'Customer quality analysis of outdoor clothing'

Program: Quality in process Technology
(Degree Project)
Examiner: Sven Hamp (HST)
Supervisor: Eric Sjolander (M.D., GreenIT)

Author:
Fazle Al Hossaini
# TABLE OF CONTENT

**ABSTRACT:** .................................................................................................................. 3  

**INTRODUCTION:** .............................................................................................................. 4  

- Problem Formulation: ........................................................................................................ 5  
- Project Description: ........................................................................................................... 6  
- Literature Review: ............................................................................................................. 8  

**CHAPTER 2-ANALYSIS OF SURVEY** .............................................................................. 14  

- Result: ............................................................................................................................... 16  
  - Market offer information: ............................................................................................... 16  
  - Buying reason: ............................................................................................................... 17  
  - Requirements and Fulfillment of outdoor clothing quality: ........................................... 17  
  - Customer support expectation: ...................................................................................... 24  
  - Preference of brand and brand quality: ........................................................................... 25  
  - Customer loyalty: .......................................................................................................... 26  
  - Internet shopping of outdoor clothes: ............................................................................ 27  
  - Customer social and environmental consciousness: .................................................... 28  
  - Discussion: ................................................................................................................... 32  

**CHAPTER 3-CLOTHING FIBRE AND MATERIAL** .......................................................... 34  

- Vegetable Fibres: Cotton .................................................................................................. 34  
- Vegetable Fibers: Flax ....................................................................................................... 35  
- Animal Fibers: Wool ......................................................................................................... 36  
- Animal fibers: Silk ............................................................................................................ 38  
- Natural Polymer Fibers: Viscose, Modal ......................................................................... 39  
- Natural Polymer Fibers: Cupro, Acetate, Triacetate ...................................................... 40  
- Synthetic Polymer Fibers: Acrylic, Modacrylic ............................................................... 41  
- Synthetic Polymer Fibers: Polyester ................................................................................. 43  
- Other synthetic polymer fibers ......................................................................................... 43  
- Inorganic Man-made Fibers .............................................................................................. 44
CHAPTER 4 – QUALITY FUNCTION DEPLOYMENT & CLOTHING TECHNOLOGY ---- 45

Clothing physiology .................................................................................................................. 45
Fiber properties .......................................................................................................................... 46
Quality house .............................................................................................................................. 48
Fiber blending .............................................................................................................................. 50
Chemical finishing: .................................................................................................................... 51
Coating and Lamination: ............................................................................................................ 51
Application: ................................................................................................................................. 52
Discussion: ................................................................................................................................. 53

CHAPTER 5 – ENVIRONMENTAL AND SOCIAL ASPECTS OF CLOTHING TECHNOLOGY: ................................................................................................................................. 54

Ecology and textile pipeline: ...................................................................................................... 54
Eco-labeling: ................................................................................................................................. 56
Code of Conduct .......................................................................................................................... 56
Fair Trade ..................................................................................................................................... 57
Discussion: ..................................................................................................................................... 59

GRAPHS AND REFERENCES: ..................................................................................................... 60
Abstract:

Purpose:

The main aim of this report is to identify customer needs of outdoor products (jackets, pants, shoes etc.) directly through customer interviews and their consciousness about environmental and social sustainability. And my report can be used as a base for ‘product design’ of Outdoor clothing. Also from my report both the suppliers and customers can get a good idea of ‘Environmental and social aspect of clothing technology’.

Design/ methodology/approach:

The whole project I divide into three consecutive steps.

First, a thorough survey will be done by asking the customers with a ‘questionnaire’. Here my intention will be to identify customer expectation about Product quality as well as their consciousness about social, economic and environmental sustainability.

Then in the second step – customer motivation factor will be identified which can be used for formulating a marketing strategy.

Finally, in the third step a systematic translation of customer needs of product quality into product/ product material requirements for design parameters. And priority of these characteristics will be made according to customer preference of product qualities. Also the physical and chemical properties of different materials used for manufacturing outdoor clothing will be discussed in this part.

Findings- The findings intended to identify customer expectation about product features and quality according to customer segmentation (age, groups and buying habits) as well as customer’s expected service from suppliers. And then translating these customer needs to product properties.

Limitations: As ‘Customer survey’ is the crucial part of this project. So, it is quite difficult to understand how the customers anticipate the question and as Sweden is not a fully English speaking country, so for the language barrier it is a question - what kind of response I shall get from them? And a successful survey depends on number of participations, choosing the right samples but my expectation is to get around one hundred questionnaires filled and carry out my research about the customer’s needs and expectations of outdoor clothing from this brief survey. But I admit that one hundred respondents are not enough to come to a conclusion about customers.

Practical implications- From the findings a marketing strategy can be estimated for any outdoor clothing suppliers and apparel retail brands. And from the detailed discussion of clothing materials, the outcomes can be used as a base of ‘product development’ for outdoor clothing. But this report is up to ‘product planning’ and ‘product design’ process.

Keywords: Outdoor clothing, Customer survey, Social sustainability, economic sustainability, environmental sustainability, product planning, product design.
**Introduction:**

Significant changes in western economies over the last thirty years have altered the ways that customers and buyers operate. Prior to the 60s and 70s, post-war shortages meant that people bought what was available and then the marketing revolution began. This meant that suppliers developed products and services to specifically address the needs of their customers. Nowadays it is quite common for many suppliers to offer the same products and services with little for the customer to choose between them. What hasn’t changed over the centuries is that people buy products and services for ‘what they do for me!’ but the buying motives vary. Motives to buy are: Pride of ownership; desire for gain; vanity; convenience; self-preservation; prestige and status; ambition; avoidance of worry; pleasure; self-improvement; fear of losing.

Clothe satisfies a wide variety of customer’s needs: they protect, define a person’s role in his social group, or help a person to express himself or to show life-style. All these factors come into play during buying process of outdoor clothing. From the survey I shall make a specific order among the influencing factors of buying process. These influencing factors of outdoor clothing are: color, shape, style, fit, wearing comfort, appearance, functionality, price etc.

Customers pursuing high-intensity sports such as mountaineering, skiing, snow-boarding, cycling or sailing, practice their sports primarily outdoors. Due to the nature of the sports the customers demand very high-quality clothes that are durable even in extreme circumstances. Thus product’s functionality is much more importance in this case. Price belongs to those decision criteria are minor importance because these outdoor clothing is more expensive than conventional clothes. Although functionality and price are usually the most decisive criteria for sportswear, appearance can be importance as well. Users may also take products visual attributes into consideration.

![Figure1](image)

**Figure 1:** use of outdoor clothes. Source: advertisement of ‘Pantagonia’, (a famous outdoor clothing brand)

And now-a-days awareness of customers towards society and environment is growing. So different companies are getting certification from different regulatory committee (e.g. ISO), and following different ‘code of conduct’ of ‘labour organization’ to contribute back to society, economy and environment. But the economic approach is based on the assumption that ‘sustainable products’ are successful only if customer perceives the products as superior to competitors’ conventional offering and admired and preferred by customers.

---

1 Whalley, Andy. *Obtaining and Retaining Customers.*
Problem Formulation:

Maintaining ‘customer relationship’\(^2\) is a key to success in today’s competitive environment. Therefore organizations need to understand their customers better – and customer analysis is a vital step towards this understanding. Customer profiling\(^3\) is the collective set of analysis that serves to best describe our customers. It includes:

1) Segmentation – this involves the subdivision of customer populations into finer groups sharing common properties. Typically, segmentation will begin with a business problem in mind – an attempt to determine which measures of a customer are important to an organization’s problem, and how the chosen measures can be used to segment the data – a vital first step in targeting strategy. It is a highly iterative and experimental process.

And for outdoor clothing the choice of customer really vary according to –
- Age
- Gender
- Usage / activity
- Living area
- Nationality
- Special interest, etc.

2) Customer intelligence – treating different customers differently: The business benefits of turning data into information as the basis of intelligent customer relationships are clear. The customer intelligence process has four elements:

---

\(^2\) The handbook of customer satisfaction and loyalty measurement - AvNigel Hill, Jim Alexander

\(^3\) The handbook of customer satisfaction and loyalty measurement - AvNigel Hill, Jim Alexander
Project Description:

The whole project work will be carried out in three consecutive steps:

1. Performing a market analysis to find about the needs and expectation of the customers by a thorough survey. Here my intention will be to identify customer expectation about Product quality as well as consciousness about social, economic and environmental sustainability. The important point I can get from this survey:
   - Identify the customers and their buying habits.
   - Differentiate the customers according to value and need.
   - **Requirements of Product Quality**
   - **Motivation Factor of customer**

2. Customer motivation factors are:
   - Benchmarking process (customer preferences of different manufacturer’s/brand’s features)
   - Loyalty of customers
   - Environmental and Social consciousness
   - Usefulness of Internet Marketing
   
The points we will get are:
   - How the customer should be treated?
   - How ‘Branding’ of product is of importance to customers?
   - How the customers are concerned about Social and Environmental sustainability?
   - Should the Manufacturer’s follow some Rule of conduct of some Labor association and Quality assurance on customer point of view?
   - How the IT can be used for Marketing?
   - Effectiveness of Internet outdoor shopping.

These points could be used to formulate a detailed marketing strategy of ‘outdoor clothing’.

3. Translating key factors of Product quality into Product Characteristics.
   From the survey result I shall get **preference** about different product quality, e.g.:
   - Price tolerance / affordability
   - Durability
   - Look and appearance
   - Design
   - Fitness
   - Easiness of caring
   - Protection against weather
   - Environmental friendliness
Some important general characteristics of outdoor products / product materials are:

- Weight and bulk
- Heat insulation
- Water proofness
- Cleanliness
- Biodegradable / disposable / recyclable
- Sewing/ attachment process
- Flame retardant
- Breathability of material / water vapor transport properties
- Friction and wear properties

Now, I shall use the House of Quality\(^3\) which is a diagram, resembling a house, used for defining the relationship between customer desires and the product material / product capabilities. It is a part of the Quality Function Deployment (QFD)\(^4\) and it utilizes a planning matrix to relate ‘what the customer wants’ with ‘how the products are going to meet those wants?’. It looks like a House with a "correlation matrix" as its roof, customer wants versus product features as the main part. It is based on "the belief that products should be designed to reflect customers’ desires and tastes". It also is reported to increase cross functional integration within organizations using it, especially between marketing and engineering.

![House of Quality Diagram]

For example, there is a close connection between customer requirement ‘reduced weight & bulk’ and engineering characteristics ‘fit, comfort and durability’. And the values in the column marked ‘relative importance’ states, how the customers value the wishes. Like this way I can identify which characteristics of ‘product/ product material’ should be given preference.

\(^4\) Quality from customer needs to customer satisfaction – Bo Bergman, Bengt kjelfsjo
From here on, I shall identify different Materials (both traditional and advanced type) used for Outdoor products and comparing their physical and chemical properties and which mostly suits customer requirements. Then I can suggest suitable materials for outdoor products.

**Literature Review:**

In order to elaborate the total project, it is important that the following terms be discussed. They are:

- Quality Function Deployment (QFD)
- Marketing Plan by Understanding Customer Needs
- Textile related customer preferences
- Textile Fibers

**Quality Function Deployment**

Quality function deployment is a means to structure and systemize the product development process. This methodology was developed in Japan during the late 1960s by Shigeru Mizuno (1910-1989) and Yoji Akao (1928- ).

One definition of QFD is provided by Slabey (1999) : “ A system for translating consumer requirements into appropriate company requirements at each stage from research and product development to engineering and manufacturing to marketing, sales and distribution.”

The work involved in Quality Function Deployment can be divided into the following four parts:

- Performing a market analysis to find out about the needs and expectation of the customers.
- Examining different companies to find out about their ability to satisfy the needs and wants of the customers
- Identifying key factors for the success of the company’s product on the market with the two steps above as a basis
- Translating these key factors into product and process characteristics in connection with design, development and production.

There are a number of methodologies for market analysis. One of them is ‘conjoint analyses. This methodology is built on statistical design of experiments with the use of simple factorial designs. Potential customers are asked to rank the different product concepts in order of preference, where important factors are chosen according to a factorial design with factors chosen at two levels.

Essentially, the QFD methodology can be divided into four steps:

1. Product Planning  
2. Product design  
3. Process design  
4. Production design

Product Planning:
The wishes of the customers are transferred to properties of the product. At the same time a valuation of these wishes is made. The final result is an identification of important product properties. The work is generally is carried out and documented in a kind of matrix called ‘The Quality House’.

The Quality House:

This describes (as a first step) customer requirements and product development and product properties, and various symbols in the matrix in the center of the house indicate the relation between two groups.

**Understanding Customer Needs:**

‘Applied Customer Insight’ helps to understand and anticipate customer expectations and needs, and then tailor the customer experience. Customer insight is an ongoing process that applies a unique, fact-based understanding of customer needs, expectations and value potential in order to personalize customer offers and experiences.

