Retro engineering approach for consumer-based quality calculation

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gemtex ROUBAIX LABORATOIRE DE RECHERCHE TEXTILE

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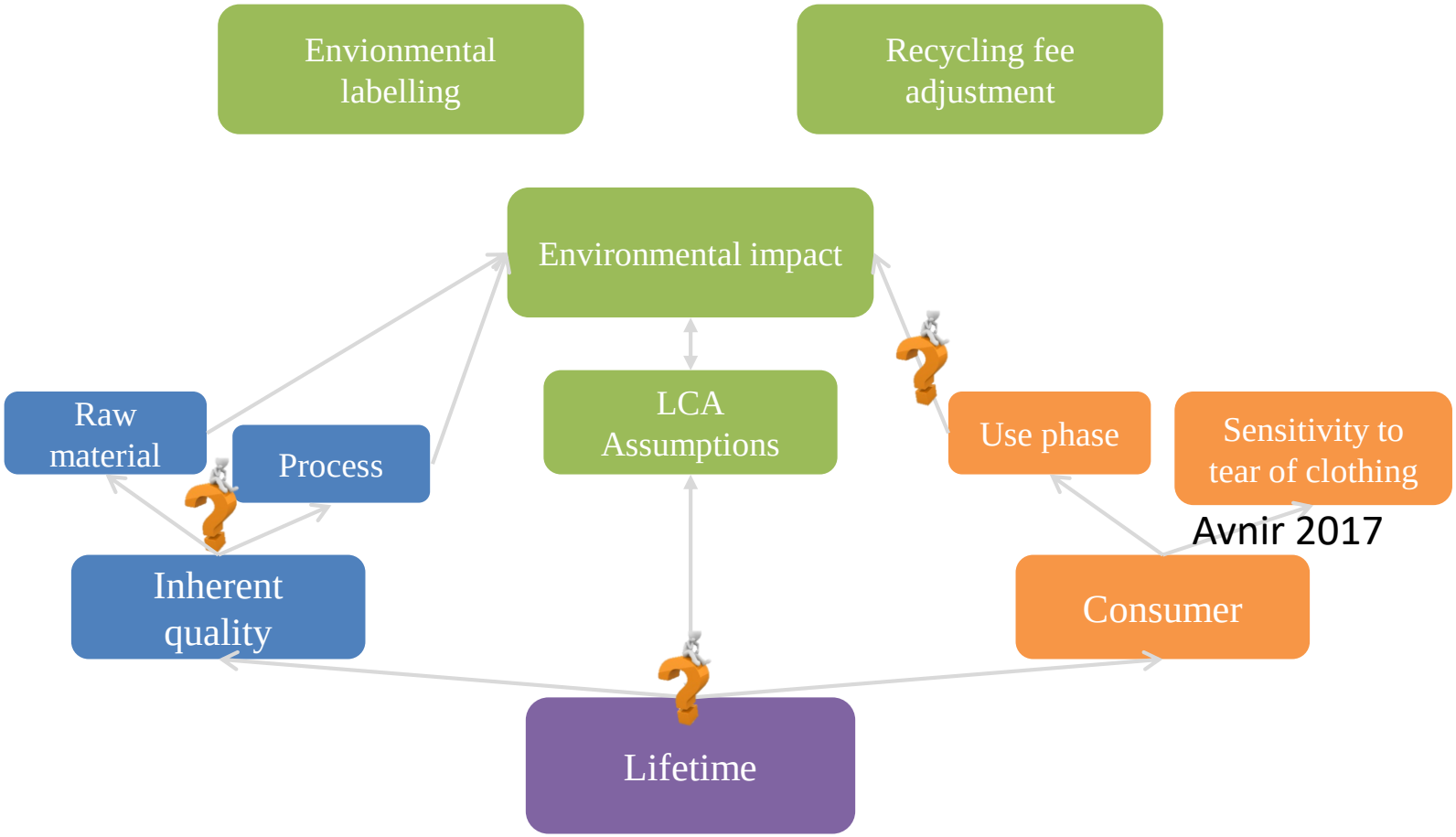
Région Hauts-de-France

Overview

- Context
- Objectives
- Application on T-shirts
- Characterization & testing
  - Yarn Characterization
  - Fabric Characterization
  - Performances tests & Results
- Consumer-based quality calculation
- Quality main contributors
- Limits and perspectives
- Conclusion

Context


Envionmental labelling
Recycling fee adjustment
Environmental impact
Raw material
Process
LCA Assumptions
Use phase
Sensitivity to tear of clothing
Avnir 2017
Inherent quality
Consumer
Lifetime

Objectives

Current proposal (ADEME):

