A Delphi-Régnier Study Addressing the Challenges of Textile Recycling in Europe for the Fashion and Apparel Industry

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Joséphine Riemens – josephine.riemens@ensam.eu*-**-***
Andrée-Anne Lemieux – aalemieux@ifmparis.fr **
Samir Lamouri – samir.lamouri@ensam.eu *
Léonore Garnier – leonore.garnier@fhcm.paris ***

* LAMIH-UMR CNRS 8201, Arts et Métiers Sciences et Technologies, Institute of Technology, 75013 Paris, France
** Institut Français de la Mode, Sustainability IFM-Kering Chair, 75013 Paris, France
*** Fédération de la Haute Couture et de la Mode (FHCM), 75008 Paris, France

FÉDÉRATION DE LA HAUTE COUTURE ET DE LA MODE

LAMIH UMR CNRS 8201

Arts et Métiers Sciences et Technologies

institut FRANÇAIS de la MODE

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Agenda

I. Research background
II. Research questions, method and steps
III. Research findings & conclusions
IV. Perspectives and limitations

I. Linear production and consumption model

Accelerated fashion consumption and production driven by the « fast fashion » phenomenon decreasing the garments' lifetime (Ellen MacArthur Foundation, 2017)

Increasing amount of discarded garments in Europe (Niinimäkii et al., 2020; Koszewska, 2018)

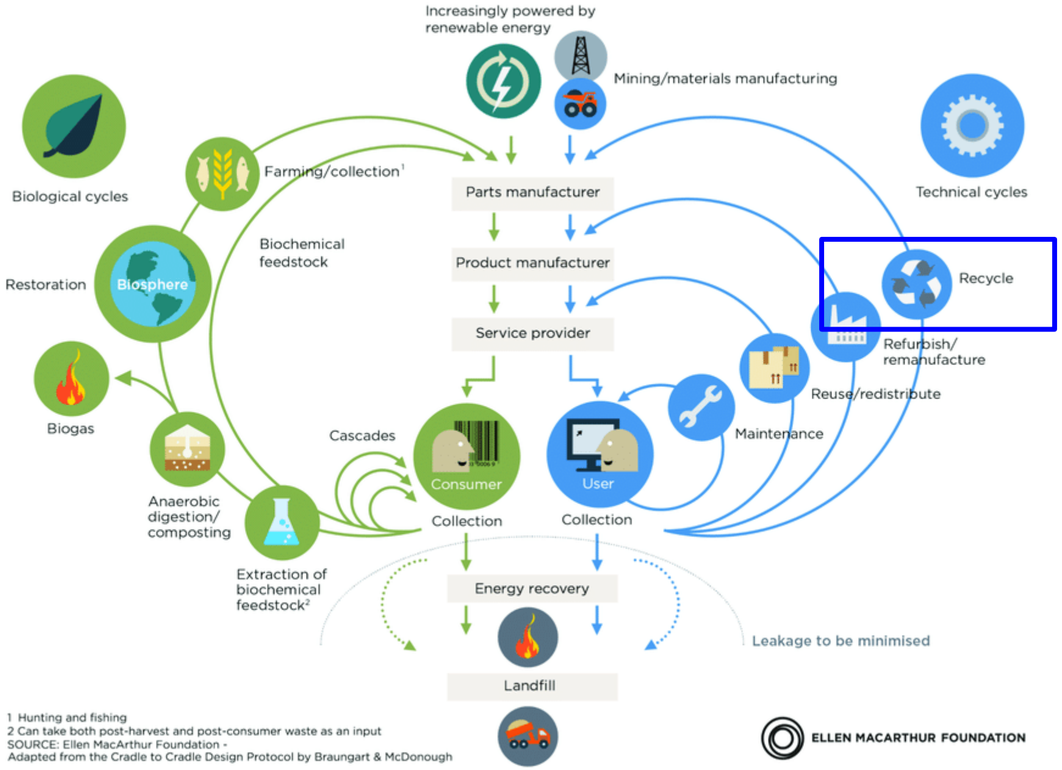
Majority of reusable textiles exported abroad (Ellen MacArthur Foundation, 2017)

Decline of the reusable rate of items (ReFashion, 2020; Nørup et al., 2019)