The human mind is exceedingly complex but that has not deterred marketers from trying to influence customers’ decision making process – this is the ‘Black Box’ model (Kolter, 2000).

![Fig 2: Black Box model (Kolter 2000)](image)

In the Black Box model, influencers range from social background, personal contacts and circumstances (lifestyle), through to values and beliefs, personality and self-image. As if that was not complicated enough, in most cases the decision to purchase is not only made by one individual – it is made by several people. This is particularly true in business-to-business buying decisions. The decision-making process contains five basic steps from recognition of need through to post-purchase rationalization and analysis – sometimes called buyer’s remorse.
Fig 3: Stages in the buying process (ref: Obtaining and retaining customers – Andy Whaley, Lan Headon, Daren O’conor.)

Whether in professional or personal capacity identify one brand or service that commands loyalty and answer these questions.

1. What feeling customers have about Brand?
2. Is there a word or phrase that sums up what the brands means to customer?
3. What has the seller done to deserve customer’s loyalty?
4. What factors in the Black Box Model is the seller appealing to?

Profiling: Customer profiling is the collective set of analysis that that serves to best describe our customers. It includes customer segmentation and Customer intelligence.*

Market plan: Depending on the result of these above analysis a market plan is developed. Market plan is analysis, planning, implementation and control of programs designed to meet customer needs.

Within a Market plan, the following elements are crucial:

- Monitoring the market environment
- Identification of customer needs
- Resources needed to satisfy customer needs in line with own needs
- Monitoring and evaluating results
- Implementing customer solution

*Described in ‘Problem Formulation’

**Consumer Preferences:**

A product’s benefits can be differentiated in functional benefits, product appearance, self-esteem, and image. *Functional benefits* represent both the technical performance of a product and workmanship. Some products simply work better, faster, slower, more silently, with fewer failures,
etc. than others. Some products may have a special appearance, too. They look better, taste better, and feel softer. Additionally, products often have an impact on how customers feel and behave within their social environment. On one hand it might have consequences for one’s self-esteem. Purchasing a product can result in feeling satisfied or in deep self-reproach. On the other hand, a transaction can improve or weaken a person’s image in her social group. Though buying green products usually improves a person’s image in her social group it might weaken it in another that is less open to environmental issues.

For describing textile-related consumer preferences I will concentrate on German surveys (IfD, 1996; Albaum, 1997; Spiegel, 1997; Niesel, 1999) whilst nevertheless being aware of the inconsistencies in connection with questionnaire surveys in the field (Dembkowski and Hanmer-Lloyd, 1994). Consumers’ general textile decision processes follow a specific order. At first, consumers take those products into consideration that they like because of their visual appearance (color, shape, style). While taking the products from the store consumers examine the products’ touch. Afterwards, they try on the products (fit, wearing comfort) and check price in relation to performance. In terms of cost and benefits these most important criteria are appearance, functionality, and price (Figure X).

The items’ relative importance varies according to how fashion-oriented customers are. Fashion-oriented consumers like to be inspired by certain products (or advertisements) and undervalue functionality and price in favor of appearance. Up to 65% of the consumers, however, are less fashion oriented and usually look for clothes first of all for replacement reasons (Albaum, 1999). Consequently, they are more price sensitive and buy clothes with a stronger functionality focus.
Figure 3 makes it clear that search cost, cost of change, and cost of disposal are less important. Image benefits and self-esteem seem to count as can be seen by the importance of buying experience and brands. There seem to be only slight differences between women’s and men’s textile-related preferences.

<table>
<thead>
<tr>
<th></th>
<th>Product Price</th>
<th>Functionality (Processing Quality)</th>
<th>Functionality (Durability)</th>
<th>Visual Appearance</th>
<th>Haptic Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Cotton</td>
<td>+</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>+</td>
</tr>
<tr>
<td>Oxygen Bleaching</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>No Colour-Brightening</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>-</td>
<td>O</td>
</tr>
<tr>
<td>No Heavy-Metal Dyes</td>
<td>+</td>
<td>O</td>
<td>O</td>
<td>-</td>
<td>O</td>
</tr>
<tr>
<td>Mechanic Shape Stabilisation</td>
<td>+</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>+</td>
</tr>
<tr>
<td>No Easy-Care Finishing</td>
<td>-</td>
<td>O</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

+ rising  o  no  - lowering

Figure 5: Effects of greening clothes on cost and benefits. Reference: Meyer and Fischer, 2000; Fischer and Wohler, 2001.

The reported importance of clothes’ kindness to one’s skin seems to stand for a call for good environmental performance. However, it is only a restricted understanding of environmental performance because it means wearing comfort or just no harm to human health while wearing clothes. Most consumers neither directly nor indirectly demand clothes that are environmentally benign in terms of a life-cycle perspective. One major reason seems to be past experiences with green clothes (Meyer, in press). Most consumers still perceive green clothes as shapeless, colorless, overpriced, etc. (GfK, 1999; Otto Versand, 2000). As will be seen below, this perception is at least partly true.
**Textile Fibers:**

<table>
<thead>
<tr>
<th>Natural Fibers</th>
<th>Man-Made Fibers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
<td><strong>Group</strong></td>
</tr>
<tr>
<td><strong>Sub-group</strong></td>
<td><strong>Name or</strong></td>
</tr>
<tr>
<td><strong>Name or</strong></td>
<td><strong>Generic name</strong></td>
</tr>
<tr>
<td><strong>Generic Name</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Vegetable (cellulose)</strong></td>
<td><strong>Natural Polymers</strong></td>
</tr>
<tr>
<td>Seed</td>
<td>Cellulosic</td>
</tr>
<tr>
<td>Cotton</td>
<td>Viscose</td>
</tr>
<tr>
<td>Kapok</td>
<td>Modal</td>
</tr>
<tr>
<td>Coconut</td>
<td>Lyocell</td>
</tr>
<tr>
<td>Bast</td>
<td>Cupro</td>
</tr>
<tr>
<td>Flax</td>
<td>Acetate</td>
</tr>
<tr>
<td>Hemp</td>
<td>Triacetate</td>
</tr>
<tr>
<td>Jute</td>
<td></td>
</tr>
<tr>
<td>Ramie</td>
<td></td>
</tr>
<tr>
<td>Leaf</td>
<td>Alginate</td>
</tr>
<tr>
<td>Sisal</td>
<td></td>
</tr>
<tr>
<td>Manila</td>
<td>Rubber</td>
</tr>
<tr>
<td>Animal Protein</td>
<td>Synthetic Polymers</td>
</tr>
<tr>
<td>Wool</td>
<td>Elastomeric</td>
</tr>
<tr>
<td>Wool</td>
<td>Elastane</td>
</tr>
<tr>
<td>Virgin Wool</td>
<td>Elastodene</td>
</tr>
<tr>
<td>Fine Hair</td>
<td>Fluorofibers</td>
</tr>
<tr>
<td>Alpaca</td>
<td>Fluoro</td>
</tr>
<tr>
<td>Llama</td>
<td></td>
</tr>
<tr>
<td>Vicuna</td>
<td>Polyacrylics</td>
</tr>
<tr>
<td>Guanaco</td>
<td>Acrylic</td>
</tr>
<tr>
<td>Camel</td>
<td>Modacrylic</td>
</tr>
<tr>
<td>Rabbit</td>
<td></td>
</tr>
<tr>
<td>Angora</td>
<td>Polyamides</td>
</tr>
<tr>
<td>Mohair</td>
<td>Nylon</td>
</tr>
<tr>
<td>Cashmere</td>
<td>Aramid</td>
</tr>
<tr>
<td>Yak</td>
<td></td>
</tr>
<tr>
<td>Coarse Hair</td>
<td>Chlorofibers</td>
</tr>
<tr>
<td>Cattle</td>
<td>Vinyl Chloride</td>
</tr>
<tr>
<td>Horse</td>
<td>Vinyleden chloride</td>
</tr>
<tr>
<td>Goat</td>
<td></td>
</tr>
<tr>
<td>Silk</td>
<td>Polyesers</td>
</tr>
<tr>
<td>Cultivated</td>
<td>Polyester</td>
</tr>
<tr>
<td>Wild (Tussah)</td>
<td></td>
</tr>
<tr>
<td>Mineral</td>
<td>polyolefins</td>
</tr>
<tr>
<td>Rock fibers</td>
<td>Polyethylene</td>
</tr>
<tr>
<td>Asbestos</td>
<td>Polypropylene</td>
</tr>
</tbody>
</table>

**Sources of Textile Fibers:**

<table>
<thead>
<tr>
<th>Cotton, Flax</th>
<th>Cellulosic is the basic scaffolding of all plants. It is formed through photosynthesis.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wool, Silk</td>
<td>The food taken in by animals is transformed into fiber-forming proteins.</td>
</tr>
<tr>
<td>Cellulosic Man-made Fibers</td>
<td>Source material is cellulose extracted from wood.</td>
</tr>
<tr>
<td>Synthetic Man-made Fibers</td>
<td>Raw material is petroleum, derived from sea plankton.</td>
</tr>
</tbody>
</table>
Chapter 2-Analysis of survey

The survey has been carried out to identify customer requirements and their fulfillment level about outdoor clothes and also their expected needs from the retailers and suppliers of outdoor clothes. The survey has been carried out by providing questionnaires to the customer and I tried to identify the motivation factor of customer expected needs. A quantitative study was then used to collect data to examine the expected needs and fulfillment level that contain specific behaviors that create a sense of overall comfort for the customer. Overall comfort positively impacts both overall quality and customer satisfaction and this ultimately leads to customer loyalty.

The survey result can be used also to ‘product design’ and ‘product development’ processes by developing of comfort-enhancing strategies for preferring engineering characteristics of clothing materials. First the essential properties and characteristics of customer of outdoor clothing must be understood and specified. That means what engineering characteristics and properties required for Outdoor clothing material should be developed according to customer expectation. This result of my survey can be used as a basis of development for this purpose in future.

Develop Question:

The questions in the questionnaire are made to effectively extract relevant information to build a picture of customer’s behavior about following points:

- Segmentation variables
  - Gender
  - Age
  - Living area
  - Activity (what activity customer use it for)
  - Where they use it mainly
  - Usage frequency
- Market offer information
- Reason of buying
- Customer requirements of outdoor clothing quality
- Customer fulfillment of outdoor clothing quality
- Customer expectation of retailer’s service
- Preference of brand and brand quality
- Customer loyalty
- Customer environmental and social consciousness
- Internet marketing

This questionnaire is developed as ‘tick mark’ option for customer, so it is not difficult and time consuming for them. And the questionnaire was developed so people can fill up the questionnaire within 10-15 minutes. The customer was also given option to give their opinion.

Data collection and Sample:

To answer the research question of customer behavior, a total of 94 interviews were conducted among adult consumers in Sweden. Respondents for these in-depth interviews were aged from 18 to
65 and balanced between age, gender and dwelling places of customers. Selection of interview place was chosen preferably at the venue of ‘Vildkamassan 2011’ at ‘International Fair’ in Stockholm. As this was a fair of Outdoor products this was the best place to get opinion of outdoor clothes customer. Other than this venue I also tried to get respondents from shops of Outdoor products like ‘Naturkompaniet’ and as I preferred to get respondents of young ages people like around 20-30 which are the main customers of outdoor clothes, so I also get respondents from different University campuses including Malardalen Hogskolan.

**Measure:**

A sample size of around 94 I took to ensure adequate item-to-response ratios. Among the respondents 51 were female and 43 were male and maximum respondents belong to the age 25-44 age group (46.67%) but I was not able to collect more respondents of people over age of 65. 51 respondents were from Metropolitan cities, 32 from smaller cities or community and 11 from countryside of Sweden. So, I tried to cover customers of all segmentation.

**Data Integration:**

Data integration is a powerful element of good survey. Data integration, where several opinions and data points are considered, aims to reduce bias and stereotypes, maintaining standards and ensure fair and accurate decision. The power of the process comes from interviewers sharing information that has been collected from the interview and then evaluation and identification of data. It should form the basis for ongoing identification of customer needs.

Here, in most of the case I show the preference of customers and sometimes the percentage. The values in the graph here do not show the number of respondents but to compare among different preference of customers. The survey could be further analyzed like cross-analyzing among all segmentation variables, and much interesting result could come out. But according to the scope of my report I analyze the survey mostly generally and according age and gender.
Result:

Market offer information:

Here we can see that regarding all age and gender people like to get information directly from the retailers of outdoor clothes. But the Internet is also getting more and more popular for getting information. Especially Female of age from 18-44 prefer to get information first from internet before going to stores. And also ‘from friends and acquaintance’ is also a vital way to get information about products for people of age 25-44 of both genders. Because I think people are more dependent on friends and acquaintance at this age range. And ‘word of mouth’ is the most effective way of passing information about products for any company than any advertisement as it is more reliable way to get information for customers.
Buying reason:

We can see that ‘change of weather’ is the main reason to buy outdoor clothes. Because in Sweden during winter the weather is quiet extreme. But amazingly not for people of age 45-64 of both genders. Special offer is the most attractive option for buying reason. Because I found that during inauguration and special occasion like ‘Christmas’ different stores and retailers gives attractive offer to lure customers. And ‘need or replacement’ is also very important factor buying new outdoor clothes. And only for younger people of age 18-24 ‘arrival of new product or style’ is important for buying the new one.