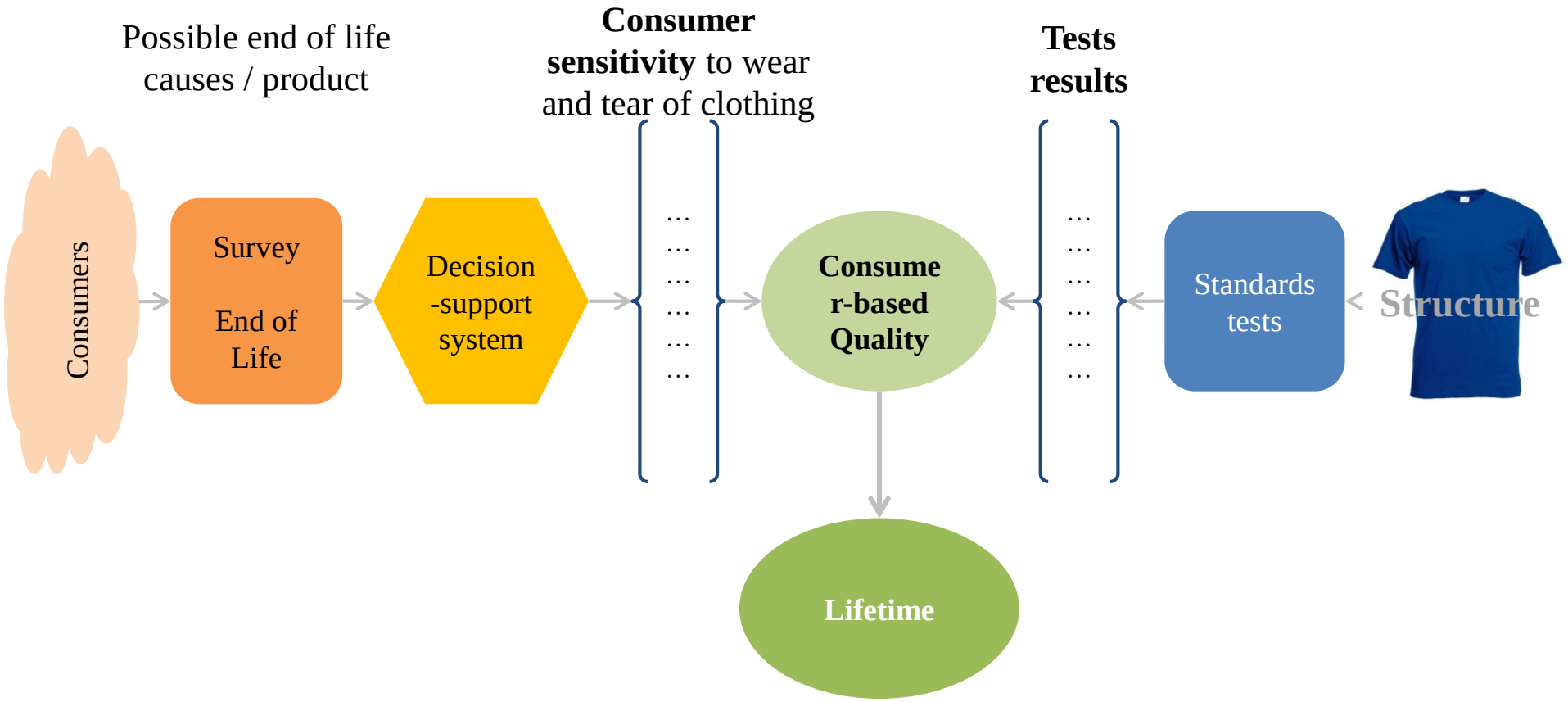
- Useful life (not measurable)
- Normative lifetime (measurable) = average lifetime measured in specifics tests conditions

Our proposal:

- Evaluation of lifetime (as close as possible to useful life)
  - Calculation of the consumer-based Quality (CQ)

