Gwilt (2012).

Earley and Politowicz(2012) proposes ten sustainable design strategies for textile and fashion designers: Some of these cover waste minimization, recycling/upcycling, reduce energy and water and design activism. The list is comprehensive, serves as a guideline and raises questions which can be addressed by the designer. Each strategy is supported with adequate examples. It is meant to be an idea generation template for apparel designer

Gwilt(2012) proposed the Fashion Design Strategies (FDS) wheel covering the garment life cycle analysis approach. The

FDS consist of strategies clearly articulated at each stage of the life cycle making it easy for a designer to consult on the alternatives available. The FDS identifies stages in Life Cycle Analysis and sustainable strategies for a designer to adopt .For example: Garment Design stage has strategies like Design for Disassembly, Design for Recycling, and Design for strong person product Attachment, Design for Closed loop.

FDS has been well developed and is useful to identify the sustainability strategies designer may pursue. However it needs to be made more comprehensive and updated.

Table 1 is a compilation of the frameworks and models of sustainable product design for fashion apparel by researchers. For more details see *Table 1 Sustainable product design for fashion Apparel: Frameworks and models*. Some of the frameworks present a list of strategies, others have organized these into broad categories with sub strategies listed, and yet others have used the Lifecycle analysis stages to list the categories. FDS identifies the life cycle stages and the strategies for ease of use by fashion designers considering sustainability issues.

Table 1 Sustainable Design frameworks for fashion Apparel by researchers				
Gwilt 2012	**Ninimaki 2011**	**Kate Fletcher 2008**	**Kozlowski, Bandecki and Searcy 2012**	**Earley and Politowicz 2012**
GARMENT DESIGN			*MINIMISE WASTE*	*DESIGN TO MININMISE WASTE*
Design for Disassembly	Multiple life cycles	Local	Multi-functional	Reduce Material Usage
Design for Recycling	Slow/Long lasting	Diversity	Durable Apparel design which last many uses	Zero waste digital printing
Design for strong person product Attachment	Customized	Organic except cotton	Repair	Zero waste Knitting
Design for Closed loop	Half way	Artisans for building attachment	Maintain	Zero waste Weaving
	Modular	No washing	Recycle	Zero waste cutting
	Co-create	Service Design speed and use involvement	Take back	Designing Durability
	Open source		Zero waste design and pattern	
	Local Production			
MATERIAL/TECHNICAL SELECTION	Design services (unique)		*REDUCE ENERGY AND WATER*	*DESIGN FOR CYCLABILTY*
Low impact Material	Design Services (for long lasting)		Select appropriate material - organic/recyclable	
Use mono materials			Tech coating to reduce laundering at use end	Reuse
			Use strategy of environmental regulation	Remanufacture
				Down cycling
				Recycling Cotton

Table 1 Sustainable Design frameworks for fashion Apparel by researchers (contd 1)				
Gwilt 2012	**Ninimaki 2011**	**Kate Fletcher 2008**	**Kozlowski, Bandecki and Searcy 2012**	**Earley and Politowicz 2012**
PATTERN MAKING and TOILING			*REDUCE CHEMICALS*	Recycling Mix
Zero Waste			Use material using less chemical	Recycling Polyester
Efficient Use of Resources			Adopt RSL chemicals	Upcycling
			Mechanical process for surface pattern	Continuous Loops
GARMENT CONSTRUCTION			*INCREASE ETHICAL PRODUCTION*	Take back
Clean Processes			Incorporate traditional, local, global craft skills	
Fair Trade Ethical Supply			Collaborate for environmental stewardship	*DESIGN To REDUCE CHEMICAL IMPACTS*
Design for Durability			Policy for suppliers to increase accountability of supply chain	Material Selection
Minimum Production Waste				Printing
				Dyeing
				Functional Finishes
DISTRIBUTION				
Minimum transport and Storage				*DESIGN To REDUCE ENERGY AND WATER*
Reduce/Reuse Packaging				Material Selection
Engage with Local Supplier				Processing (Dye / Print / Embellish /
				Functional Finish
GARMENT USE LAUNDERING and REPAIR				Transportation
Multifunctional				Consumer Laundry
Modular				
Design for water and energy efficiency				
Design for ease of maintenance/repair				
Upcycle				*DESIGN THAT USES NEW TECHNOLOGIES*
Design for Product Service System				Making Materials
				Processes
				End Of Life
END OF LIFE			*END OF LIFE*	
Leasing/Take Back			Material appropriate for recycling	
Remanufacture			Material appropriate upcycling repair	*DESIGN THAT TAKES KNOWLEDGE FROM NATURE AND HISTORY*
Material reuse /recycle			Systems and services for take back	Nature creating New Models
Resue of Product			Incorporate features for repair	Historical Models
			Incorporate features for replacement	

