Unit 7.2 Features of Design for Longevity

Content

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7.2.1 Introduction

Why is it important to ask the question of lifespan? [1,2,3]

Growth in textile demand and production

Reduced lifetime of textiles

Increase of environmental impacts

- Prolonging the use period is one of the possible ways of increasing sustainability within the field of textiles and clothing.
- Predicting and understanding the factors that affect lifespan can help increase it and adjust quality to the intended use.

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7.2.1 Introduction

- Clothing utilization decreases
- Using a garment 9 months longer could reduce carbon emissions from textile consumption by 27% or reduce waste by 22%. [6]

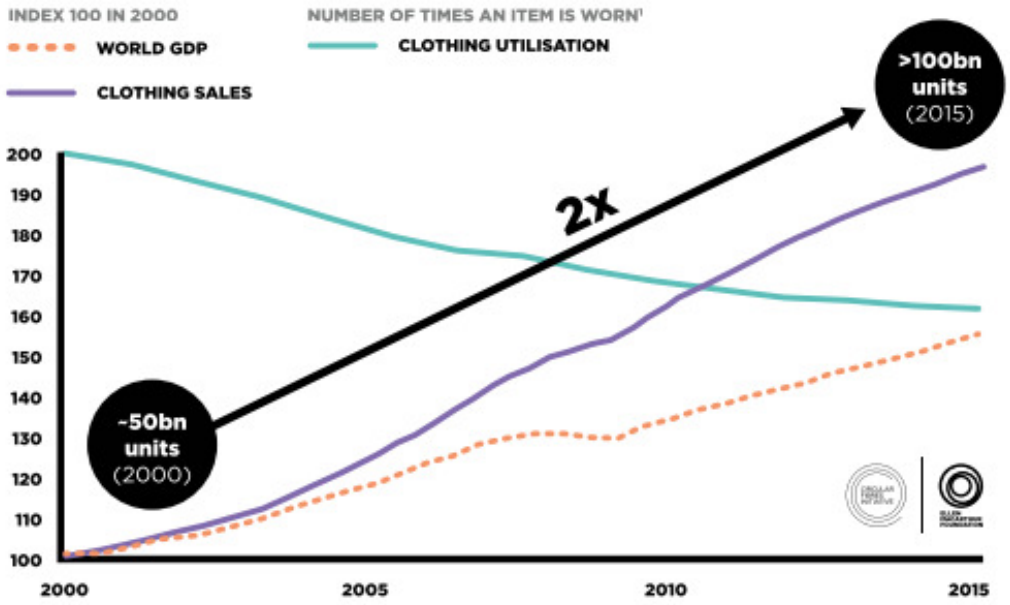

Figure 1: Growth in clothing sales and decline in clothing utilisation since 2000 [8]

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7.2.1 Introduction

How does lifespan influences the environmental evaluation ?

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7.2.1 Introduction

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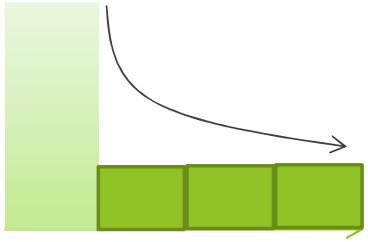
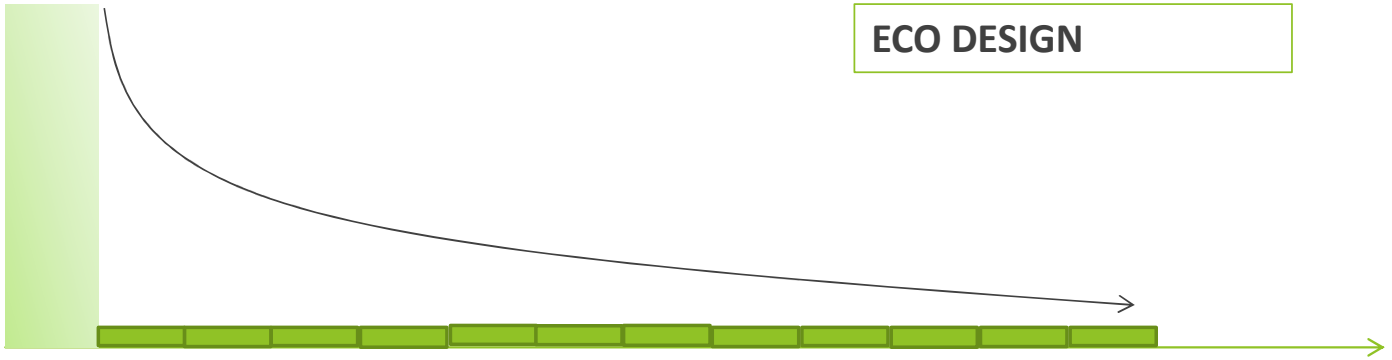


Lifespan : 3 uses

The more the product is used, the more the environmental impact related to one usage will decrease.