Requirements and Fulfillment of outdoor clothing quality:
This is the most important topic in my report. The requirements and Fulfillment factors are analyzed according to different segmentation like age, gender, dwelling areas, activity, using area. The points that are analyzed to know preference among these points:

- High price value : High quality
- Easy to get hold of:
- Long life : durability
- Easy to understand how to take care of your clothes for them to stay long: after-care properties.
- Easy to understand how to take care of your clothes so as not to affect the environment more than necessary: after-care environmentally.
- Look good: appearance.
- Feeling modern: style/design.
- Have a good fit: fitness.
- Easy to repair if the clothes tearing: easiness of repair.
- Easy to clean and freshen: washing and drying.
Knowing how to get rid of the clothes, in the most environmentally friendly way, when they are exhausted: environmentally disposable.

Protection against Weather

The clothes have some sort of eco-or fair trade: maintaining ‘labor rule of conduct’ and ‘environmental management system’ during importing and manufacturing.

And the customers are given five options to give relative importance to these points. Like:

**Numeric importance scale:**

- Crucial for my purchase = 5
- Very important = 4
- Fairly important = 3
- Not so important = 2
- Not important at all = 1

In the graphs the bars show the fulfillment and the lines show the importance value. The line (importance) shows the goal (how far the customer wants the supplier to go), and the bar then shows the position, how far from the goal the suppliers are. The difference (gap) between the line and the bar is then the grade of satisfaction. And here only the important part of the graph is shown and the full graph is given at the end – ‘Graphs and references’

1. Requirement and fulfillment analysis according to age:
For age range 18-24Y ‘Look good’ is the most important factors among all quality, and they give less importance to the point ‘environmentally disposable’, ‘easiness to repair’, ‘eco or fair trade’ and ‘aftercare properties’. And their expected quality regarding ‘feeling modern’ is quiet fulfilled. But they are quiet unsatisfied regarding ‘good fit’ and ‘look good’ and the suppliers has the option to work more on these factors. They also give much importance to ‘high price value (quality)’.

For age range of 25-44Y ‘durability’ is the most important factor of outdoor clothing. They also give importance to ‘look good’ and ‘good fit’. People of this age range also give less importance to ‘environmentally disposable’, ‘easiness to repair’, ‘eco or fair trade’ and ‘aftercare properties’. And amazingly they are quite satisfied regarding all points or quality of outdoor clothing.

People of age within 45-64 give most importance to ‘protection against weather’. And they have fewer objections against any points regarding quality of outdoor clothing, i.e. they are almost satisfied about the service of outdoor clothing quality.

We can see that people of all ages give less importance to point ‘environmentally disposable’, ‘easiness to repair’, ‘eco or fair trade’ and ‘aftercare properties’. And in most factors they are quite satisfied about the quality of outdoor clothing. Customer think their expectation regarding ‘eco or fair trade’ are quiet fulfilled, their knowledge regarding different ‘labor rule of conduct’ and ‘environmental management system’ and their knowledge regarding these points also analyzed which will be shown later.

2. Requirement and fulfillment analysis according to gender:

In this case my observation is that women are more concern about ‘good fit’ of outdoor clothes and they are quite unsatisfied about the fitness of outdoor clothes. And men are more concerned about
'looking good' and they are quite satisfied about that. Women are quite unsatisfied about the 'cleanliness' of outdoor clothes according to their psychology and they give less importance to 'durability' and 'repairing capability' of outdoor clothes than men. Both genders are far satisfied about ‘eco or fair trade’ and ‘environmental disposable’ factor whether these two points are not of any importance to them.

3. Requirement and fulfillment analysis according to dwelling place:

People of metropolitan city give most importance to ‘good fit’ and ‘looking good’ of outdoor clothes as also people of smaller cities. People from both of these areas have almost same kind of expectation about service of outdoor clothes. And people of smaller cities are more satisfied about after care properties of outdoor clothes.

For people of countryside cities ‘protection against weather’ is the most important factor and they are satisfied about the service of outdoor clothes regarding this factor. And they care more ‘durability’ and less concern about ‘look good’ and ‘feeling modern’ than people of other areas.
4. Requirement and fulfillment analysis according to using areas:

Here we find that when customers use outdoor clothes at town, then look good, feeling modern and good fit is the most important to them and there is lack of fulfillment regarding these factors. Using of outdoor clothes in challenging environment, good fit and protection against weather is the most important factors to the customers and ‘cleanliness’, ‘looking good’ and ‘long life’ is also important to the customers. It is found in the survey that most of the customers use outdoor clothes in nature. During using in nature the expectation level is quite similar as using in challenging environment. Like ‘protection against weather’, ‘good fit’ is the most important and ‘cleanliness’, ‘look good’, ‘long life’ is important too. Regardless of using place ‘good fit’ is always important and customers actually don’t care about ‘environmental disposability’ of outdoor clothes.

5. Requirement and fulfillment analysis according to activity:

The main activities the outdoor clothes are used for Hiking in the woods and fields, skiing, fishing or hunting, cycling, going to and from work, profession, as soon as going outdoors etc.
Here we can see that ‘high price value (high quality)’ and ‘protection against weather’ is important regarding all activity of outdoor clothes to the customers.

There are some important observations like:

When customers use outdoor clothes to ‘go outdoor’, ‘look good’, ‘feeling modern’ and ‘good fit’ have more importance and lack of fulfillment to the expectation but ‘repairing capability’ and ‘eco or fair trade’ has less importance compared to other activities.

For ‘fishing’, customers give more preference to ‘durability’ and less importance to ‘after care properties’ and ‘environmental disposable’ factor.

For activity during profession ‘good fit’ is the most important factor of outdoor clothing. ‘Repairing capability’ is also important and customers are quite unsatisfied when they use it during profession.

When customers use outdoor clothes to go to and come from work, ‘good fit’ is the most important factor and the supplier has to do more to satisfy customers for this activity.
Overall importance of requirements during buying of outdoor clothes:

Here we can find that overall importance of ‘good fit’ is the most for customers of outdoor clothing and ‘environmentally disposable’ is the least important factor.
Customer support expectation:

Here we can see that ‘warranty of product’ is the most expected support that customer want from suppliers. The customer preference of expected service from suppliers are also analyzed according to age and gender segmentation:
Here it is seen that actually Swedish people doesn’t have special preference of any particular brand except male people of age range 25-44. Among their preferred brands are Haglofs, North face and younger people like international brands like Nike, Adidas.

And the influencing factors of brand are like following:
Customer loyalty:

‘Loyalty’ is not an easily defined term. It presupposes an object, towards which the will is directed, such as brand name, a company or a product. Loyalty also has a time aspect, a relation over time, which can be divided into two dimensions (Soderlund, 2001):

1. A behavioristic dimension
2. A mental dimension, including attitudes and intensions towards objects.

When a customer unconscious need is satisfied, customer always wants to share his/her experience with other and a loyal customer mostly has a single preference of brand. So, I tried to point out ‘loyal customer’ by asking two questions and the result is like following:

We can see that most of the customer has a second choice of brand whether most of them share their buying experience with others. So, my analysis shows that only 11% customers fulfill both dimensions to be a loyal customer.
Internet shopping of outdoor clothes:

Here we can find that whether people are fond of searching ‘product features’ on website but they are not much interested to buy product online. And we also see from above that (market offer information) to know about the market and product ‘looking first on the internet and then going to stores’ is the second best choice for customers.

But, whether purchasing on internet is one of the most rapidly expanding channel of shopping and online shopping is the fastest growing application of the internet ("Internet usage, commerce statistics and demographics", 2001; Shim et al., 2001) but it is not the first choice to purchase outdoor clothes online. Online apparel sales are estimated to total $12 billion in 2002 (Beck, 2001). However, this figure is dwarfed by apparel sales from other distribution channels, totaling around
$200 billion, and total US online sales, estimated at about $2.5 trillion (“Internet usage, commerce statistics and demographics”, 2001; Retail apparel sales statistics and trends 1999-2000, 2000). Growth in online apparel sales lags far behind other online product sales, such as books or CDs, and online apparel sales figures currently stand at only 27 percent of all online sales (Beck, 2001; “Internet usage, commerce statistics and demographics”, 2001).

One key reason for this is the nature of apparel shopping. When consumers are shopping for apparel, they like to physically examine the products to assess color, size, design, and fabric. Also, for apparel products, fit is very important. Due to the sensory and interactive nature of the apparel purchase process, apparel products are categorized as high-risk items (Bhatnagar et al., 2000) and apparel shopping has been associated with high perceived risk (Hawes and Lumpkin, 1986). Several studies found that the inability to examine apparel products contributes to the high risk associated with the in-home shopping channel (Bhatnagar et al., 2000; Kwon et al., 1991).

**Customer social and environmental consciousness:**

Now-a-days all people are becoming more and more concerned about their society and environment. Especially the governments of European countries are now giving much importance to keep the society and environment safe and sound. For example most of the outdoor clothes are manufactured outside Europe. They prefer to import these products from China, India, Vietnam, Bangladesh etc. Because the chemicals that used for manufacturing (especially dyeing, bleaching) are really hazardous for environment. But it is my opinion is that the clothing buyers should be aware of how these products are really manufacturing. What kind of process are the clothing producing countries are following and how the workers of these countries are treated. Only then social and environmental responsibility will be fulfilled. But these wants should come from the voice of customers. Because if the customers are aware of these factors and only then the ‘outdoor clothing companies’ will try to fulfill the customer needs regarding social and environmental contribution. Because even for customers whether they are far from the manufacturing industries but they may be affected by the manufacturing chemicals like some very hazardous chemicals e.g. metals like Cr, Zn etc. which are used to dye clothes and also different acid, base chemicals are used during bleaching which remain on the surface of clothes for a long time.
Social consciousness:

Here we can see that Swedes are very much concerned about their society regarding all ages and genders even they are willing to pay more for the products for this reason.

Knowledge about ‘Labor rule of conduct’:

There are many ‘code of conduct’ of different labor association like ILO and to maintain the working environment that the suppliers should follow. But the Swedes are not much aware about these ‘code of conduct’ especially the male around 25-44 years of age. But older people specially female around age of 45-64 have better knowledge. So, whether the customers are very serious about the society but because of lack of knowledge about ‘labor rule of conduct’ this will not come into play for ‘outdoor cloth supplier’ to follow the ‘labor code of conduct’.
Environmental consciousness:

![Bar chart showing environmental consciousness](chart1.png)

We can see that customers are really less concerned about products eco-friendliness especially male people around age of 25-44. But here also we can see that older people more concerned about green product. May be, because the suppliers do not provide that much information regarding this. So, the customers do not have that much option to know about the product’s eco-friendliness.

Knowledge about toxicity of manufacturing chemicals:

![Bar chart showing knowledge about toxicity](chart2.png)

The result is really frustrating as we can see that people regardless of age and gender really have no idea about what kind of risk they are at by using unsafe outdoor clothes as they have really lack of knowledge about the manufacturing process of manufacturing of outdoor clothes, so they cannot really demand their needs regarding this factor. And also it is found that the suppliers also don’t have any intention to inform about this to their customers. But if the customers are kept in dark about what risk they are at, the suppliers will not be interested to develop the ‘green product’. So, to make
the customers attracted to eco-friendly product first of all knowledge has to be provided to the customer about the toxicity and effect of different chemicals used in outdoor clothes.

Customer segmentation according to green behavior:

Here we can see that 31% of customers actively think about buying green products and they check product’s eco-friendliness before buying of outdoor clothes. 15% customers are quite confused and they try to check product’s eco-friendliness but not sure how and where to get this information. But most of the customers (54%) still do not think much about green products.

I also find difference to their given importance to different points when buying outdoor clothes:
‘After-care environmentally’ and ‘eco or fair trade’ is very important for green customer. And there is a drop down of given importance from green-customer to customer who does not check products eco-friendliness for points like ‘after care environmentally’, ‘disposable environmentally/ recyclable’ and ‘eco or fair trade’. Here from the graph we can also compare the preference given to these points by different types of customer and overall-customer.