Table 1 Sustainable Design frameworks for fashion Apparel by researchers (contd 3)				
Gwilt 2012	**Ninimaki 2011**	**Kate Fletcher 2008**	**Kozlowski, Bandecki and Searcy 2012**	**Earley and Politowicz 2012**
			Incorporate features for upgrade	
				DESIGN FOR ETHICAL PRODUCTION
				Designers in Factory
				Designers in Community
			INNOVATION TECHNOLOGY AND CLEAN TECHNIQUES	
			Nanotechnology coating to reduce energy and material	*DESIGN TO REDUCE THE NEED TO CONSUME*
			digital printing	Multifunction
			Material used for closed loop production	Fine Fit
				Online Customization
				Online crowdsourcing
				Online Co-design
				DESIGN TO DEMATERIALISE AND DEVELOP SYTEMS AS SERVICE
				Designers for rent
				Repair and Maintenance
				Designers as service providers
				DESIGN ACTIVISM WELLBEING
				Transparency
				Products as Politics
				Design without Labels

The present researcher has identified several sustainable product design strategies that can be considered useful in the fashion industry and these are incorporated into a comprehensive checklist. The checklist developed for the study is an adaptation of Gwilt (2012)and is presented as a part of

Table 2.For more details see *Table 2 Checklist for Sustainable Fashion Design Strategies and Analyses of Apparel Brands*.

Table 2 Checklist for Sustainable Fashion Design Strategies and Analyses of Apparel Brands				
	Swedish Apparel	*Swedish Apparel*	*Indian Apparel*	*Indian Apparel*
	Filippa K	*H and M*	*Bhusattva*	*Van Heusen*
GARMENT DESIGN				
Design for Disassembly	-	-	-	-
Design for Recycling, upcycling, upgradation ,reuse, remanufacture	*Filippa K*	*H and M*	-	-
Design for strong person product Attachment(Durable, Customise and co create)	*Filippa K*	-	-	-
Design for Closed loop	*Filippa K*	*H and M*	-	-
Design for Slow/Long lasting	-	-		-
Design for Customized	-	-	*Bhusattva*	-
Design for Half way	-	-	-	-
Design for modular	-	-	-	-
Design for Co create	-	-	-	-
Design for Open source	-	-	-	-
Design for Local Production	-	*H and M*	-	-
Multifunctional/Modular	-	-	-	-
MATERIAL/TECHNICAL SELECTION				
Low Impact	*Filippa K*	*H and M*	-	-
Mono materials	-	--	-	-
Organic fibre /Recycled	*Filippa K*	*H and M*	*Bhusattava*	*Van Heusen*