Only 12% of global material flows for clothing would be recycled mainly through **mechanical recycling** and recycled textile outputs are limited to "**open-loop" applications** *(i.e. insulation material, wiping cloths, or mattress stuffing)*

Chemical recycling solutions are being developed to advance textile recycling for **"closed-loop" applications** but **only 1% would still be recycled for new clothes** (Ellen MacArthur Foundation, 2017)

I. Increasing pressure to enhance textile recycling

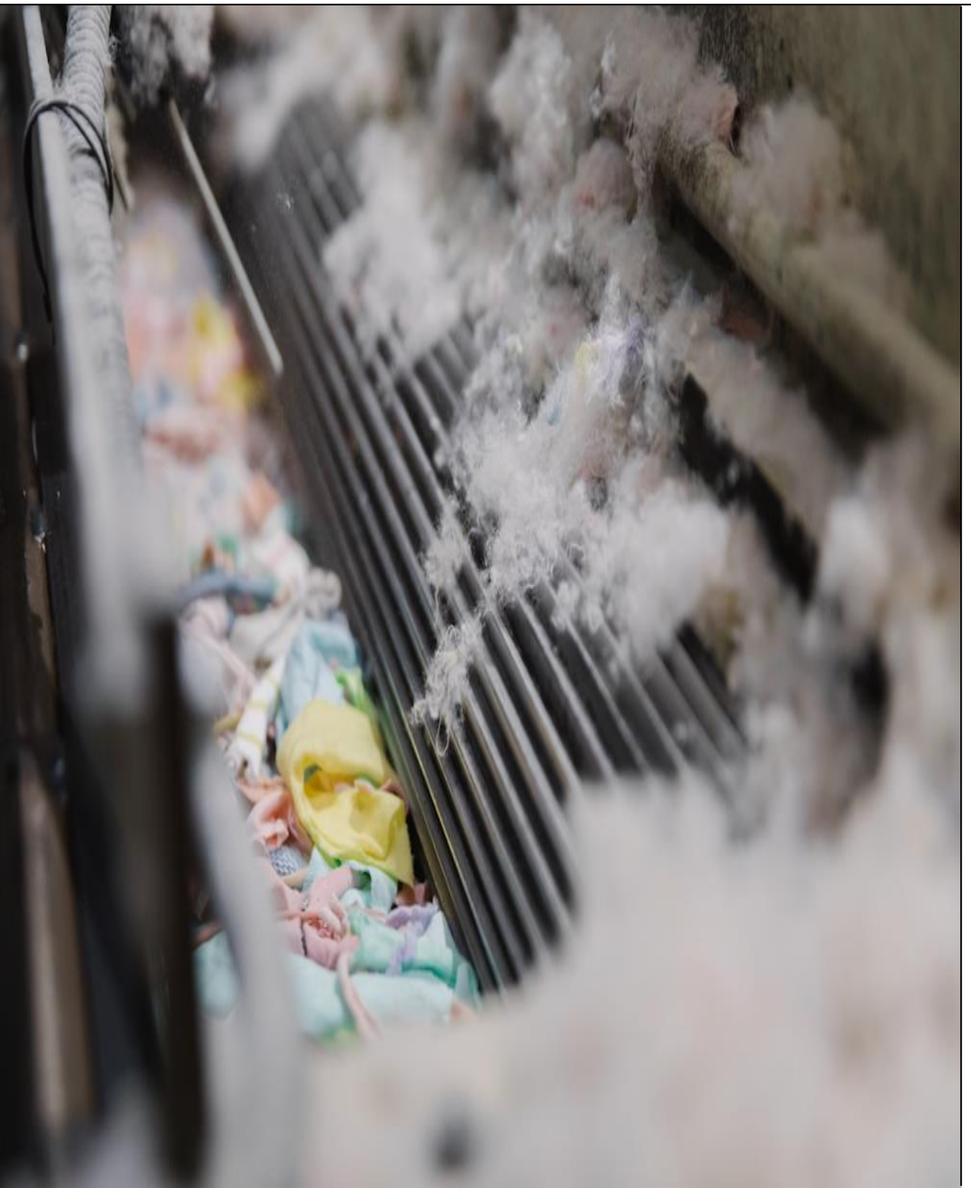


Ellen MacArthur Foundation, 2017

Textile recycling identified as a critical priority in this wider transition towards a **circular economy** to reduce the **ressource-pressure** while ensuring **viable business models** in the long-term facing up to ressource scarcity (Sandvik & Stubbs, 2019; Koszewska, 2018; Allwood, 2014)