**Discussion:**

From my analysis it is found that for ‘product development’ and ‘product design’ of outdoor clothes, the best way is to do that for specific segmentation of customer. Like according to activity, using place especially according to age, gender there is differences between requirements and fulfillment level of customers. Like the customers who use the outdoor clothes for different kinds of activity e.g. hiking, fishing, skiing etc. ‘protection against weather’ is more important. And the customer who use it for go outside or in town, ‘look good’, ‘feeling modern’ is much more of importance. But there is also some similarities between different type of customer like the customers who use outdoor clothes ‘in nature’, ‘challenging environment’ or who lives in ‘countryside town’ prefer ‘durability’ and ‘protection against weather’. So customer’s expectation varies mostly on which condition they use it and how they use it and this also varies from age to age and genders also. But mostly for all types of customers ‘look good’, ‘feeling modern’ and ‘good fit’ is important. From my survey suppliers of outdoor clothes can find some interesting information like these and they will also know what scope they have to satisfy the customers more by measuring the gap between ‘requirement level’ and ‘fulfillment level’.

In my survey I also tried to measure what kind of service customer expect from the suppliers of outdoor clothes and this would be helpful for the suppliers to build a strong marketing strategy in future. The important point I get is as following:

- Customers of younger ages (18-24) prefer to buy whenever a new fashion trend arrives to cope up with the trend whether for differences of weather in Sweden for every ‘new season’ it is important to have new kind of outdoor clothes for customers. Most interestingly ‘special offer’ like ‘discount’ is most effective way for the supplier to get customer.
- Most customers like to have Brand’s product but only 11% customers are really loyal to a specific brand.
- One of my interests is to find out about internet shopping of outdoor clothes. I found that internet is still the second best choice to get market information for customers and customers are quite suspicious to get proper information like color, design, fabric, fitness about clothes from internet.

The most important outcome of my survey I think result I got about customer’s consciousness about society and environment. Customers of Sweden have better responsibility to towards the society and even they are willing to pay more for that reason.

But still more than half of the customers don’t really think much about the product’s eco-friendliness and this point is also is of less importance when they buy product. Because most of the time I found that suppliers really don’t provide much information regarding their product’s sustainability or even if they say their products are sustainable and eco-friendly but they don’t show any proof or certification. Customers have less idea and so they are less concerned about how to after-care of product and how to dump their cloth after it is worn-out so it does not affect environment. And from
my point of view the supplier should give proper information regarding these points to be clear to their customers. And obviously the customers should be properly educated to know about manufacturing chemicals and manufacturing processes of outdoor clothes through different information media like newspaper, TV channels etc.
Chapter 3 - Clothing Fibre and Material

Fibers from plants and animals are constructed from natural polymers. Polymers are very large molecules. The common features of all fibers are that they are constructed from large polymer molecules which lay alongside each other and are bonded together.

Cellulosic man-made fibers are formed from natural polymers of plants (cellulose). The cellulose is dissolved and then forced through spinning jets.

Synthetic man-made fibers are derived from petroleum products. Their polymers are formed synthetically (artificially).

Vegetable Fibres: Cotton

Construction: Cotton is composed of cellulose, the foundation of all plants. Each cellulose layer is formed from fibrillar bundles composed of individual fibril (fibril = tiny fiber). Spaces between the ordered lattice of the fibrillar structure, as well as the hollow fiber center, are easily penetrated by water. Moisture can be stored in the cavities. Sweat can be absorbed and later can be rinsed out again during washing. Cotton is strong when it is swollen in water. This is because the presence of water promotes a more uniform distribution of stresses across and along the cellulose layer. The high strength of cotton fiber is a consequence of its construction from highly organized cellulose chain molecule in the fiber interior (crystalline region). Its low elasticity is due to slippage between the crystalline regions.

Clothing Comfort

Thermal insulation: Cotton fibers are relatively fine and flexible. Therefore they are often made into textiles which have a low proportion of entrapped air (low specific volume). Warmer more voluminous materials can be made, however, by appropriate choice of yarn and fabric constructions and through roughing (raising) the surface.

Moisture absorption: Cotton can absorb up to 20% of water vapor without feeling wet. Cotton fabrics absorb liquid very rapidly and can contain up to 65% of their own weight without dripping. Cotton dries slowly.

Next-to-skin comfort: Cotton is very comfortable next to the skin because of its fineness and softness.

Other Important Properties

Strength: The strength of cotton is good. It is stronger when wet than when dry. Abrasion resistance and durability are good.

Extensibility: The extensibility is relatively low, at about 6... 10%.

Elasticity: Cotton has a very poor elasticity and therefore it creases easily.

Electrostatic charge: It develops scarcely any electrostatic charge because it always contains moisture which conducts the charge away.

Fineness, Handle: Cotton fibers are fine and soft, they have a pleasant handle.
Improvements of properties by finishing:

**Mercerizing:** treatment of cotton under tension with caustic soda solution causes the fiber cross-section to become more circular. The result is higher strength and luster.

**Crease-resist / easy-care finish:** the elasticity of cotton and hence its resistance to creasing, can be improved by cross linking the cellulose chains, using synthetic resins. However there is a consequence reduction in its strength and absorptivity, although it will dry more quickly.

**Anti-shrink finish:** shrinkage is deliberately induced in the fabric to avoid such shrinkage appearing after subsequent wet treatments.

**Water repellent finish:** cotton textiles can be made water repellent by impregnating them with special chemicals. (e.g. silicones).

Applications:

Rain-wear (water repellent finishes). Trousers(jeans).

Aftercare Properties

**Washing:** Cotton can be boiled. Lower temperatures for colored items.

**Chlorine:** Can be bleached with chlorine. Chlorine bleaching is less common nowadays.

**Ironing:** Ironing temperature 200 degree Celsius the goods should be damp.

**Dry Cleaning:** Cotton is not sensitive to solvents. (A = all normal solvents can be used)

**Drying:** Can be dried in a tumble dryer. Exception: fabrics liable to shrinking.

**Textile labeling:** the laws governing product description allow the name ‘cotton’ to be applied only to fibers obtained from the seeds of the cotton plant.

International cotton emblem: the cotton emblem is registered internationally. It serves clearly to identify textiles made from pure cotton and implies good quality. it may not be applied to fiber blends.

![International Cotton Emblem](source)

Fig 6: international cotton emblem

Vegetable Fibers: Flax

**Construction:** like cotton, flax fibers are constructed from cellulose chain molecules. Flax is stiffer, partly because of the cement which holds the fiber ultimates together. It has a smoother surface and a darker color than cotton.

**Clothing Comfort**

**Thermal insulation:** Yarns and fabrics made from the smooth flax fibers do not enclose much air and have relatively poor insulation properties. Linen fabrics feel fresh and cool, a distinct advantage for summer clothing.

**Moisture absorption:** Linen is highly absorbent. It takes up water rapidly and releases it quickly again to the surroundings. In hot weather this helps in regulating the microclimate between body and clothing.
**Next-to-skin comfort:** Flax fibers are stiffer and harder than cotton and are therefore less supple.

**Other Important properties**

**Strength:** Flax has very good tenacity and durability. It is stronger wet than dry.

**Extensibility:** The extensibility of flax, about 2%, is the lowest of all apparel fibres.

**Electrostatic charge:** This is practically nil, since the fiber always contains moisture.

**Surface, Luster:** Because of its smooth surface, linen fabric has a subdued luster, does not soil easily and does not shed lint.

**Fineness, Handle:** The coarse fiber bundles give linen a firm handle.

**Improvements of properties by finishing:**

Like cotton, linen fabrics can be given an easy-care treatment.

Applications: trousers, jackets, interlinings for stiffening.

**Aftercare Properties**

**Washing:** Linen can be boiled. Lower temperatures for colored items.

**Chlorine:** Can be bleached with chlorine.

**Ironing:** Can be ironed up to 220 degree Celsius. The goods should damp.

**Dry Cleaning:** Linen can be cleaned with all of the usual solvents.

**Drying:** Can be tumble dried.

**Textile labeling:**

The laws governing product descriptions allow the name linen to be used only for fibers originating from stems of the flax plant. Textile made from 100% linen may be described as pure linen. The term ‘half-linen’ may be used for fabrics in which the warp is made only from cotton, the weft is only linen.

Linen seal: the linen industry in Western Europe has created Linen seal for its products and registered the mark world-wide. The seal may be used to identify pure linen and half linen textiles. Linen industry regulations specify that linen content of blends must be at least 50%. The linen seal is a guarantee of quality.

**Other vegetable fiber:**

Kapok: hair cells from the kapok fruit.

Properties and applications: kapok fiber cannot be spun into yarns because they are very weak. Their density is only 0.35 g/cm³, due to the large air-filled lumen. The fibers are water repellent, fine, soft, and lustrous.

Kapok is suitable as filling for life-jackets.

**Animal Fibers: Wool**

Construction: the wool fiber is made of protein molecules (keratin). The construction gives the wool fiber an extra-ordinary elasticity. Heat and moisture together can relax bonds between the protein chains. The bonds are re-formed during cooling and drying and this is the source of good smoothing and shaping properties of wool.

Wool absorbs moisture. It can absorb about 1/3 of its mass of water vapor without feeling wet. Its surface is water repellent because it is covered by extremely thin skin, the epicuticle. The skin causes liquid water to roll up into droplets while allowing the passage of water vapor. The scales on the fiber
surfaces are capable of hooking onto one another to cause felting, under the influence of water, heat and mechanical action.

**Clothing Comfort**

**Thermal insulation:** In smooth, combed yarns, the fine wool fibers are tightly constrained; they can scarcely crimp. Fine combed yarns enclose less air and therefore provide less insulation (“Cool Wool”). Bulky woolen yarns have a looser structure. The fibers can develop their crimp inside the yarn and due to the large amount of entrapped air, offer excellent protection against cold.

**Moisture absorption:** Wool is hygroscopic. It can absorb up to a third of its weight in moisture vapor without feeling wet. Perspiration (weak acids, alkalis, salts) will be chemically bound and neutralized. Water vapor is absorbed very rapidly, but water droplets are repelled. Liquid water is absorbed only very slowly. Such behavior is called “hydrophobic”. We wool dries very slowly.

**Next-to-skin comfort:** The softness of wool depends on its fitness. Lambs wool and fine Merino wool are especially soft. Wools which are coarser than about 30 um can irritate the skin.

**Other Important Properties**

**Strength:** Wool has adequate strength which, nevertheless, is lower than that of most normal apparel fibres. Textiles made from wool are not particularly durable.

**Extensibility:** The fibers have very good extensibility, which is greater when wet than dry. Dripping wet wool garments should be laid flat to dry, to avoid stretching.

**Elasticity:** Elasticity and “springiness” are excellent. Crease soon drop out of wool clothing (especially under the influence of steam)

**Formability:** The molecular chains in the wool fibers can be oriented under the influence of heat and moisture. In the way, wool fabrics can be more or less durably shaped.

**Felting:** Felting is the matting together of fibers, under the influence of mechanical action, heat and water. It is facilitated by the scales on the fiber surface which can hook onto each other. The effect is utilized for the production of felts but it is disadvantage in the aftercare of wool clothing.

**Fineness, Handle:** Wool fibers may be fine or coarse, depending on the type. The very finest Merino wools (less than 16 um) are designated as Super 100’s. They are sold at special auctions and made into extremely fine, soft fabrics.

**Electrostatic charge:** Wool fibers develop only small electrostatic charges, because they always contain some moisture which conducts the charge away.

**Flammability:** Wool does not burn easily. It is suitable for protective clothing.

Improvement of properties by finishing:

- Anti-felting treatment: wool can be made machine washable by chemical treatments which greatly reduce the tendency of the fibers to felt.
- Carbonizing: removal of vegetable impurities using sulphuric acid.
- Decatizing: application of heat and flames can be improved by treatment with chemicals which combine with wool protein molecule.
- Fulling: deliberate felting of wool materials. The materials shrinks and becomes denser.
- Moth proofing: impregnation of fabric with chemicals which make the fibers inedible and to which the moths are averse.
- Permanent creasing: ironed creases can be durably fixed through heat, pressure and chemicals.
- Raising: fiber ends are teased out of the textile material. The wave structure is obscured. Often follows fulling.
- Water repellency: wool textiles may have their water repellency enhanced by treatment with chemicals.

**Application:** pullovers, overcoats, winter blouses, socks, stockings.
Aftercare Properties

**Washing:** Washable wool can be machine-washed. Use wool detergent.

**Chlorine:** Should not be chlorine bleached.

**Ironing:** Iron at 150 degree Celsius, with steam or a damp cloth.

**Dry Cleaning:** Can be cleaned using Perchloroethylene.

**Drying:** should not be dried in a tumble dryer, or in direct sunlight, or over direct heat.

Textile labeling:

The regulations governing product labeling allow the terms ‘New wool’ or ‘virgin wool’ to be used only fibers shorn from a living sheep or lamb. Virgin wool products must be made from wool fibers which have not previously been spun into yarn or felted, nor previously been incorporated into a finished product. Textile made from 100% virgin wool may be labeled as pure new wool, or pure virgin wool. An allowance may be made for 0.3% of adventitious foreign fibers, and of 7% for visible ornamental affects. New wool and virgin wool descriptors may also be used in blends where there is only one other fiber present, and where the proportion of virgin wool is at least 25%. The term ‘pure wool’ may also be used for products made from recovered wool.