ECO DESIGN

B



Lifespan : 12 uses

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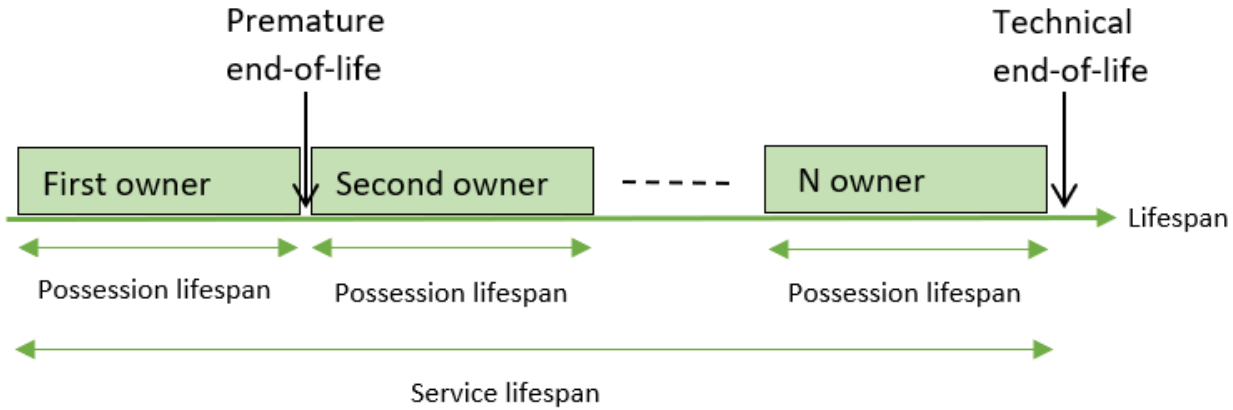
7.2.2 Obsolescence in the fashion industry

Types of obsolescence : [3]

- Absolute obsolescence = Product related, technical end of life
- Relative obsolescence = Consumer related, premature end of life (Psychological / Situational / Never worn / Functional / Sentimental)

Service lifespan: Product perspective. Period during which the products are technically usable.

Possession lifespan : Period when the consumer uses the product.



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7.2.2 Obsolescence in the fashion industry