Textile recycling targeted in the EU forthcoming policies (*i.e. separate collection mandatory by 2025, incorporation of recycled content, digital passport*) (EU Strategy for Sustainable Textiles, 2021)

I. Limited research area on textile recycling



Limited research area mostly explored from a **technical perspective** (Shirvanimoghaddam et al., 2020) whereas textile recycling relies on a complex value chain and its improvement is pointed out as requiring a system-level change (Ellen MacArthur Foundation, 2017)

Fragmented literature with **very few comprehensive research** and **limited empirical studies** impeding an explicit evidence-based state-of-the art on the current challenges in the sector

Flourishing literature on textile-specific barriers to the implementation of the **circular economy** (Brydges, 2021; Chen et al., 2021; Kazancoglu et al., 2020) **but failing to provide a systematic analysis** of the existing issues related to the textile recycling value chain

II. Research questions & designed method

RQ1: What are the current bottlenecks in the textile recycling value chain ?

RQ2: What are the priority challenges to address in order to enhance textile recycling in the sector ?

Systematic literature review to identify the recurring challenges acknowledged in the existing literature

Purposely designed qualitative study using the **Delphi method** and applying the **Regnier Abacus** technique

It appeared as the most relevant method

To **advance empirical knowledge** on textile recycling while **outlining the priority challenges to address in the sector**
To **evaluate a series of wide-range assumptions** on the topic with a wide panel of experts and generate valid results in a **timely manner**
To **minimize the risk of bias** while **ensuring participation** due to distinct business interests and unaccustomed exchange of views of the different stakeholders involved

II. The Delphi method

What is it ?

Widely used-method pioneered by the Air-Force-sponsored Rand Corporation in the 50s to forecast the potential of military technology (Gordon, 1970)

Structured around an **anonymous, controlled and iterative feedback process** to **minimize the typical group interaction shortcomings** (Hsu & Sandford, 2007)

Suitable to investigate complex and multidisciplinary problems (Agrawal et al. 2019), to explore or expose underlying assumptions or information leading to differing judgements, and to seek out information that may generate a consensus (Delbecq et al., 1975)

What are the key steps ?

Questionnaire submitted anonymously to an expert panel

Responses counted and processed

Questionnaire updated based on expert responses and submitted to the same participants along with a feedback report

Iterative process until common tends are achieved through consensus and dissensus

II. The Régnier Abacus technique

What is it ?

Developed by P. François Régnier in the 1970s in the medical field to offset usual drawbacks of working groups (Régnier, 1983)

Based on the **“traffic signals” logic** with a **color panel** to collect and share opinions on a topic in order to promote constructive debates and **facilitate decision-making**