Wool mark and woolblendmark: the ‘wool mark’ is applied to pure new wool. The mark guarantees a certain product quality level: color fastness, strength, and dimensional stability. The wool blendmark is applied to blends where there is only one other fiber and a virgin wool content of 60%. It guarantees the same quality levels as for the wool mark. Both the wool mark and wool blendmark are strictly regulated and controlled.

![Woolmark Blend and Woolmark](http://www.szyouyi.com/know1.htm)

Figure 7: Labeling of wool fabric

source: [http://www.szyouyi.com/know1.htm](http://www.szyouyi.com/know1.htm)

Animal fibers: Silk

**Construction:** the basic fiber substance is fibrion. Like wool it is made from long chain protein molecules. The physical, chemical and clothing comfort properties of silk are determined by the molecular chains and their orientation in the fiber interior. These are disposed in crystalline layers, somewhat like the leaves of a book. This result in high strength and good resilience.

**Clothing Comfort**

**Thermal insulation:** Silk is seen as both cool and warm. Filament silk is made into fine fabrics, with a small volume of enclosed air, which lie smoothly on the skin. This gives a cooling effect. Nevertheless, these fine, compact silk fabrics are good insulators because the layer of warm air, which lies between fabric and skin, is not able to escape very easily.

**Moisture absorption:** Like wool, it can absorb and hold about 1/3 of its weight of water vapor without feeling wet. Liquids are absorbed rapidly into the non-crystalline regions of the fiber interior.

**Next-to-skin comfort:** Silk is very pleasant to wear, because of its fineness and softness.
Other Important Properties

**Lustre, Fineness, Handle:** The most important of degummed silk are its typical lustre, its fineness and its pleasant handle.

**Strength:** Silk has a very good tenacity.

**Extensibility:** Extensibility is very good; it lies between 10% and 30%

**Elasticity:** Silk has outstanding resilience. With the exception or very fine, smooth, weighted woven fabrics, it does not crease badly, wrinkles tend to fall out.

**Electrostatic charge:** It builds hardly any electrostatic charge, because it always contains moisture which conducts the charge away.

**Sensitivity:** Perspiration, deodorant sprays and perfumes can cause color changes and can embrittle the fiber. Therefore arm lining should be used.

**Scroop:** When a silk fabric is compressed by hand, it makes a rusting sound somewhat like the crunching of fresh snow.

**Improvement of properties by finishing:**
Degumming: the natural silk gum makes knitted and woven raw silk fabrics harsh and rough. The sericin gum is removed by a gentle boiling in mild soap solution.

Weighting: the degummed silk is made heavier and firmer again by the addition of metallic salts, or other chemicals.

Aftercare Properties

**Washing:** Gentle detergents, minimum agitation cool rinse, a dash of clear vinegar in the last rinse.

**Chlorine:** Do not bleach.

**Ironing:** Iron on the back at 120 degree Celsius to 150 degree Celsius. Do not press seams. Steam and water can leave stains.

**Dry cleaning:** Colored and sensitive articles should be dry cleaned.

**Drying:** Do not tumble dry. Do not dry in direct sunlight.

**Application:** Ski underwear, gloves.

**Textile labeling:**
The regulations governing the labeling of textiles stipulate that the word ‘silk’ may be used only for fibers obtained from the cocoon of the silk moth. Phrases such as ‘artificial silk’ and ‘man made silk’, or the use of the ‘silk jersey’ and ‘silk damask’ for cotton fabrics are not permitted.
The silk seal: the internationally recognized Silk seal stems from the European Silk Secretariat. It stands for pure silk and good quality.

Natural Polymer Fibers: Viscose, Modal

**Fiber composition:**
Viscose: chemically, the cellulose is scarcely altered by the viscose process. After fiber formation again it is cellulose, and it is called regenerated cellulose. Thus the chemical structure of viscose is comparable to cotton but of lower strength.

Modal: fibers are made by a modified viscose process. Longer cellulose molecules and an improved of the structure and orientation of the crystalline areas. this yields a higher strength, both wet and dry, better textile performance properties.
Clothing Comfort

Thermal insulation: Viscose filament yarns are made into smooth textiles with a low volume of entrapped air (low specific volume). Staple fiber yarns made from viscose or modal can yield textiles with varying specific volumes, so that the insulation properties can be controlled to some extent. The fiber itself has only a small influence on insulation.

Moisture absorption: Viscose and modal are very absorbent. In normal conditions, they absorb 11 to 14% of water vapor. In liquid water, they swell and can absorb 80 to 120% of water. They are more absorbent than cotton.

Next-to-skin comfort: Viscose and modal fibers are fine and soft. They are very comfortable to wear.

Other Important Properties

Strength: Viscose has significantly lower dry strength than cotton. The wet strength is low; it is only 40 to 70% of the dry strength.

Extensibility: The breaking extension is 15 to 30% - more than double that of cotton.

Elasticity: Poor resilience is a feature of all cellulose fibers. Viscose and modal wrinkle easily.

Electrostatic charge: Very low, because the fibers always contain moisture.

Fineness, Handle: Fabrics may be fine and soft or firm, depending on the fiber fineness and the fabric construction.

Coloration: Viscose and modal are excellent substrates for dyeing and printing. Colors are very bright.

Lustre: Can range from high lustre to matt, depending on the fiber cross-section and the additional delustrants.

Improvement of properties by finishing:

Easy-care treatments: viscose fibers swell in water, they become thicker. This causes viscose fabrics to shrink. Swelling and shrinkage can be reduced by treatment with synthetic resins. The treatment also improves wrinkle recovery but moisture absorbency is reduced. Modal fibers swell less and fabrics shrink less than viscose so that, in the absence of chemical finishing, the fabrics are more stable.

Aftercare Properties

Viscose and modal are washable, easy iron, not wrinkle-resistant.

Lyocell:

Recently a new process has been developed. This utilizes an organic (amine oxide) solvent which together with water, is capable of dissolving the cellulose in a single step. Since almost all of the solvents can be recovered and reused and since the use of carbon disulphide is avoided, the new process is much more environmentally friendly. The resulting fibers have a structure and properties significantly different from the viscose types, so a new generic name, Lyocell, has been specified for the products of this new process.

Natural Polymer Fibers: Cupro, Acetate, Triacetate

Fiber composition: Cupro is regenerated cellulose fiber. The manufacturing has been discontinued in some countries for cost and environmental reasons.

Properties, application: as a regenerated cellulose, the important fiber properties are similar to those to viscose. Cupro’s pleasant handle and good absorbency are special prized. It is not a very important textile fiber. The main outlets are in lining fabrics.
Aftercare Properties

Cupro is machine washable, iron able, not wrinkle-resistant.

Textile labeling: the cupro label is used for regenerated cellulose fibers which has been produced by the cuprammonium process.

Acetate, triacetate:

Fiber composition:

Acetate: cellulose acetate is a partial chemical combination of cellulose and acetic acid.
Triacetate: the completely-reacted cellulose triacetate is not as soluble in acetone.
Acetate and triacetate are cellulose derivatives; the hydroxyl (−OH) groups of cellulose are more or less substituted with acetyl groups. Triacetate represents full substitution of the hydroxyl groups.

Properties, Applications

Acetate has a sophisticated, subdued lustre, full handle and elegant drape. It is the closest approach to natural silk. Elasticity and stability are better than viscose. Acetate is thermoplastic and sensitive to dry heat. It has low moisture absorption so that it dries rapidly but is susceptible to electrostatic charging.
Triacetate has better resistance to heat than acetate and lower moisture absorbency. It is also thermoplastic; it can be textured and permanently creased or pleated. The other fiber properties are similar to acetate.
Acetate and triacetate are produced as both filament and staple fibers for dresses, blouses and lining fabrics.

After-care property: Acetate must be washed and ironed carefully. It is not wrinkle-resistant.
Triacetate is machine washable and iron able. It is quite wrinkle-resistant.

Textile labeling: the textiles labeling regulations reserve the terms Acetate and Triacetate for fibers which have been produced from cellulose acetate. Example: Arnel (acetate), Tricel (triacetate).

Synthetic Polymer Fibers: Acrylic, Modacrylic

Fiber composition: the polyacrylic linear chain molecule is built from repeating units of CH₂CHCN.
There are three broad types of acrylic fibers: normal acrylics, modacrylics (modified acrylics), which are highly resistant to burning, and the porous fiber Dunova.

Properties
Acrylics are produced almost exclusively as staple fibers. They have a wool-like handle, low density and good resistance to light and chemicals. Like all synthetic fibers they are thermoplastic and wrinkle-resistant (though they are susceptible to deformation in steam or hot water)
Acrylic yarns are usually voluminous and are very soft and warm, somewhat similar to wool in character. Heat will cause the fibers to shrink strongly. By mixing such fibers with stabilized fibers in a spun yarn, a subsequent heat treatment will induce bulking in the yarn, due to the shrinkage of the unstabilised fibers. Acrylic yarns have a high specific volume, due partly to the low density of the fabrics.

Applications: Acrylics are spun into staple yarns either alone or blended, specially with wool. The yarns are made into knitted fabrics, outerwear.
Modacrylics are modified acrylic fibers. Their properties include flame resistance. They are made into protective clothing.

Porous acrylic fibers contain many micro-capillaries which are able to absorb liquids. They are used for warm and absorbent underwear.

**Aftercare Properties**

Acrylics are wrinkle resistant, machine washable and will dry quickly. They are susceptible to heat and must be ironed carefully.

Textile labeling: the textile labeling regulations reserve the name acrylic for fibers which have been made from at least 85% acrylonitrile. The label must show the generic name acrylic. Trade name may also be given, e.g. ‘courtelle’, ‘dolan’, ‘dralon’, ‘dunova’, ‘wolpryla’. For modacrylics, the proportion of acrylonitrile must lie between 50% and 85%.

**Synthetic Polymer Fibers: Polyamide, Nylon**

**Fiber composition:** Polyamides are linear macromolecules containing amide groups (-CO-NH-) at regular intervals. Different types of polyamide are made by using starting materials (monomers) of different sizes (different number of carbon atoms). Nylon 6 has 6 carbons in repeating unit and nylon6.6 has two sets of six carbons.

Applications: nylon 6 and nylon 6.6 are used in apparel fabrics. There are special nylon types for particular end uses. Examples are high-bulk, antistatic, and high-lustre fibers. Filament yarns, usually textured, are about 80% of nylon production. They are utilized in sheer stockings, foundation garments, swimming, sports, linings, dresses and weather-proof clothing. Staple fibers are blended with wool, cotton, or other man-made fibers for apparel fabrics. They are used in knits, plush and also used for fleece fabrics.

Aramid fibers are used mostly for fiber reinforced plastics. They are also utilized in protective clothing such as fencing vests and clothing for forestry workers, racing drivers.

**Clothing Comfort**

**Thermal insulation:** Insulation properties depend on whether the fiber is produced as flat filament, textured filament or staple yarn. Flat filaments entrap very little air and have low insulation. Texturing increases the specific volume and allows more air to be enclosed for better insulation. Staple yarns may be either fine and smooth or more voluminous.

**Moisture absorption:** Nylons absorb little water; between 3.5 and 4.5%. In textured yarns the capillary spaces are capable of transporting liquid water effectively.

**Next-to-skin comfort:** Fine and soft nylon are utilized for apparel fabrics.

**Other Important Properties**

**Strength:** Nylon is very strong and has excellent abrasion resistance. The wet strength is 80 to 90% of the dry. Aramid fibers have about five times the tensile strength of apparel fibers.

**Extensibility:** Breaking extension is very high either wet or dry. Depending on the fiber type it may be from 20 to 80%.

**Elasticity:** Nylon is very resilient and wrinkle-resistant.

**Electrostatic charge:** Very susceptible but can be reduced by special antistatic treatments.

**Fineness, Handle:** Fineness ranges from microfibers to coarse fibers. Fabrics may be fine and soft of firm according to fiber fineness, fabric construction and finishing.

**Lustre:** From matt to high lustre depending on fiber cross-section and addition of delustrants.

**Formability:** Is thermoplastic; can be permanently shaped under the influence of heat. This property is utilized for texturing and heat setting.

**Chemical resistance:** Nylon is resistant to alkalis and many solvents. It is attacked by concentrated acids.

**Light resistance:** Nylon will yellow and lose strength on long exposure to sunlight. Resistance can be improved by including special chemicals in the sipping melt.
**Biological resistance:** Nylon is resistant to moulds and fungi. It does not decompose.

**Heat resistance:** Nylon is sensitive to dry heat.

**Aftercare Properties**
Nylon is machined washable, quick drying and wrinkle-resistant but should be ironed with care.


**Synthetic Polymer Fibers: Polyester**

**Clothing Comfort**

**Thermal insulation:** Flat filament yarns enclose little air, textured yarns are better insulators. Staple yarns may be fine and smooth or very bulky with corresponding poor or good insulation.