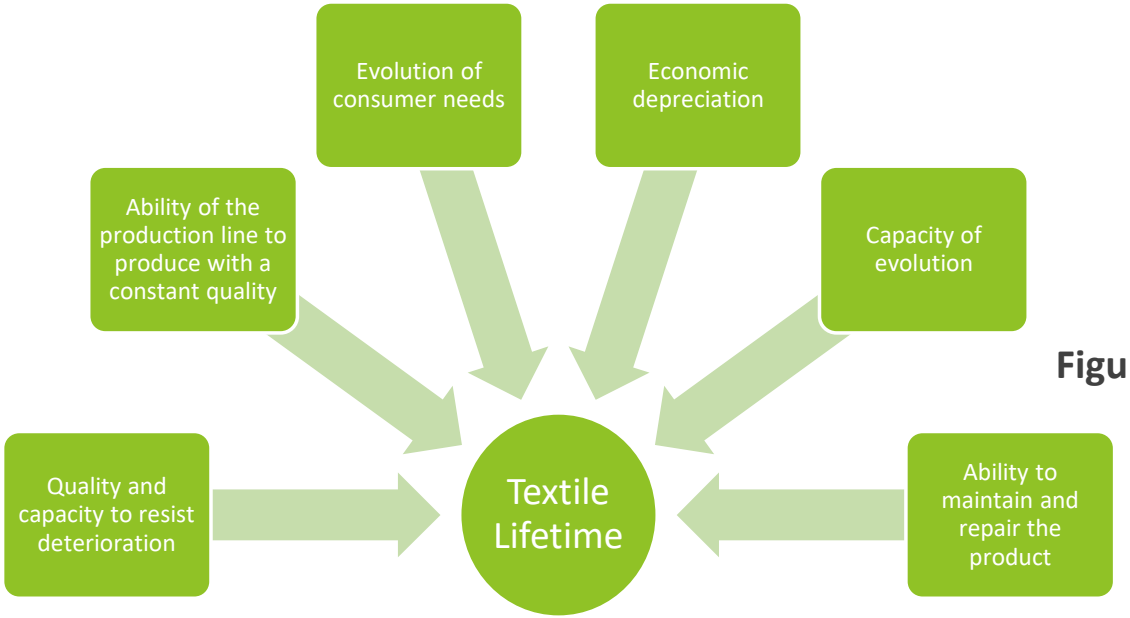

Figure 2. Influences on textile lifespan [4]

The entire production chain is involved, from manufacturer to consumer.

It is difficult to make a precise analysis of the entire textile chain, so we are focusing on end-of-life analysis oriented towards the consumer and the disposal causes.

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7.2.3 Quality for Longevity

Some definitions :

- Durability/Longevity : Refers to the length of service or life of a product. [5]
- Lifespan : Generally translates durability over time, the ability of a product to perform a function under given conditions of use and maintenance until a limit state is reached. [4]
- Design for longevity : This corresponds to the quality that is applied to the product so that it lasts as long as possible. It corresponds to quality with regard to the weak points of the product, which are the points to which the consumer is sensitive. For this reason, it is necessary to look at the nature of the constraints and their consequences on the products. [4]

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What are the causes of disposal?

- Physical and emotional causes. [3,4]
- Emotional causes are subjective, while physical causes are objective.
- To estimate product longevity, we need to consider technical performances such as resistance to color change, to holes .. To do so, performance tests are performed.

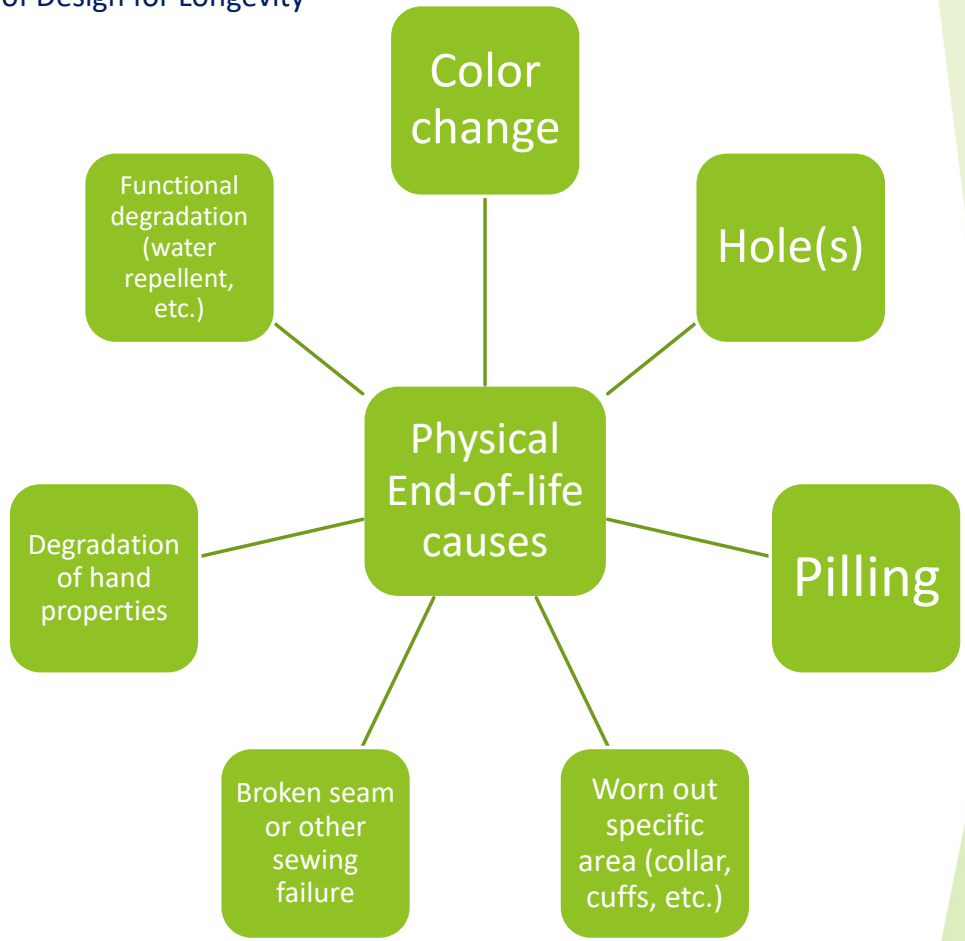

Figure 3. Examples of physical end-of-life causes

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7.2.4 Test and Measurement Methods for Quality Evaluation