Table 2 Checklist for Sustainable Fashion Design Strategies and Analyses of Apparel Brands(Contd 1)				
	Swedish Apparel	*Swedish Apparel*	*Indian Apparel*	*Indian Apparel*
	Filippa K	*H and M*	*Bhusattva*	*Van Heusen*
PATTERN MAKING and TOILING				
Zero Waste	-	*H and M*	-	-
Efficient Use of Resources	-	-	-	-
GARMENT Production CONSTRUCTION				
Design for water and energy efficiency	*Filippa K*	*H and M*	-	-
Clean Processes	-	*H and M*	-	-
Fair Trade Ethical Supply	-	-	-	-
Design for Durability	-	-	-	-
Minimum Production Waste	-	-	-	-
Tech coating to reduce laundering at use end	-	-	-	-
Use less chemicals or adopt RSL for processes like printing, dyeing	-	-	-	-
Adopt mechanical processes for surfaces	-	-	-	-
Adopt ethical production	-	-	-	-
Incorporate traditional ,local,, global craft skills	-	-	*Bhusattva*	-
Processing and finishing which consume less energy and water and	-	-	-	-
Adopt technology like Nano technology- coating to reduce energy and materials	-	-	-	-
Adopt digital printing	-	-	-	-
Non toxic colours	-	-	*Bhusattva*	*Van Heusen*
Certified factory	-	-	-	-

Table 2 Checklist for Sustainable Fashion Design Strategies and Analyses of Apparel Brands (Contd 2)				
	Swedish Apparel	*Swedish Apparel*	*Indian Apparel*	*Indian Apparel*
	Filippa K	*H and M*	*Bhusattva*	*Van Heusen*
DISTRIBUTION				
Minimum transport and Storage	*Filippa K*	*H and M*	-	-
Reduce/ Reuse Packaging	-	-	-	-
Engage with Local supplier	*Filippa K*	*H and M*	*Bhusattva*	-
GARMENT USE: LAUNDERING and REPAIR				
Design for water and energy efficient clothing care	*Filippa K*	*H and M*	-	-
Design for Ease of Repair and Maintenance	*Filippa K*	-	-	-
Up Cycle	*Filippa K*	*H and M*	-	-
Multifunctional/Modular	-	-	-	-
END OF LIFE				
Remanufacture	-	-	-	-
Material reuse /recycle/	*Filippa K*	*H and M*	-	-
Reuse of Product	*Filippa K*	*H and M*	-	-
Take Back	*Filippa K*	*H and M*	-	-
Leasing/Rent/Share	*Filippa K*	-	-	-

METHODOLOGY

The research process was divided into three parts. First a literature review was undertaken to investigate the models and frameworks covering sustainable product design strategies for fashion apparel. The second part consisted of developing a checklist using the FDS framework by Gwilt as the main template and it was modified to add the works of other researchers. The new checklist can be referred to in *Table 2 Checklist for Sustainable Fashion Design Strategies and Analyses of Apparel Brands.*

The last part of this research consisted of assessing companies from two countries on the sustainability strategies and practices followed. Information regarding the sustainable strategies and practices communicated by the companies through written reports like sustainability reporting of the last two years, other research articles published in journals and industry magazines relevant to these companies, were examined. In this study, we considered the sustainability strategies communicated to the stakeholders as a proxy of the practices adopted by the companies. The new checklist of sustainable fashion apparel design strategies was used to conduct an exploratory analysis of the evidence in the reports.

Table 2 in part presents the new checklist for sustainable design strategies of fashion Apparel derived from various researchers who are practicing fashion designers themselves. Further it provides an analysis for the four apparel brands considered in

the study. Wherever secondary sources like Fillipa K Sustainability Report(2016); H& M Sustainability Report (2017) provided evidence in regard to the use of a specific strategy the same is indicated in the Table 2.

Since the study was exploratory in nature only two apparel brands each were selected from each country and evaluated against the checklist of strategies developed. From each country one mass market brand and one Pret a Porter /Ready to wear brand was chosen for analyses. The sample size was 4 fashion apparel brands two each from India and Sweden. The Indian brands covered are Bhusattva (pret) and Van Heusen (mass market) and the Swedish brands include: Fillipa K (pret) and H and M(mass market).