**Moisture absorption:** Polyester scarcely absorbs water. Transport of liquid water in the yarn capillaries is good.

**Next-to-skin comfort:** Fine and soft fibers are used for apparel fabrics.

**Other Important Fiber Properties**

**Strength:** Polyester and nylon have the highest tensile strength and abrasion resistance of all textile fibers. The wet strength of polyester is the same as the dry.

**Extensibility:** The breaking extension is between 15 and 50%; somewhat lower than nylon.

**Elasticity:** Is very good, it is very wrinkle-resistant.

**Electrostatic charge:** Is very high but can be reduced by antistatic treatments.

**Fineness, Handle:** Fiber fineness ranges from microfibers to coarse fibers. Fabrics are fine and soft or stiff depending on the fiber fineness fabric construction and finishing.

**Lustre:** From bright to matt depending on fiber cross-section and addition of delustrants.

**Formability:** Polyester is thermoplastic; it can be textured.

**Chemicals:** Unaffected by most acids, alkalis and solvents. Can be degraded by strong, concentrated acids and alkalis and a few solvents.

**Light resistance:** Very good.

**Biological resistance:** Resistant to moulds and fungi; does not decompose.

**Heat resistance:** Polyester has the best heat resistance of all synthetic fibers used for apparel fabrics.

**Aftercare Properties and Labeling**
Polyester textiles are machine washable, quick drying and wrinkle-resistant

**Other synthetic polymer fibers**

**Synthetic Fibers:** Elastomerics, Fluorofibers, Chlorofibers, Olefins, Vinylals.

<table>
<thead>
<tr>
<th>Generic group</th>
<th>Chemical composition</th>
<th>Special Properties</th>
<th>Application</th>
<th>Trade marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastomerics</td>
<td>Elastane is manufactured from at least 85% of polyurethane.</td>
<td>Very highly extensible (up to 80%) and elastic; easily dyed. Compared to rubber can be made finer, more</td>
<td>Usually in combination with other fibers for swimwear, foundation fabrics, stockings, stretch clothing.</td>
<td>Lycra, Dorlastan, Elastan, Enkaswig</td>
</tr>
<tr>
<td>Fiber Type</td>
<td>Description</td>
<td>Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorofibers:</td>
<td>Poly tetrafluoroethylene (PTFE)</td>
<td>Washable, more resistant to light and oxidation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water repellent, outstanding chemical resistance, heat resistant, can scarcely be dyed.</td>
<td>Microporous membrane for weather proof clothing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorofibers:</td>
<td>Polyvinyl chloride (PVC), Polyvinylidene chloride</td>
<td>Voluminous fabrics are very war; high chemical resistance.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water repellent, outstanding chemical resistance, heat resistant, can scarcely be dyed.</td>
<td>Thermal underwear, protective clothing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Olefins:</td>
<td>Polyethylene, Polypropylene</td>
<td>Low density, low softening temperature, absorbs no water. Absorbs no water but good capillary action.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water repellent, outstanding chemical resistance, heat resistant, can scarcely be dyed.</td>
<td>Sports undergarments (rapid wicking of perspiration).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water repellent, outstanding chemical resistance, heat resistant, can scarcely be dyed.</td>
<td>Separation yarn kuralon.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Inorganic Man-made Fibers:** Glass, Carbon, Metal.

**Special properties**

**Glass:** Non-flammable, low moisture absorption, low extensibility, brittle.

**Carbon:** High heat resistance, high strength, stiff.

**Metal:** Wire-drawn are very finely drawn out metal; flat-drawn are like fine ribbons. Lurex is very thin sheet of metal, sandwiched between films of acetate or polyester.
Chapter 4 – Quality Function Deployment & Clothing Technology

Clothing physiology
Heat Insulation and Air Exchange

To prevent excessive heat losses in cooler climates, the body’s natural thermal regulation mechanisms have to be supplemented by insulation. For a stationary person, about 50% of the insulation is provided by air trapped inside the clothing, about 30% by the external air film and about 20% by the fibers. Thus the enclosed air is the most important insulator. Bulky constructions, having a large volume of enclosed air have good insulation properties and are especially suitable for winter clothing; thin, smooth fabrics are better for warm environments.

To maintain an equable balance of heat and moisture in the microclimate, between skin and clothing, some ventilation is required. Air exchange is regulated mainly by three factors.

Firstly it depends on the surface texture, mediated by fiber type, yarn and fabric construction and finishing.

Secondly it depends on the garments construction. Tight-fitting garments will restrict ventilation and may lead to discomfort due to a build-up of heat and moisture. Loose garments can promote ventilation like a chimney.

The third influence is motion which can be provided externally by wind or by transportation (such as a bicycle), or internally by the pumping action of body movements such as working or running. Motion disturbs one or more of the various air layers and thus reduces heat insulation considerably.

The so-called “functional clothing”, i.e. work-sport and protective clothing, may regulated ventilation by various enclosures. A very effective supplement to the human thermoregulation system is obtained by providing more or fewer layers of clothing (the onion effect).

Moisture Absorption and Moisture Transport

The human thermoregulation system dispenses dry heat and according to the heat load, more or less moisture. This moisture has to be taken up and dispersed by the clothing. This is accomplished by absorption into the fibers and by capillary transport between the fibers. At normal levels of heat stress and low to medium levels of perspiration, hygroscopic (absorbent) fibers are preferable. Their absorptive is quite sufficient to take up the released moisture and to transport it, by diffusion within the fibers, to the surface where it is evaporated into the external air layer. When perspiration rates are very high, then more liquid moisture is formed which has to be transported by capillary action (wicking). Wicking is much faster than diffusion so greater quantities of moisture can be transported to the outside. However, if the rate of evaporation at the surface is much less than the rate of generation of liquid perspiration at the skin the fabric may become saturated which leads to the uncomfortable “wet cling” effect. Because fabrics made from non-absorbent (synthetic) fibers dry more rapidly, the wet cling effect may persist for a shorter time and so provided that their construction allows efficient wicking, non-absorbent fabrics may feel more comfortable under some circumstances than absorbent ones.

Special double-layer fabrics have been developed for sportswear in which the inner layer of the fabric comprise a non-absorbent, synthetic material in a yarn with excellent wicking properties whilst the outer layer is made of an absorbent fiber such as cotton. Liquid perspiration is transported rapidly through the inner layer to the outer where it is stored and evaporated. The inner layer
remains (or quickly becomes) dry so the wet cling effect is avoided or minimized. Good results can also be obtained by using mixtures of fibers with different absorptive capacities.

**Next-to-skin Comfort**
The sensation of contact of clothing with the skin can be very comfortable (softness, suppleness) or it can be unpleasant (scratching, prickling, and clinging). These sensations depend mainly on the fineness of the fibers and their moisture content. Coarse fibers tend to yield scratchy and prickly sensations. Perspiration can build a film on a smooth fabric surface which can cling to the skin and feel uncomfortable; a similar effect can arise on dry skin though static charging of the fabric. An irregular or hairy fabric surface makes fewer contacts with the skin. This allows the air to move more freely between skin and clothing.

**Fiber properties**

Fiber properties can only be assessed comparatively. Therefore they have been summarized in tabular form. From the wide range of available data, only those properties which are of importance for apparel fabrics are presented.

**Fiber Length (staple)**
Long fibers allow the production of yarns with low hairiness. The shorter the fibers, the greater the frequency of protruding fiber ends.

**Fiber Density**
The density of a fiber affects the weight of its fabrics. In general, fibers with a low density allow the production of light, voluminous fabrics.

**Moisture Absorption**
Most fibers will absorb a certain amount of water from the atmosphere. The amount absorbed depends on the relative humidity of the air. Moisture absorbed by clothing can conduct away electrostatic charges.

**Biological Resistance**
Cellulose and protein fibers are decomposed; synthetic fibers are not.

**Tenacity**
Tenacity is the breaking force per unit of fineness, expressed in cN/tex (cN=1/100 Newton). The higher the value, the better is the strength and the durability of the corresponding fabrics.

**Breaking Extension and Elasticity**
Together with the fabric construction, fiber extensibility and elasticity influence the general comfort, the formability, the dimensional stability and the wrinkle resistance clothing. Breaking extension is given in percent, based on the initial length. Elasticity is the property which allows a fiber to recover its length after it has been extended. Fibers never return completely to the original length; they always retain a greater or lesser part of the extension.

**Fiber fineness (linear density):**
Linear density is the fiber weight per unit length. The units are tex or dtex (decitex).

-Tex = mass in grams of one kilometer of fiber
-Dtex = mass in grams of ten kilometers of fiber

The smaller the number, the finer is the fiber. A fineness of 2 dtex indicates that 10km of fiber has mass of 2 grams.
<table>
<thead>
<tr>
<th>Fiber type</th>
<th>Fiber composition</th>
<th>Fineness D tex</th>
<th>length mm</th>
<th>density g/cm³</th>
<th>Moisture absorption</th>
<th>Biological resistance</th>
<th>tenacity Standard condition cN/tex</th>
<th>tenacity Wet % of dry value</th>
<th>Breaking extension Standard condition %</th>
<th>Breaking extension Wet % of dry value</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>vegetable fiber</td>
<td>Cotton Cellulose</td>
<td>1...4</td>
<td>450...900</td>
<td>1.50..1.54</td>
<td>7......11</td>
<td>Poor</td>
<td>25......50</td>
<td>100..110</td>
<td>6......10</td>
<td>100......110</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Flax Cellulose</td>
<td>10...40</td>
<td></td>
<td>1.43..1.52</td>
<td>8......10</td>
<td>Poor</td>
<td>30......55</td>
<td>105..120</td>
<td>1.5......4</td>
<td>110......125</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Fiber</td>
<td>Wool Keratin-protein</td>
<td>2...50</td>
<td>50.....350</td>
<td>1.32</td>
<td>15......17</td>
<td>Poor</td>
<td>10......16</td>
<td>70......90</td>
<td>25......50</td>
<td>110......140</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Silk Fibro-protein</td>
<td>1...4</td>
<td></td>
<td>1.25</td>
<td>9......11</td>
<td>Poor</td>
<td>25......40</td>
<td>75......95</td>
<td>10......30</td>
<td>120......200</td>
<td>Very good</td>
</tr>
<tr>
<td>Cellulosic</td>
<td>Viscose Regenerated-cellulose</td>
<td>1...22</td>
<td>38.....200</td>
<td>1.52</td>
<td>11......14</td>
<td>Poor</td>
<td>18......35</td>
<td>40......70</td>
<td>15......30</td>
<td>100......130</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Modal</td>
<td>1...22</td>
<td>38.....200</td>
<td>1.52</td>
<td>11......14</td>
<td>Poor</td>
<td>35......45</td>
<td>70......80</td>
<td>15......30</td>
<td>120......150</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Acetate Cellulose acetate</td>
<td>2...10</td>
<td>40.....120</td>
<td>1.29...1.33</td>
<td>6......7</td>
<td>good</td>
<td>10......15</td>
<td>50......80</td>
<td>20......40</td>
<td>120......150</td>
<td>Good</td>
</tr>
<tr>
<td>synthetic</td>
<td>Polyester Poly(ethylene-terephthalate)</td>
<td>0.6...44</td>
<td>38.....200</td>
<td>1.36...1.38</td>
<td>0.2......0.5</td>
<td>Very good</td>
<td>25......65</td>
<td>95......100</td>
<td>15......50</td>
<td>100......105</td>
<td>Very good</td>
</tr>
<tr>
<td></td>
<td>Nylon Polyamide</td>
<td>0.8...22</td>
<td>38.....200</td>
<td>1.14</td>
<td>3.5......4.5</td>
<td>Very good</td>
<td>40......60</td>
<td>80......90</td>
<td>20......80</td>
<td>105......125</td>
<td>Very good</td>
</tr>
<tr>
<td></td>
<td>Acrylic Polycyrlonitrile</td>
<td>0.6..25</td>
<td>38.....200</td>
<td>1.14...1.18</td>
<td>1......2</td>
<td>Very good</td>
<td>20......35</td>
<td>80......95</td>
<td>15......70</td>
<td>100......120</td>
<td>Very good</td>
</tr>
<tr>
<td></td>
<td>Polypropylene Polypropylene</td>
<td>1.5...40</td>
<td>38.....200</td>
<td>0.90...0.92</td>
<td>0</td>
<td>Very good</td>
<td>15......60</td>
<td>100</td>
<td>15......200</td>
<td>100</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Elastane Polyurethane</td>
<td>20...4000</td>
<td>38.....200</td>
<td>1.15...1.35</td>
<td>0.5......1.5</td>
<td>Very good</td>
<td>4......12</td>
<td>75......100</td>
<td>400......800</td>
<td>100</td>
<td>highest</td>
</tr>
</tbody>
</table>

Standard condition: 20°C and 65% RH  
High humidity: 24°C and 96% RH  

*Source: The data collected and gathered from the documents provided by 'Bangladesh College of Textile Engineering'  

Table: Comparison among different properties of different types of fiber
Quality house:

- Weak relationship
- Strong relationship
- Co-relation between engineering characteristics

- Thermal insulation
- Breathability/ water vapor transport property
- Strength
- Extensibility
- Elasticity
- Fineness
- Withstand to temperature
- Density
- Chemical resistance
- Biological resistance
- Light resistance
- Formability
- Lustre
- Coloration
- Specific bulk/ volume
- Water repellency
- Wrinkle recovery

Easy to get hold of
Long life
After care - environmentally
Look good
Feeling modern
Good fit
Repairing capability
Protection against weather
Environmentally disposable
Description of quality house:

‘Water repellency’ property of textile fabrics mainly enhanced by different kinds of finishing. Like cotton can be made water repellent by impregnated by special chemicals like silicones. These improved finishes are used in rain-coat.