The tests to be performed depend greatly on the final use of the product. The notions of function and service provided are then essential. For example, expectations are not the same for a t-shirt worn daily and a suit jacket worn occasionally. [6]

- The textile industry has a large number of standards that allow the evaluation of textiles at all scales (from fibers to finished product) and in relation to all types of constraints.
- Some of them concern resistance to manufacturing constraints (e.g.: color fastness to calendering), others are oriented to constraints of use (e.g.: color fastness to washing). We will focus on this 2nde category because we want to see the performances of the products facing the constraints of use.

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Examples of commonly performed tests

Table 1. Commonly performed tests

Type of test	Constraint	Associated standard
Color Fastness	Water	NF EN ISO 105 – E01
	Daylight	NF EN ISO 105 – B01
	Sweat	NF EN ISO 105 – E04
	Domestic laundering	NF EN ISO 105 – C06
	Hotpressing	NF EN ISO 105 – X11
	Rubbing	NF EN ISO 105 – D02
Resistance to deformation	Dimensional change in washing and drying	NF EN ISO 5077
	Spirality after laundering	ISO 16322 : 1, 2, 3
Seam strength	Seam tensile properties	NF EN ISO 13935 : 1, 2
	Slippage resistance of yarns at seam	NF EN ISO 13936 : 1, 2, 3
Resistance to the apparition of a hole	Abrasion resistance	NF EN ISO 12947 : 1, 2, 3, 4
	Bursting	NF EN ISO 13938 : 1, 2
Pilling resistance	Surface pilling and fuzzing	NF EN ISO 12945 : 1, 2, 3

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Example of Color Fastness test

For color fastness tests, the principle is to subject a specimen to the mentioned fade factor and then evaluate the color degradation using a grey scale, in accordance with ISO 105-A02 and ranging from 1 to 5, the value 5 corresponding to the best score and reflecting "no degradation". [4]

For example, if we want to evaluate the color resistance to sweat, textile samples are put in contact with acid and basic solutions (representing sweat), then put in the oven for several hours (representing the contact with the human body). At the end of the test, the color is compared to the one at the beginning.

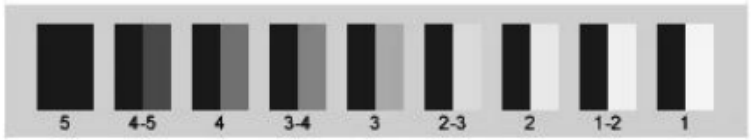

Figure 4. Grey scale [4]

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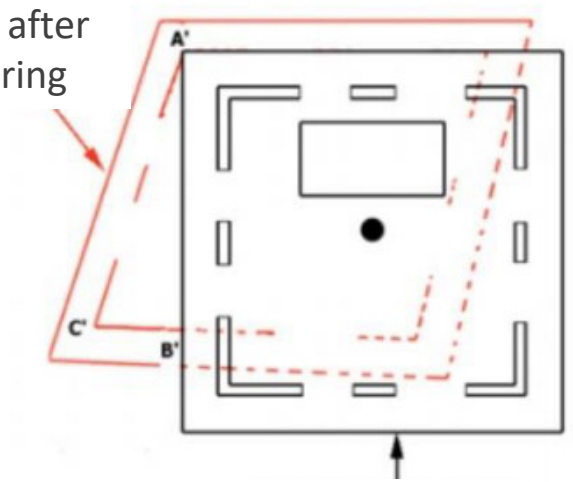
Example of Spirality test

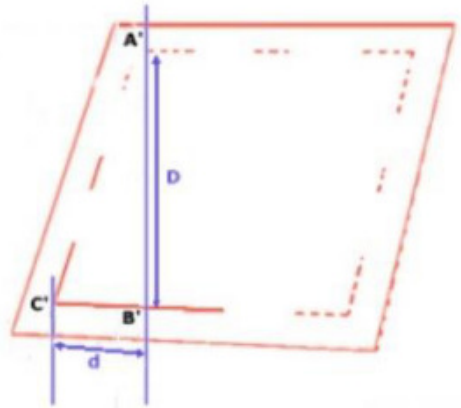
The idea of the spirality test is to measure the distortion after laudering. It is particularly visible at the side seams that move to the front and back of the product. The result is expressed as a percentage. The higher the percentage, the bigger the deviation.