$$CQ = f(clothe, consumer)$$

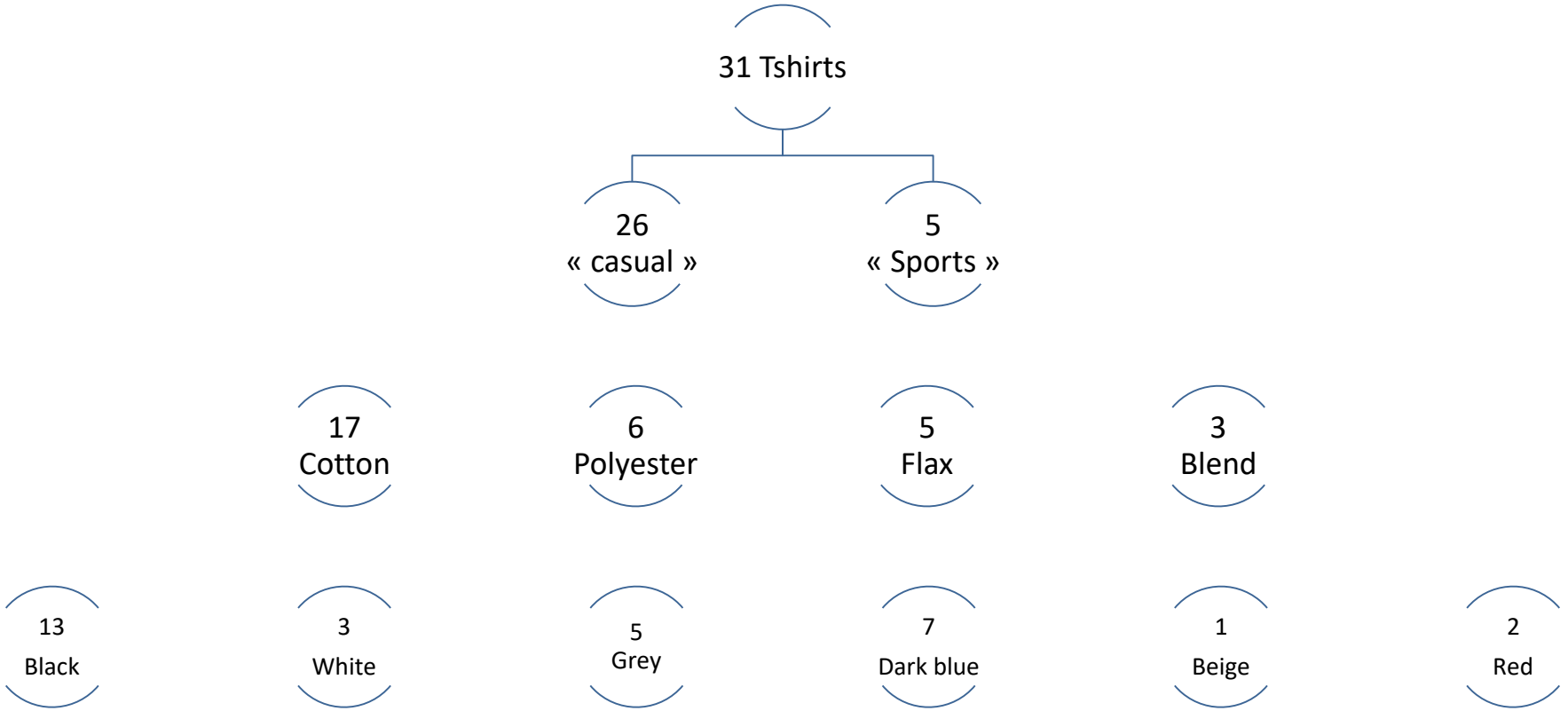
Methodology



Application on Tshirts

31 T-shirts tested

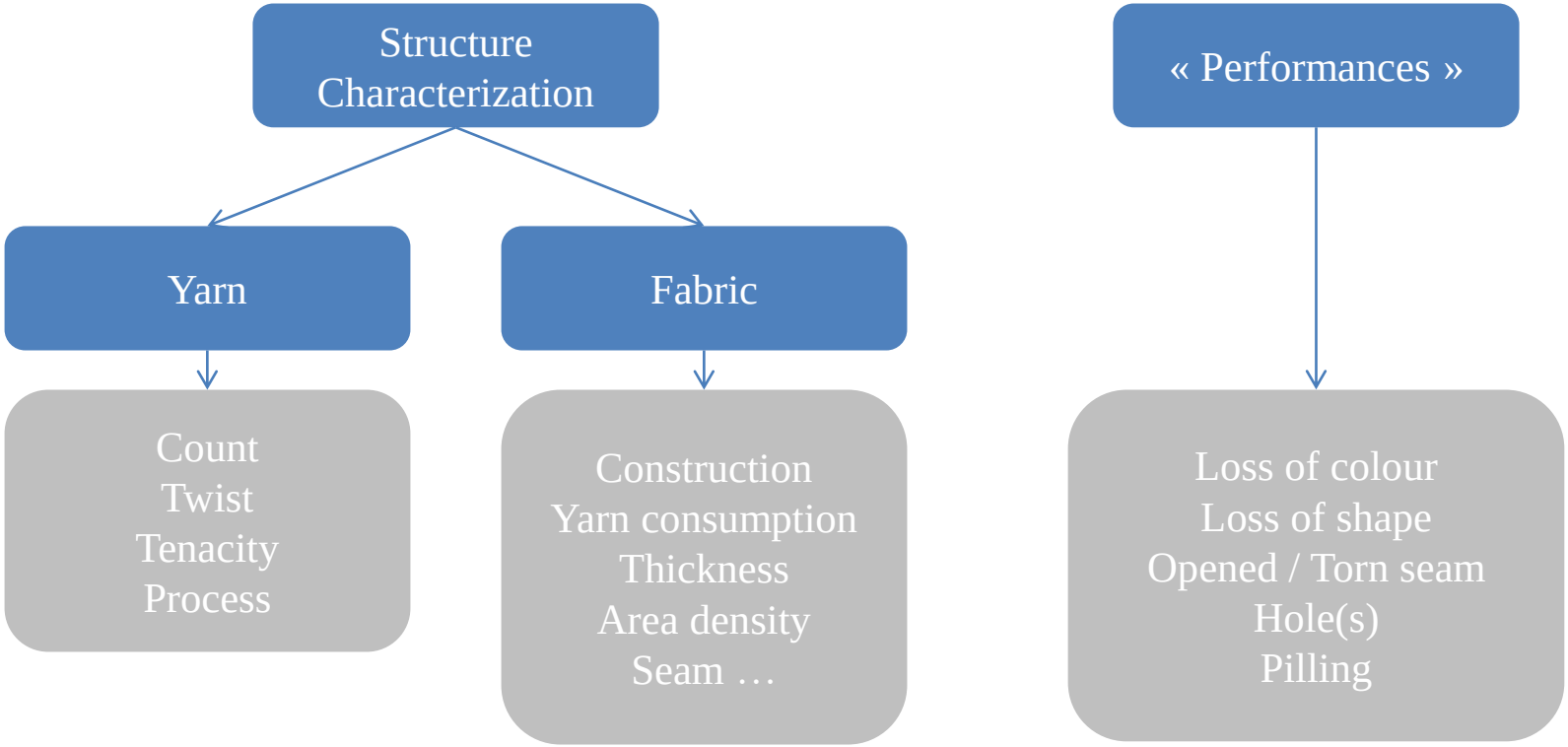
Source : national & international textile retailers