The fabrics which enclose much air have relatively good ‘Thermal insulation’ property. Thermal insulation is important property for ‘protection against weather’ especially in cold weather. Linen has relatively poor thermal insulation whereas Silk gives a cooling effect and is good thermal insulator. Viscose fiber itself has only a small influence on insulation but the insulation property can be controlled to some extent.

Moisture absorption is the property of fabric to take up water rapidly and release quickly to the surroundings. In hot weather this is comfortable to human skin. Linen is a highly absorbent.

Formability is the fabrics property of more or less durably shaping property. So, this property has a relationship with ‘good fit’. Like Acetate and Triacetate all synthetic fibers are thermoplastics and these can be permanently creased or pleated and thus have a better formability.

‘Specific volume’ is the volume of unit of area and it is inversely proportional to ‘density’. Among the synthetic fibers ‘Acrylic’ yarns are the most voluminous and low density.

Most synthetic fibers are ‘wrinkle-resistant’ which is important to shaping property of clothing.

From natural fibers silk has the best ‘luster’ property. But most of the synthetic fiber has the better ‘luster’ property which imparts better appearance of product.

Different fiber properties like ‘wrinkle recovery’ or ‘thermal insulation’ can be improved by giving special coating on the fiber surface which decreases the property like ‘moisture absorption’ as the pores of fabrics are covered after these kind of finishing.

‘Chemical resistance’ varies according to the chemical composition of the fiber composition. Most synthetic fiber is susceptible to solvents. On the other hand natural fibers are able to withstand higher temperature.

Strength of fiber is measured by Breaking extension and elasticity which is discussed above. Because the ‘elasticity’ property loses consequently its temper as wearing of clothes which effect the durability of clothes. And from above table we can see that natural fibers have low breaking extension and elasticity and synthetic fibers have higher value.

‘Extensibility’ and ‘elasticity’ both has impact on ‘good fit’ and ‘repairing capability’ whereas there is inverse relation between these two engineering characteristics. As extensibility is the property of fiber that how much the fiber can be extended under a load and ‘elasticity’ is the property how much the fiber recovers its original shape after the load is removed.

‘Fineness’ of fiber is measured by mass in grams of ten kilometers of fiber. So there is a proportional relation between ‘density’ and ‘fineness’. Smaller the number of fineness the finer is the fiber. ‘Fine’ fiber is easier to shaping of cloth than coarse fiber as finer fibers are softer, denser and more
comfortable. So, the finer fiber is used for all-weather clothing and for also soft, flowing outerwear materials.

There is a relationship between engineering properties ‘thermal insulation’ and ‘specific bulk’ of fiber. As low specific volume of fiber has the capacity to entrap low volume of air and has lower thermal insulation property and vice versa.

**Fiber blending**

Fiber blending is used either to improve the quality, by compensating a weakness in the properties of a given fiber type, or to achieve special optical effects. Blending will also influence processing efficiency, yarn fineness, and cost.

**Typical blending and blending ratios**

Blending can be effected at either of two stages in textile manufacture. During staple yarn production, by blending different types of fibers. During fabric production, by mixing yarns made from different fibers or filaments. Any combination of natural fiber and man-made fiber yarns is possible, in principle.

It is especially advantageous to blend natural fibers with man-made fibers. In this way, the most desirable properties of both fiber types can be exploited, whilst some of their disadvantages can be partially offset.

The most popular blends are those of wool with polyester, nylon and acrylics and of cotton with polyester, nylon, viscose and modal. The superb clothing comfort properties of the natural fibers are supplemented by the high strength, abrasion resistance and resilience and the good aftercare characteristics of the synthetic man-made fibers to make textiles with excellent all-round performance. The cellulosic man-made fibers are valuable blending materials because produced with the ideal length and fineness for making fine yarns.
Special effects can be obtained with man-made fibers through controlling their luster and shrinking potential. The best staple fiber blends are obtained when the different fibers are closely matched in their extensibility, length and fineness.

The most common blending ratios are between 70:30 and 50:50.

**Chemical finishing:**
Chemical finishing aims to effect a radical change in the basic fiber or fabric properties, in order to improve some aspect of its behavior:

<table>
<thead>
<tr>
<th>process</th>
<th>application</th>
<th>Procedure and objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water repellent</td>
<td>All apparel fabrics and weather clothing</td>
<td>Impregnation or spraying with water repellent chemicals (e.g. silicones). Can be durable or temporary depending on the chemical process.</td>
</tr>
<tr>
<td>Stain resistant</td>
<td>All apparel fabrics</td>
<td>Application of stain repellent substances. Silicones are used mainly for water-borne stains; synthetic resin for oil-borne stains. Usually a degree of water repellence is also imparted.</td>
</tr>
<tr>
<td>Hygienic (bacterial, fungicidal)</td>
<td>All apparel fabrics</td>
<td>Application of chemicals which hinder the growth of micro-organisms on the textile and on the human skin.</td>
</tr>
<tr>
<td>Rot proofing</td>
<td>Natural fibers</td>
<td>Protection of the textile from organisms that promote decomposition</td>
</tr>
<tr>
<td>Anti-pilling to improve life of clothes</td>
<td>Synthetic fiber, wool</td>
<td>Reduction of the tendency for piling (formation of tiny fiber pills on the fabric surface) using film-forming polymers, or solvents.</td>
</tr>
<tr>
<td>Easy-care</td>
<td>Cotton, viscose</td>
<td>Application and fixation of chemicals which reduce the sensitivity of the fiber to moisture and to creasing. Fabrics become more resistant to wrinkling, do not shrink and will dry faster.</td>
</tr>
<tr>
<td>Appearance (perchmentizing)</td>
<td>Cotton</td>
<td>A range of processes giving a variety of effects from transparency to opalescence, together with more or less stiffening. Often there is a high degree of lustre.</td>
</tr>
</tbody>
</table>

**Coating and Lamination:**
Coating is the application of a layer of natural or synthetic polymer to one side of the fabric, followed by fixation in a curing oven. Coating also imparts different improvement of properties to the fabric which are a combination of the original material and coating (polyurethane, polyvinylchloride). The polymer film can be applied directly to the fabric. However, if the fabric is an open one, or the material to be applied has a low viscosity, the liquid will first be applied to a carrier paper and then transferred from there to the target fabric.

Lamination is the superimposition and bonding of two or more fabrics, or a fabric with paper, film, or foam. The bonding can be achieved with an adhesive or by heat, whereby a polymer film or foam is melted onto the surface of one fabric and then the other fabric is pressed onto it.
**Application:**

**Application for protective clothing:**

<table>
<thead>
<tr>
<th>Protection against</th>
<th>Groups at risk</th>
<th>Protective measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain, Snow, Wind</td>
<td>Hikers, construction and farm workers</td>
<td>Wind and weather protection with impregnated and laminated fabrics, microfiber fabrics and membrane systems e.g. Gore-tex, Sympatex</td>
</tr>
<tr>
<td>Extreme cold, Snow and Ice</td>
<td>Winter sports, Polar researchers, Astronauts</td>
<td>Low temperature protection from multiple layer and wadded clothing</td>
</tr>
<tr>
<td>Extreme heat, Fire, Sparks</td>
<td>Welders, fire fighters, racing drivers, Astronauts</td>
<td>High temperature and flame protection from flame retardant finished fabrics, special synthetic fibers, lamination with Aluminium</td>
</tr>
<tr>
<td>Mechanical force</td>
<td>Mountaineers, welders, motor cyclist, police, military</td>
<td>Injury protection with padded leather or fabrics made from special fibers, e.g. Kevlar</td>
</tr>
<tr>
<td>Smoke, Toxic fumes, Acids, alkalis</td>
<td>Emergency services</td>
<td>Chemical protection with waterproof and gas proof fabrics e.g. rubber coating; special non-wovens with activated carbon.</td>
</tr>
<tr>
<td>Water hypothermia</td>
<td>Surfers, divers</td>
<td>Surfing and diving suits made from elastomeric fabrics e.g.</td>
</tr>
</tbody>
</table>

**Application on Weather proof clothing:**

Function: the main purpose of weather-proofing clothing is to keep out wind and rain, but also cold, whilst allowing perspiration moisture to escape from the body. If these requirements are not met then, even under normal conditions of exertion, either the body becomes soaked with perspiration or the clothing become wet, which could lead to hypothermia.

There are various textile constructions which are more or less capable of fulfilling these requirements. Liquid water is prevented from entering by having fabrics with a dense, smooth and hydrophobic (non-wetting) surface. Water vapor can diffuse outwards between the yarn and fibers, driven by the higher temperature and vapor pressure on the inside of the garment.

Traditional weather protection:
Heavily milled and raised wool fabrics and densely-woven fabrics of cotton, nylon, or polyester, with a hydrophobic finish will resist the penetration of water for a certain time. However, with continuous exposure to severe conditions, clothing made from such materials will eventually become wet and its protective value will diminish.

For a complete and durable barrier to wind and water, coated textiles can be used which however, normally do not permit the escape of water vapor.

Modern weather protection:
Modern textile constructions are impermeable to water, or resist wetting for a longer time, whilst allowing water vapor to diffuse through. When made from synthetic fibers they are also easy-care. Four basic systems can be distinguished.
• Microporous coating: the coating has very fine pores which allow the passage of water vapor but not liquid water.
• Microporous membranes: these are very fine films, about 0.02 mm (the thickness of domestic cling-film), containing very fine pores. They are used either by laminating onto a textile structure or by interleaving between two fabrics.
• Hygroscopic membrane: hygroscopic means water-absorbing. They take up perspiration and transport the vapor through the continuous film to the outside. ‘Sympatex’ is a hygroscopic membrane made from polyester.
• Microfiber fabrics with a hydrophobic finish: this is a development of the traditional technology, in which very fine synthetic fibers are used to make tightly woven fabrics having very small pores. These are better able to resist wetting and penetration by liquid water whilst still allowing water vapor to diffuse. As with the traditional technology, a hydrophobic finish enhances the water resistance. Examples are ‘Tactel’ and ‘trevira-finesse’ in polyester.

Discussion:
Here in this chapter first I discuss about clothing physiology, so it is easy to understand for the reader how the ‘engineering characteristics’ effect human body. Then comparison of different properties of different clothing fiber material is shown. From the data collected ‘the quality house’ is developed. And with the comparison of different fiber materials it is easy to understand which kind of material could be useful for imparting which property. But actually now-a-days pure 100% single fiber is not used for clothing. Different technology like ‘blending’, ‘chemical treatment’, ‘coating’ and ‘laminating’ is used to improve the property and appearance.

My report could be used as the base for further ‘product development’ and ‘product design’. So I tried to give the reader a brief idea that which technology can be used and from the ‘quality house’ is used to transfer the customer preference of quality into engineering characteristics. So, if further study is done for ‘product development’ and ‘product design’ for any specific ‘segmentation of customers’ or for specific types of activities so the information provided in this chapter could be used as a base for future development. And here I tried to focus more on ‘Protective clothing’ and ‘weather-proof’ clothing as these are the main function of all types of customer for outdoor clothing.

But more laboratory experimentation is needed to find more about different co-relation of engineering characteristics.
Chapter 5 – Environmental and social aspects of Clothing Technology:

Ecology and textile pipeline:

Ecology is the study of the relationship between life and physical environment. Conservation of and responsibility for the environment is a study of all human enterprise, since every generation must bequeath a safe and healthy environment to the next. Textiles are worn intimate contact with the body; they form a personal environment which should be protected by appropriate systems of manufacturing and eventual disposal.

General principles of environmental conservation:
- Avoidance of materials which stress the environment
- Reduction in consumption of materials
- Recycling of used materials

Collaboration is required between manufacturers, retailers, consumers, and legislature. Legislation should be towards those areas which are most important in preserving and enhancing the quality of life. Examples are the regulations governing the handling of hazardous and poisonous substances, and controls on emissions, waste and water impurity.

The interaction between man, textiles, and environment are demonstrated by lifecycle analysis of a given product through the whole textile pipeline.