FINDINGS

A new checklist was compiled by the present researcher. Gwilt had identified 25 sub strategies under 7 broad categories. The new checklist of the present researcher has identified 43 sub strategies under the 7 categories .The new checklist is inclusive and gives more details. *See Table 2 Checklist for Sustainable Fashion Design Strategies and Analyses of Apparel Brands* for details of the checklist and analyses of various brands.

The analyses broadly reveals that Fillipa K and H and M use a wide variety of strategies towards sustainable fashion design as compared to their Indian counterparts. Both the Swedish brands worked on the entire life cycle of an apparel to improve environmental sustainability.

Fillipa K and H & M both adopted around 15 sub strategies each.Of the 21 business models identified in a separate study (Nerurkar 2017;Nerurkar 2018) Swedish brands Fillipa K and H and M use at least 9 of these business models.

Specifically, published data on Fillipa K shows evidence of the following sub strategies covered in the product design of sustainable fashion apparel. Garment design: design for recycle, closed loop, durability and design for multiple lifecycles .Material and Technical Selection: Low impact or organic was chosen. In Garment production: design for water and energy efficiency was chosen. As a part of Distribution: transport and sourcing are sustainably conducted. As part of garment use, laundering and repair, Fillipa K has apparel designed for less use of water, ease of repair, material reuse, reuse of product. As a part of end of life it uses Take back, lease and share.

H and M strategies are similar to Fillipa K and include design for recycling, closed loop, design with local production, low impact material, organic, zero waste**;** design for energy and water efficiency, sustainable means of transport and packaging are used, and suppliers selected also use sustainable means. In garment use and laundering and repair: it is similar to Fillipa K except that it does not seem to use rent and leasing. However it does have a take back strategy.

Bhusatvva, the Indian apparel brand uses five sub strategies: Design for customization, organic fibre, incorporates traditional skills, engages with local suppliers and uses

nontoxic colors and Van Heusen uses only two sub strategies: use of organic fibre and natural dyes.

RESEARCH LIMITATIONS

The exploratory nature of the study with a convenience sample is a major drawback. Further the study lacks empirical data from producers, designers and consumers that would be of great use.

Practical Implications

As consumers are increasingly interested in the perceived benefits of sustainability, companies will be required to explore Sustainable driven innovation opportunities in design or business models (Nerurkar 2015).This study explores the alternatives offered by sustainable product design in the fashion apparel industry.

This study may serve as a starting point to engage Indian fashion apparel designers in a conversation about the role and relevance of sustainability and the use of Life Cycle analysis framework to stimulate ideas for improving their environmental sustainability. It appears that Indian fashion apparel brands have a long way to go. If they are able to mesh sustainability with an emphasis on psychosocial factors affecting design (Nerurkar 2016) Indian fashion apparel brands will be able to win the hearts and minds of it global consumers. The road to sustainability has to be carefully laid out with clear milestones.

Despite the exploratory and descriptive nature of the research, the study has made important observations. The sustainable product design for fashion apparel checklist developed for this study highlights the rather scattered approach to the implementation of sustainability strategies and practices by Indian fashion apparel brands as compared to their Swedish counterparts.

Sustainability in fashion apparel does not mean the end of fashion. Sustainable fashion by Indian apparel must balance the personal and symbolic needs of users with the environmental and social benefits while building new paradigms. The lack of awareness, education and scope of discussions may be the hurdles designers encounter in India.

CONCLUSIONS

In this paper a checklist for mapping the strategies and practices for sustainable fashion apparel is presented and used in order to analyze sustainable the fashion apparel brands in India and Sweden. The research was carried out taking into consideration only the information reported on the website of the companies and published in research articles. As the research is devoted to understanding the practices for environmental sustainability and of an exploratory nature it sheds light on some interesting findings.

FUTURE SCOPE

A future research step could be the extension of this analysis to other countries, in order to compare the results of Indian companies with the others. The research methodology could use the case based analysis or empirical survey in order to validate the results obtained by this research.

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