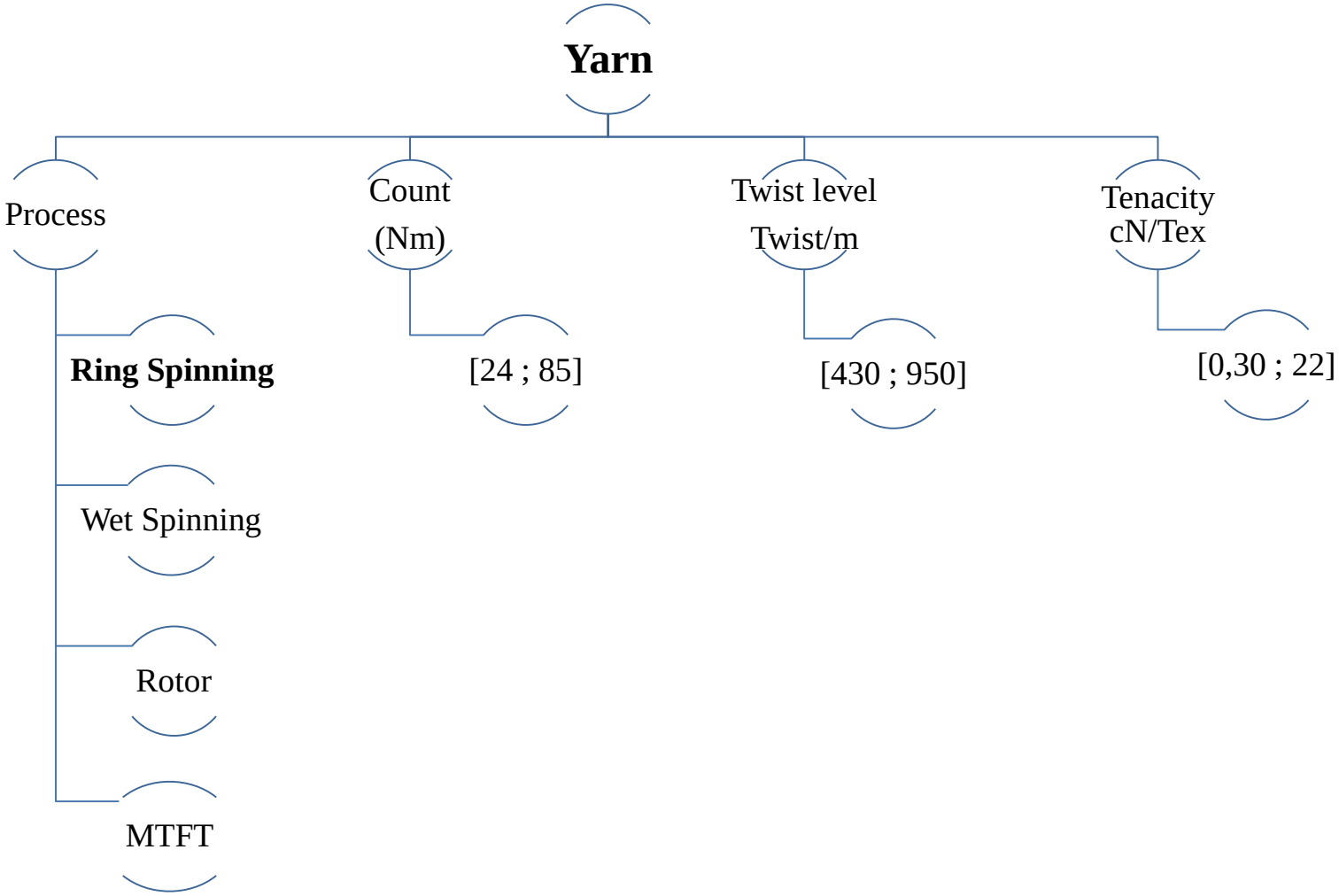
Characterization & testing

31 T-shirts tested

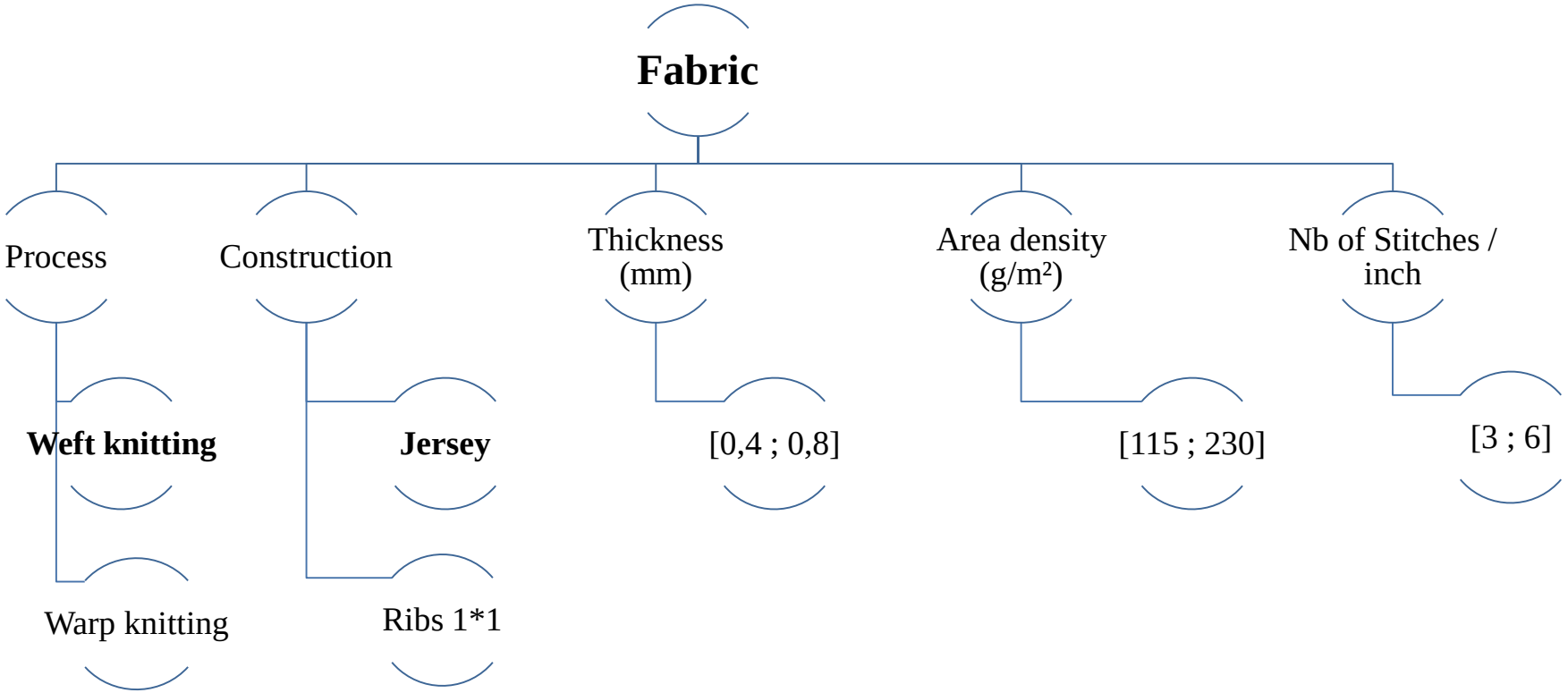
Source : national & international retailers textile



Yarn characterization



Fabric characterization



Performances tests results

All tests have been led at Gemtex Laboratory according to ISO standards

			Min	Max
Colour	Colour Fastness	Light	-	
		Washing	2	5
		Water	3	5
		Perspiration	-	
		Ironing (4h)	4,5	5
		Rubbing dry	3,5	5
		Rubbing wet	2,5	5
Shape	Dimensional stability (%) 10 wash	Column	-15	3
		Row	-6	8
	Spirality (%) 10 wash		0,5	15
	Appearance		-	
	Elasticity		-	