<table>
<thead>
<tr>
<th>Fiber production</th>
<th>Yarn production</th>
<th>Fabric production</th>
<th>finishing</th>
<th>Clothing manufacture</th>
<th>Wearing, after-care: laundering, dry cleaning</th>
<th>Recycling: incineration, Burial</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>manufacturing</td>
<td>utilization</td>
<td>Disposal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table: the textile pipeline

Life cycle analysis:

A life cycle analysis attempts to determine the impacts upon the environment of a product throughout its whole lifetime. It considers the consumption of raw materials, energy, chemicals, water etc. in production, utilization, and disposal. Industry is beginning to increasing use of life-cycle analysis because there can be positive advantages in identifying for potential for savings in materials and energy. Life cycle analysis is a relatively new discipline which has not yet been standardized or fully developed.

<table>
<thead>
<tr>
<th>Life-cycle analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>input</strong></td>
</tr>
<tr>
<td>Materials requirements</td>
</tr>
<tr>
<td>Raw materials: Fibers, yarns, fabrics</td>
</tr>
<tr>
<td>Auxiliary materials: Dyes, solvents, Oils, fats, lubricants,Other chemicals</td>
</tr>
<tr>
<td>Packaging</td>
</tr>
<tr>
<td>Office supplies</td>
</tr>
<tr>
<td>Other materials</td>
</tr>
<tr>
<td>Factory plant</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Air</td>
</tr>
</tbody>
</table>
Table: in a life cycle analysis, the resources required for production and consumption of a product (inputs) are set against the value of the products and the environmental consequences (outputs).

Source: Kunert

Ecology and manufacturing:

Economic production of natural fibers requires fertilization and irrigation of the land, and protection of the plants or animals against pests and diseases. There is a risk of degrading the soil and contaminating ground-water if the proper precautions are not taken. The production of man-made fibers, either from natural polymers or from fossil fuels requires expensive chemical processes. In spinning, weaving and knitting, chemicals are required as protectives and lubricants. Chemicals are indispensable in finishing: for coloration and to enhance the fibers and fabric properties. In many production stages there is the risk of contaminating the air and water; noise and waste are produced and considerable quantity of energy are consumed. The textile industry worldwide makes extensive use of road, rail, sea and air-transport. Large quantities of packaging materials are used both for transportation and for final presentation to the consumer.

Measures which can be taken to reduce the impact of manufacturing upon the environment include:

- Improved agronomic practice: such as breeding new varieties, integrated pest management, soil conservation, computer-controlled fertilization and irrigation, use of non-persistent pest – control chemicals.
- Improved process management: such as minimizing the consumption of water, energy, and chemicals; substitution of persistent chemicals with biodegradable ones; introduction and observation of environmental controls; installation of more ‘environmentally friendly’ plant and machinery. The disadvantage is the enormous cost of implementation which leads to higher product prices. Industries which have few environmental controls also have lower manufacturing costs.

Ecology and Utilization:

Wearing of clothing:
Adverse reactions of the human skin to clothing are not rare. They usually are connected with wearing very tightly fitting clothing, abrasive materials or nickel plated buttons or other decoration. Allergies or skin diseases have been found to certain dyestuffs (benzidine derivatives), dyeing auxiliaries (carriers), or formaldehyde derivatives (easy-care finish), natural rubber and silk gum (sericin). Various so-called ‘eco labels’ have been devised which guarantee that the products have been tested and found to contain not or more than certain permitted levels of various chemicals which (when present in highly concentrated form) may be injurious to health.

Clothing aftercare:
Laundering and dry cleaning require energy, water, and chemicals, laundering assistants contain primarily detergents, bleaching agents (oxidants, fluorescents) and water-softening agents (phosphates). Phosphates are fertilizers; they can cause eutrophication of waste water of by encouraging the growth of plant life (algae). Modern washing powders and liquids use substitutes for phosphates which are usually biodegradable. Dry cleaning uses hydrocarbons to dissolve greasy soil. Modern dry cleaning processes are closed systems, subject to strict regulation, in which the solvent is almost completely recycled.
Eco-labeling:

There is demand from some consumer groups that textile labels should give information about any potential harmful chemicals which may be contained in the product. In various countries, either governmental or private organizations have developed sets of criteria which can be embodied in a labeling scheme to satisfy these demands. A typical example from Europe is the label for ‘textile tested for harmful substances’ by the ‘Eco-tex standards 100’. This label guarantees that:

- No potentially carcinogenic dyestuffs have been used
- Heavy metals are present in such small quantities that their concentration, when dissolved in perspiration, would be lower than the permitted levels for drinking water.
- Pesticides are present in concentrations lower than those permitted for foodstuffs
- Formaldehyde shall not exceed a certain concentration
- The pH value is neutral or slightly acid like human skin
- Textiles intended for babies and small children should not release any dyestuff on contact with saliva


Other than this there are so many organizations to maintain standards and provide this kind of labeling, i.e. Swan and EU Flower, Bluesign etc.

**Code of Conduct**

It is increasingly common for textile companies set up their own code of conduct, or as it is also known as the Code of Conduct. This is a written document on a voluntary basis has been composed by the company and their suppliers must follow. In order not to codes of conduct should be too sprawling follow most companies the eight ILO core conventions on human rights in the workplace, the UN Declaration of Human Rights and the CRC.

To maintain a Code of Conduct includes a lot of time and money. Many are so-called "audits", which are checks with the suppliers, both unannounced and unexpected.

**ILO’s eight core conventions on human rights in the workplace**

The ILO is the UN specialized agencies for employment - and employment issues that brings out standards for labor rights. These standards serve as templates for member countries when they establish laws. Today, the ILO has 177 member countries and each country has representatives from government, employers and employer associations. What separates the eight ILO core conventions of the other conventions is that all member states must comply with them. Thereafter, a country can ratify

---

5 URL: [http://www.oeko-tex.com/oekotex100_public/content4.asp?area=hauptmenue&site=bausteine&cls=02](http://www.oeko-tex.com/oekotex100_public/content4.asp?area=hauptmenue&site=bausteine&cls=02)
and implement voluntary, among other Conventions to its laws:

- Prohibition of forced labor
- Freedom of Association and Protection of the Right to Organize
- Bargaining and the collective right to organize
- Equal pay between men and women for work of equal value
- Abolition of Forced Labour
- Discrimination in Employment and Occupation
- Minimum Age for Employment
- Action on the Worst Forms of child labor

Based on the basic principles of ILO many organizations establish a voluntary code of conduct for textile and garments industry. These organizations bring together business, NGOs and trade unions to jointly improve working conditions. This may involve working with local organizations can help with staff training, establish a system regarding employee complaints and carry out on solution. Examples of these kind of organizations are ‘Fair Labor Association’, ‘Fair Wear Foundation’, ’SA8000 - Social Accountability International’, ’BSCI - Business Social Compliance Initiative’ etc.

Today it is seen that mostly large garment and textile companies have a Code of Conduct, as such ‘H & M’, ‘Lindex’ and ‘arctic fox’ etc.

**Fair Trade**

Many producers in developing countries often have limited resources and are difficult to compete in world markets. In order to act there, and sell their products, they are forced to push their prices, lowering the requirements for working and selling via multiple intermediaries who themselves take a large share of the credit. The result is that many do not get paid enough for their work and thus cannot support themselves, their families and develop its local community.

It is against this background, fair trade movement has emerged. By promoting a commercial where a human and community development center to poverty and social exclusion should be avoided. Fair trade is not support - it is a trading partnership between producers, importers, stores and consumers, which is characterized by openness, reciprocity and respect for all parties. Fair pay, good working conditions, sustainability, respect for human rights and the environment allows for the long term economic and social development.

Fair trade is not a new phenomenon in Sweden; the option has been discussed and has been active, both nationally and internationally, since the late 1960s. The first vision around the need for changes in world trade appeared already in 1964, under a UN conference, where a large number of countries in the South urged the world to work for decent trading conditions, "trade not aid '(trade instead of aid). Under UN auspices, were discussed and developed in the 1970s also suggested how the playing-field in world trade could be achieved. The UN has continued to be clear about the importance of changing trading conditions, including Millennium Declaration which states that a non-discriminatory trading system must be created. Despite these attempts, the world's countries still in a very long way in creating more equitable conditions in world trade.

---

7 URL: http://www.fairtrade.se/cldoc/351.htm (date: 2011-05-27)
General criteria for fair trade:

- Good working conditions, sustainability, reasonable salary / payment, and environmental awareness.
- An open, democratic organizational structure.
- A stimulating, and friendly dialogue between all actors, to which participation is essential.
- Promoting long-term and stable trade relations.
- Work shall comply with the UN Declaration on Human Rights, United Nations Convention and ILO core conventions.
- Promote equality between men and women.
- Disseminating information, educating and campaigning for educational and informational purposes.
- Give priority to products as much as possible processed in the country of origin.

The purpose and objective of the fair trade movement is to marginalized producers in developing countries are given opportunities to improve their economic and social situation, such as affordable health care and schooling for their children. Being able to plan long term for their business and not have to depend on the unpredictable world prices and market rules is another win, and to be able to get out of an unprofitable production patterns, for example by finding other means of livelihood. Essentially, fair trade movement, the producer the potential to stimulate and contribute to society through that organization's investment in eg education, health and environmental concerns in their own local community.

Operating players: There are four major international organizations working directly with Fair Trade:

FLO - Fair-trade Labeling Organizations International offers an independent product label that guarantees the consumer that the product is produced according to the manufacturer's working and living conditions. FLO is the newest addition in the fair trade movement, formed in 1997. FLO has 19 labeling initiatives in 23 countries around the world, including Swedish Fair-trade Sweden.

WFTO - World Fair Trade Organization (formerly IFAT - International Fair Trade Association) co-operation Organization and meeting venue for producers in the South, particularly in the agricultural and handicraft sector, and organizations in the North. Practice is to create markets, evaluation of each other, exchanging information and advocacy. The fact that the producer be WFTO certified today means that one supports fair trade criteria, and works to realize this and they approved of WFTO. As WFTO-member you are to be exclusively with Fair Trade (including the Fairtrade-branded) products.

NEWS! - Network of European World Shops. An association of the approximately 2500 worldwide stores in Europe. Its primary business is to sell goods produced under fair trade criteria. Also work actively to disseminate information about fair trade at the consumer level and advocacy on trade rules and policies against makers.

EFT - The European Fair Trade Association. The members of the EFTA consists of the 12 largest importing organizations in nine European countries, no Swedish importer is still connected to the EFT. Purchase products from producer organizations under fair trade criteria. In their respective countries
importing organizations function as wholesalers and retailers sometimes. Selling goods through world shops or commercial retail, more than half of the goods in the European World shops are coming from EFTA members.

Fair Trade is a trading partnership, based on dialogue, transparency and respect that seeks greater equity in international trade. Fair trade promotes sustainable development by offering better trading conditions and securing the rights of marginalized producers and workers-especially in the South. Fair trade organizations are actively engaged in supporting producers, to encourage increased awareness and campaigning for changes in the guidelines to protect the conventional international trade and the way it is practiced.

**Discussion:**

Maintaining Eco-labeling, Code of conduct and Fair trading could be useful way to inform the customers about the manufacturing and trading process and customers will then be more confident to purchase products after seeing and being informed about these factors. To cope up with Social and Environmental sustainability these are important for both customers and suppliers perspective. And suppliers should be more concerned about how they are affecting the society and environment and they should invest to develop eco and society friendly product which is an inevitable demand now and the customers should more concerned about their demand regarding social and environmental sustainability.
Graphs and references:

1. Requirement and fulfillment analysis according to age:

![Graph showing comparison customer satisfaction different age groups]

2. Requirement and fulfillment analysis according to gender:

![Graph showing comparison customer satisfaction gender]

Comparison customer satisfaction
Different age groups

Comparison customer satisfaction
Gender
3. Requirement and fulfillment analysis according to dwelling place:

Comparison customer satisfaction
Type of dwelling

4. Requirement and fulfillment analysis according to using areas:
5. Requirement and fulfillment analysis according to activity:

![Graph showing fulfillment analysis for various activities]

- fulfillment-hiking
- fulfillment-skating
- fulfillment-fishing
- fulfillment-cycling
- fulfillment-to & from work
- fulfillment-profession
- fulfillment-walking outdoor

Activities include:
- hiking
- skating
- fishing/hunting
- cycling
- to and from work
- profession
- walking outdoor
Reference:

1. Quality from customer needs to customer satisfaction- Bo Bergman, Bengt Klefsjo
2. Clothing Technology from Fiber to Fashion – Hannelore Eberle, Herman hermanling. Peter Menzer.
4. Fashion Retailing – Grete Birtwistle and Cristopher M. Moore
5. Obtaining and Retaining Customers – Andy Whaley, Lan Headon, Daren O’conor.
6. WHAT’S IN IT FOR THE CUSTOMERS? SUCCESSFULLY MARKETING GREEN CLOTHES- Arnt Meyer