To evaluate the spirality, a square of known dimensions is drawn on the product. After laudering(s), the spirality is calculated as follows:

Spirality% = 100* d/D

Layout after laundering





Initial layout

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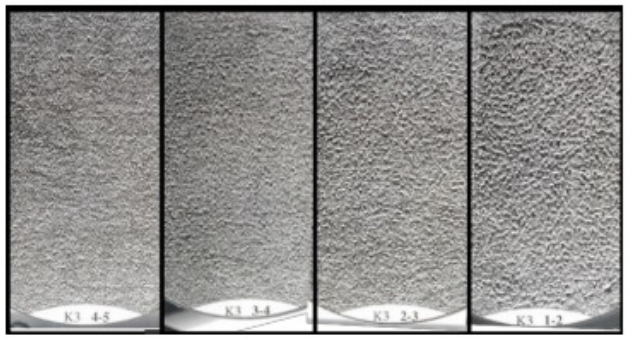
Example of Surface Pilling test

The objective is to determine the propensity of fabrics to pilling by means of repeated rubbing.

- In the standard NF EN ISO 12945-1, test specimens are placed in a pilling box lined with cork. The apparatus has two boxes mounted on a rotating axis. The rotation implies a displacement and random friction of the specimens between them and against the cork.
- In the standard NF EN ISO 12945-2, a Martindale device rubs the fabric against itself in a specific movement.

In both cases, after a set number of cycles, the condition of the specimens is assessed by visual inspection using a rating scale, with a value of 5 corresponding to "no degradation".



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How to go from performance test results to a longevity estimation?

- Performance profile : It allows to visually mark the performances of each product, but it doesn't allow to rank them against each other.
- Each test gives a result that is independent of the other tests performed. These collected results are specific and do not reflect the quality in a global way, nor do they take into account the consumer.
- Longevity is expressed in years, in the number of wears, in the number of washes... In all cases, it is a unique value. It is therefore necessary to aggregate all the test results into a single value.

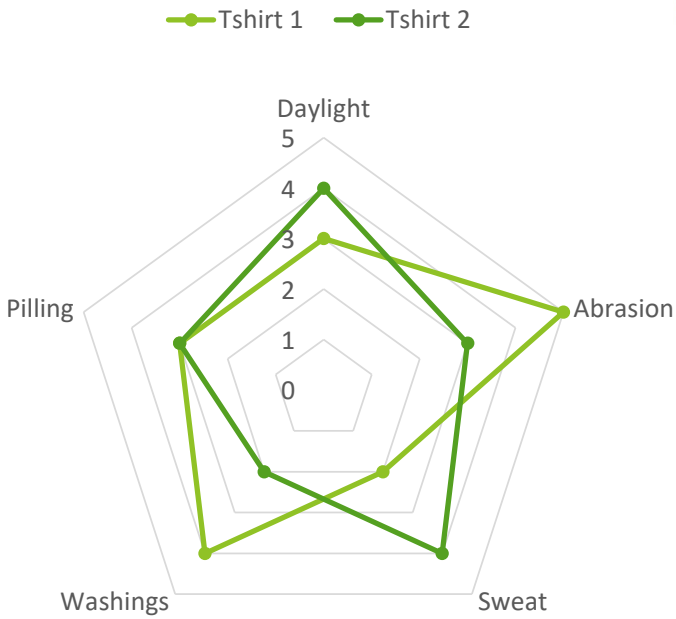

Figure 5. Random example of performance profile on 5 tests for 2 t-shirts

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Aggregate values

To aggregate values, the first question to ask is: what weight should be given to the different tests? Does the result of the washings have more influence than the pilling on the lifetime? To be able to assign weights, we must rely on the consumer and the points to which he is sensitive.

Data aggregation methods belong to three main families :

- Complete aggregation methods
- Partial aggregation methods
- Local aggregation methods

Local aggregation methods are rather intended for choice problems than for classification.

The approaches of complete aggregation and partial aggregation, consist respectively in aggregating the performances of an object and to compare them by pair using an outranking relation.