- Green: the expert strongly agrees
- Light green: the expert agrees
- Orange: the opinion of the expert is mixed
- Light red: the expert disagrees
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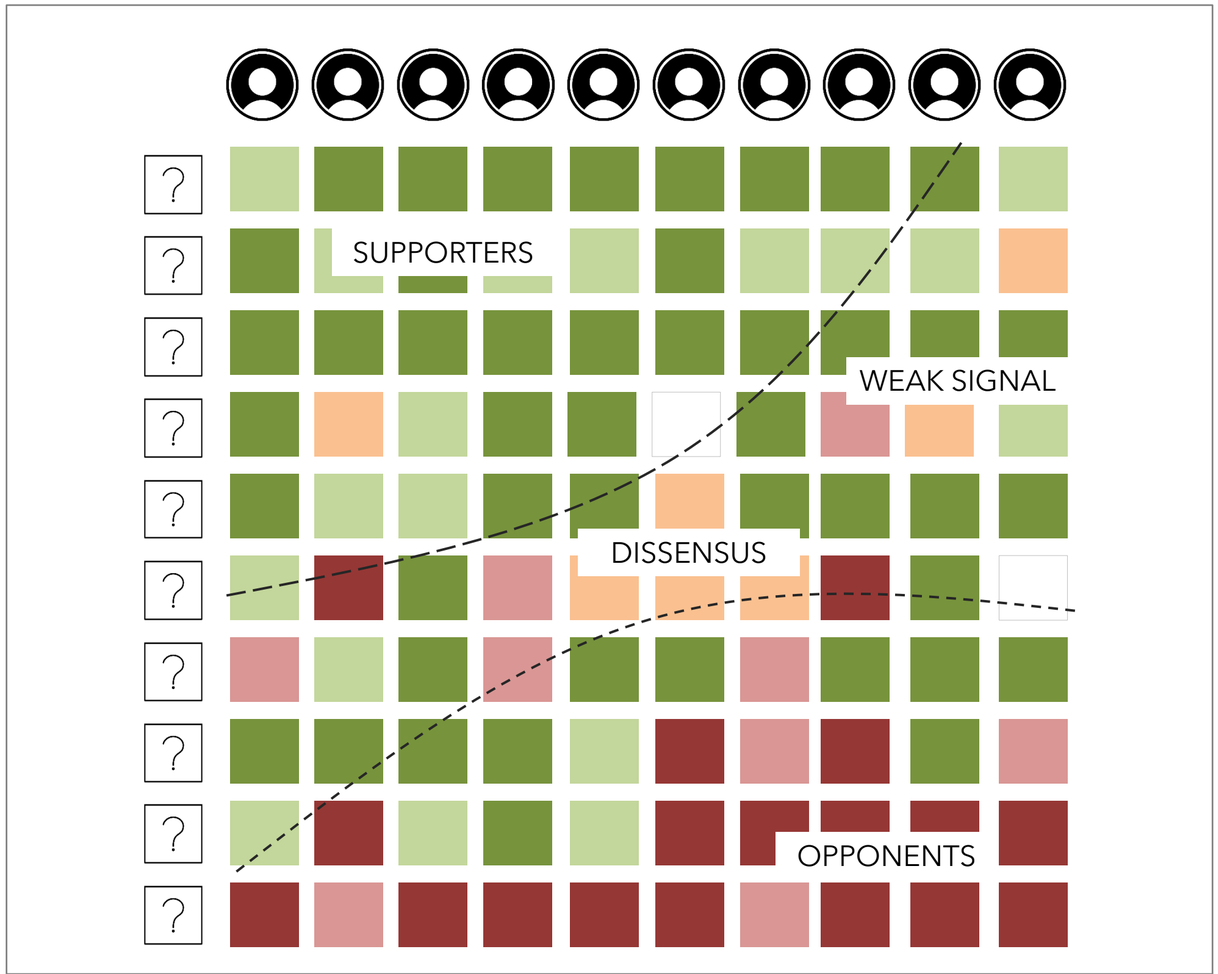
How does it work ?



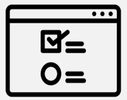
II. Research steps

Literature review on textile recycling challenges and **formulation of 23 corresponding statements**

Selection of a panel of **28 experts** engaging with the management of textile recycling for the fashion and apparel industry

1st round Votes and comments on the 23 statements

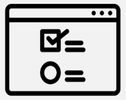
100% of experts participation



Revision of the statements based on the experts' votes and comments

2nd round Votes and comments on **21 revised statements**

86% of experts participation - no new responses decision to close the questionnaire



Results analysis through ColorInsight based on the experts' votes and comments from both rounds

II. Literature review & formulation of statements

PRODUCT & MATERIAL

The profusion of material mix and fiber blends

The use of chemical substances during the manufacturing process

The yarn and fabric construction complexity

The presence of external disruptors

The increasing introduction of new materials

The loss of recycled output quality during the recycling process

The detrimental effects of use conditions on the recycled output quality

The limited recyclability of current recycled output

TECHNOLOGIES & INFRASTRUCTURES

Insufficient infrastructures for textile collecting waste

Poor accuracy and speed efficiency in current manual product sorting

The lack of recycling technologies towards high value applications

The insufficient maturity of new recycling technologies

The lack of manufacturing technologies for an ease disassembly

The absence of disassembling technologies to efficiently separate the product components