Performances tests results

All tests have been led at Gemtex Laboratory according to ISO standards

			Min	Max
Seam	Seam tensile properties (N)	Column	70	250
		Row	50	270
Hole(s)	Bursting		In progress	
	Fraying resistance		In progress	
	Abrasion resistance (martindale)		In progress	
Pilling	PillingBox (14000 cycles)	Mass loss (%)	0	3
		Gradation (/5)	3	5
	Martindale (8000 cycles)	Mass loss (%)	-1,5	16
		Gradation (/5)	1,5	5

Consumer-based quality calculation

Consumer sensitivity to wear and tear of clothing

- α Colour
- α Shape
- α Seam
- α Hole(s)
- α Pilling

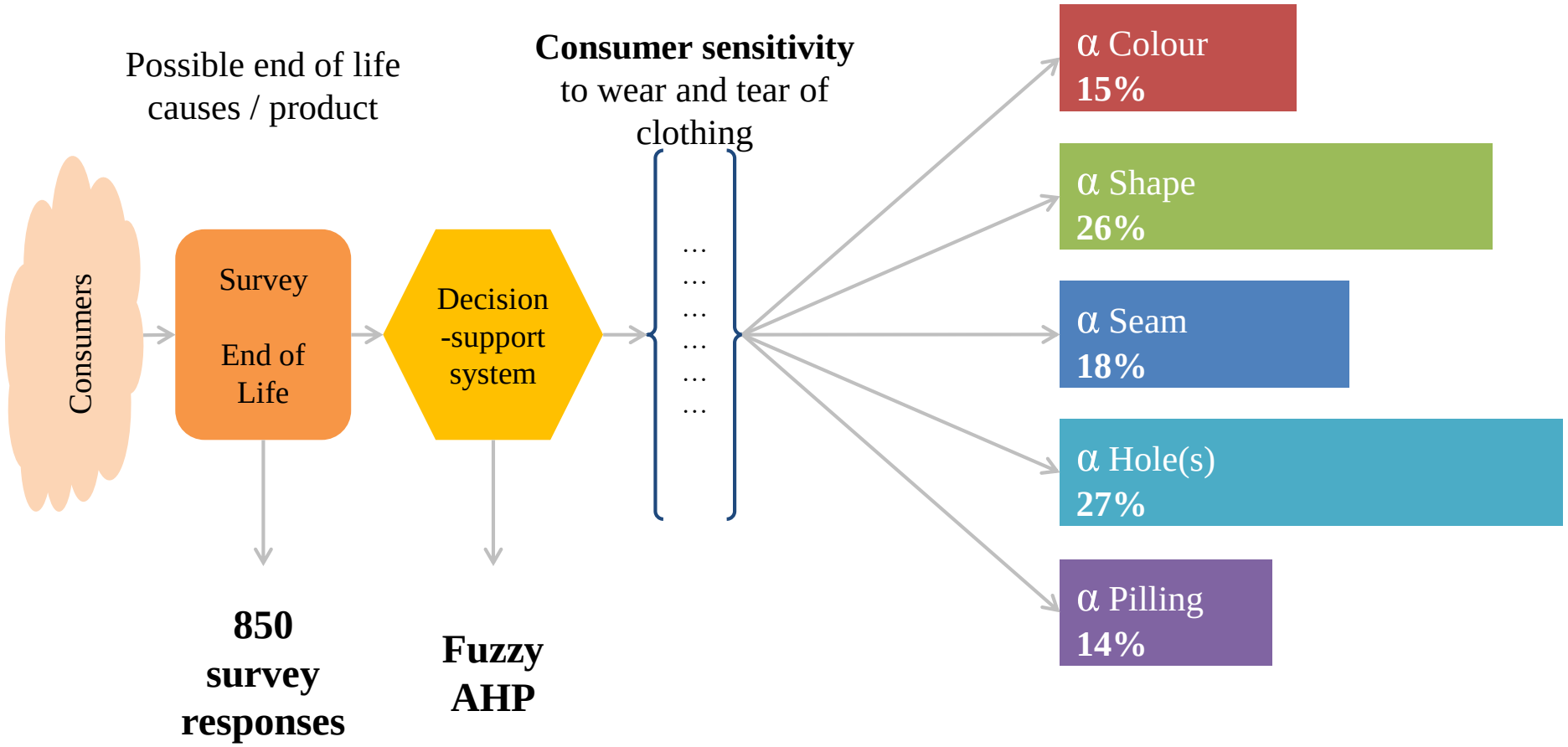
$$\sum_{i=0}^{n} \alpha_i * Test_i$$

Tests results

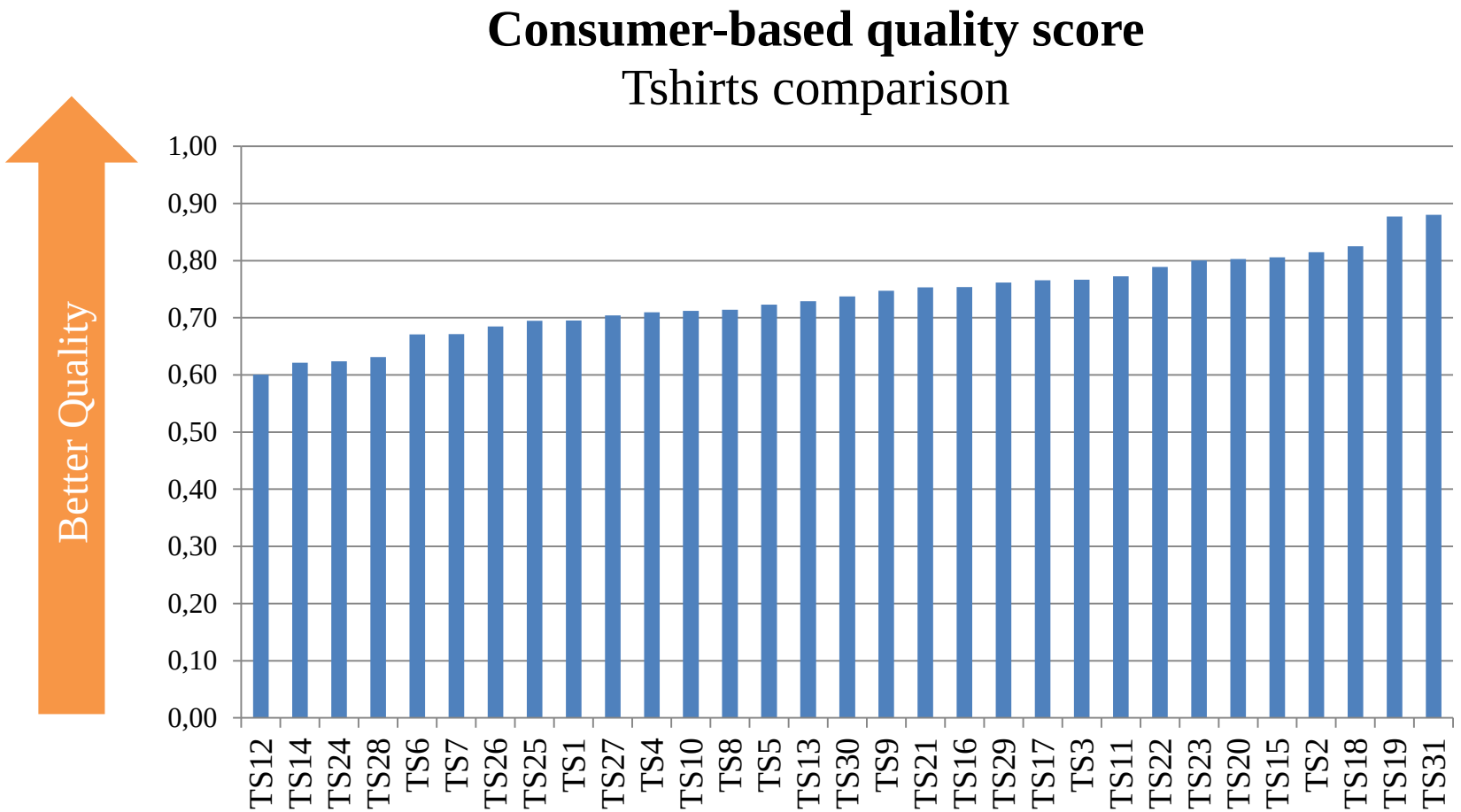
- Average colour results
- Average shape results
- Average seam results
- Average hole(s) results
- Average pilling results