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7.2.5 Perceived Quality/ Influence of Consumer Perception

- Since the objective is to gather all the test results into a single value, it is interesting to look at the relative importance of each degradation in the disposal decision.
- Not all defects are perceived in the same way by the consumer. The defects that lead to discarding are different depending on the type of garment.[6]

Example of type of garment	Major defects
Denim	Break down at stress points / Component failure
Knitwear	Distortion, shrinkage, loss of shape / Pilling
Tailoring (regular wear)	Wear and tear / Component failure / Distortion

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7.2.5 Perceived Quality/ Influence of Consumer Perception

- A study conducted in France on 901 persons showed that the apparition of holes and deformation are the two most important causes of a t-shirt disposal, followed by the broken seams, the degradation of color and the apparition of pilling.[4]

Table 2. Consumer perception of wear on a t-shirt , in France [4]

	Degradation of color	Deformation	Broken seams	Holes	Pilling
Consumer perception (%)	15,1%	25,9%	18,2%	27,1%	13,7%

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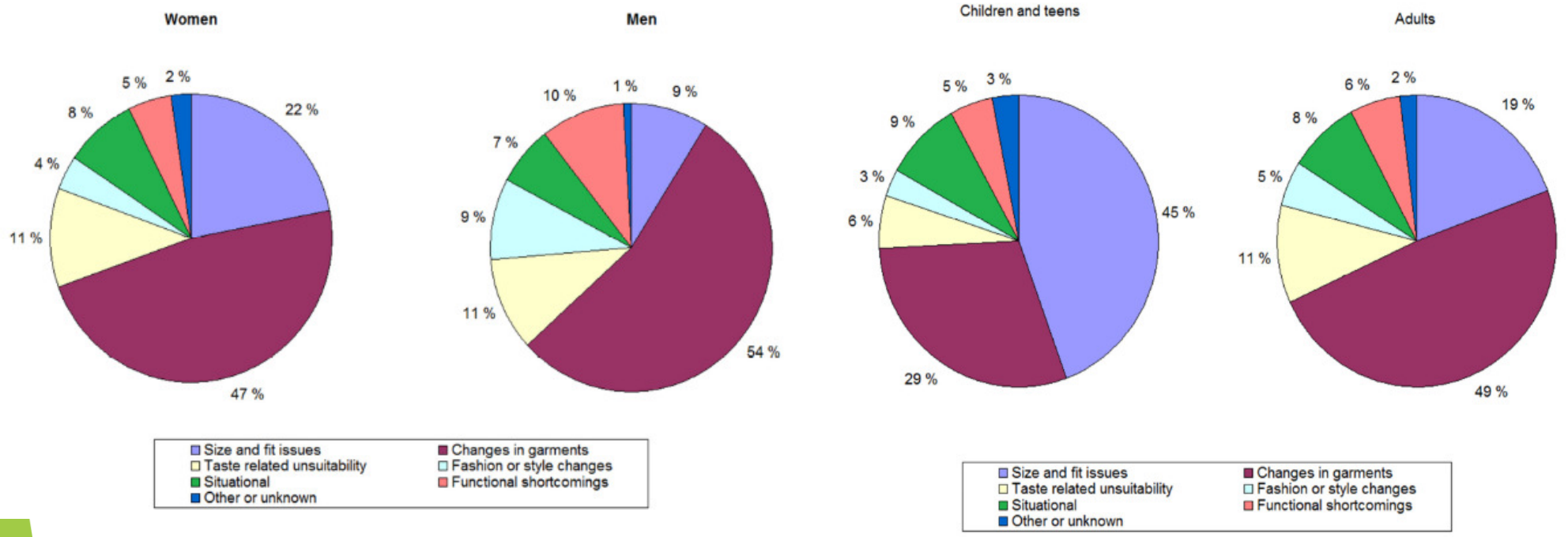
7.2.5 Perceived Quality/ Influence of Consumer Perception

- The perception of degradation also depends on who is looking (man, woman, adult, child...) [3]



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7.2.6 Design for long-lasting clothes

Several design factors may increase lifespan [6]:

- Tailored and semi-tailored pieces -> frame the form well aesthetically
- Oversized knits and kimono shapes -> versatile and “comfortable”
- “Classic” styles (black dress, tailored shirts, pencil skirt, chino-style trousers…)
- Core colors (black, white, navy, grey, red)
- Clothes that facilitate size adjustment to allow for reasonable variations in shape
- Designing garments for multi-functionality (reversible coats for example)

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