Consumer -based Quality

Consumer sensitivity

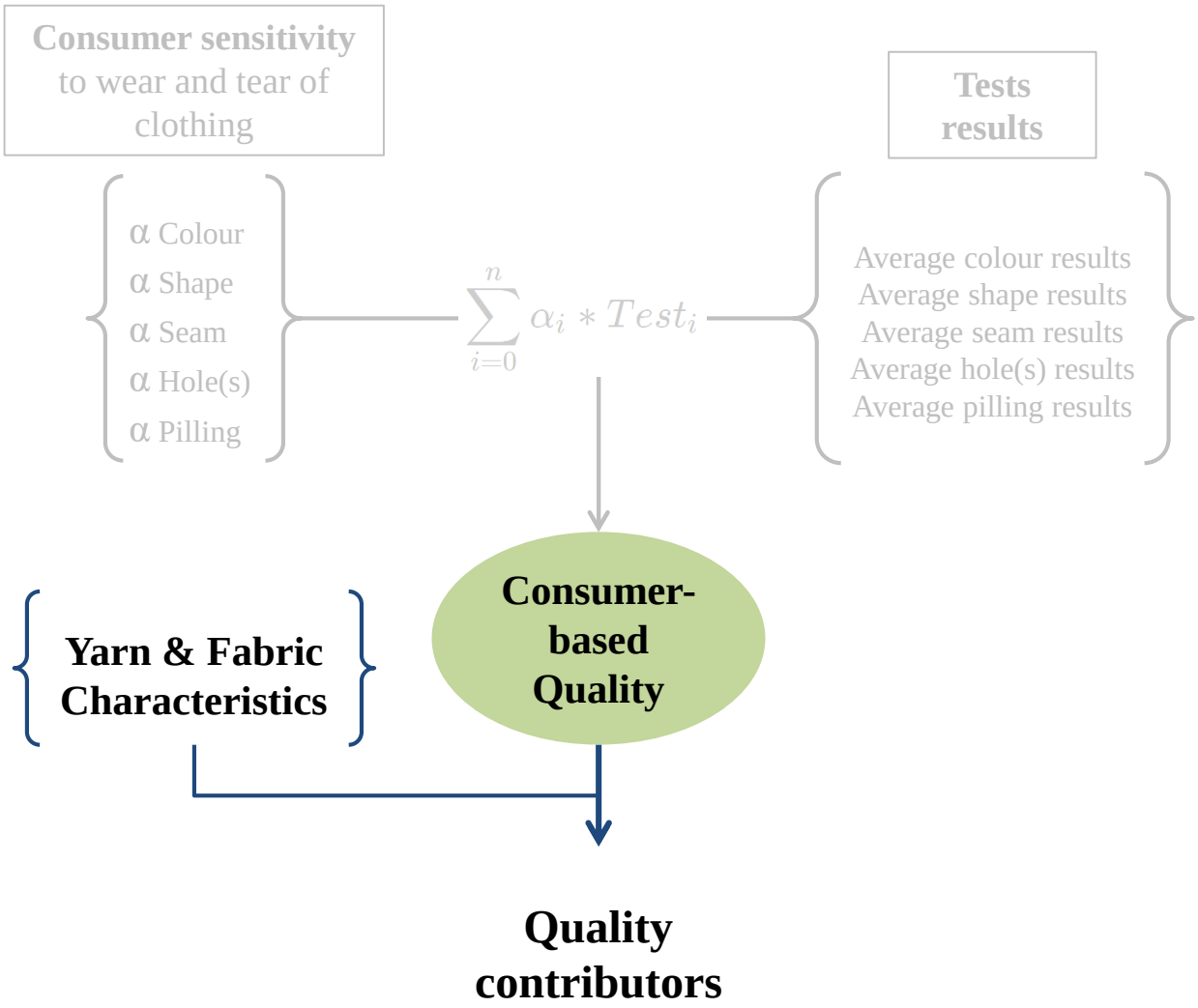


Consumer-based quality score



Hole(s) (= 27% consumer sensitivity) are not taken into account yet

Consumer-based quality calculation



Quality contributors

Use of Principal component Analysis (PCA) - Analysis for **24 Tshirts**

Higher Quality Score

=

Thiner yarn

High nb of stitches/inch

Lower thickness & area density

Results are exclusively valid for studied Tshirts

Hole(s) are not taken into account yet

Quality contributors

Use of Principal component Analysis (PCA) - Analysis for **Coton Tshirts (17)**

Higher Quality Score

=

High yarn tenacity

High nb of stitches

Results are exclusively valid for studied Tshirts

Hole(s) are not taken into account yet

Limits & perspectives

Limits

- ~ 30 T-shirts tested ➔ **representativeness** (material, process)
- Is there a need of a standard Tshirt with a standardized lifetime ?

Perspectives

- Short & mid term
  - Evaluate lifetime through repeated washing cycles (in progress)
  - Model a consumer-based quality / lifetime relation to predict lifetime
  - Incorporate into LCA assumptions
- Long term
  - Improve the methodology
    - Wider consumer focus (fashion, emotionnal attachment, physiological tests)

Conclusion

- Methodology to evaluate the lifetime
  - Based on the consumer-based quality
    - Depend on the **manufacturing process** and on the **consumer**

- Better evaluation of the lifetime to reduce the LCA assumptions

- Highlight of **ecodesign strategies** through retro engineering approach
  - **Quality contributors** using the Tshirts characteristics and the calculated quality score and data mining technique (PCA)

Thanks for your attention

Any questions ?