The absence of digital solutions to connect supply and demand

The lack of demonstrable environmental performance of end-of-life treatment

INFORMATION

The lack of information on material and chemical content through tracking technologies

MARKETS

The high research and investment costs to integrate innovative technologies

The lack of profitability for recycled output

COORDINATION

The deficient awareness and education on textile recycling

The missing alignment between the stakeholders

The missing clear regulatory framework to support textile recycling

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II. Selection of the experts' panel

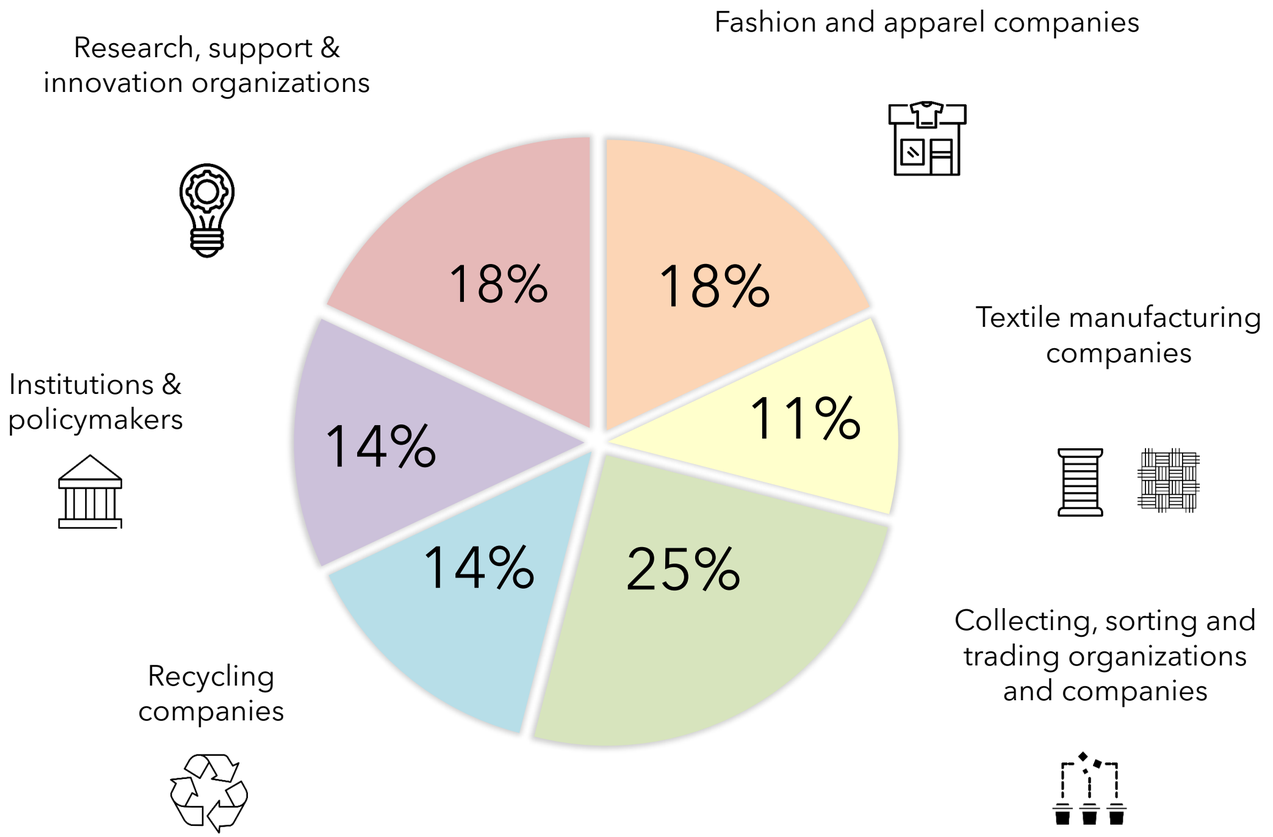
Panel of **28 experts representative of the different stakeholder groups** in Europe to confront their views on this system-level topic

How did we proceed ?

Definition of the relevant stakeholder groups reflecting the different actors involved in the recycling value chain

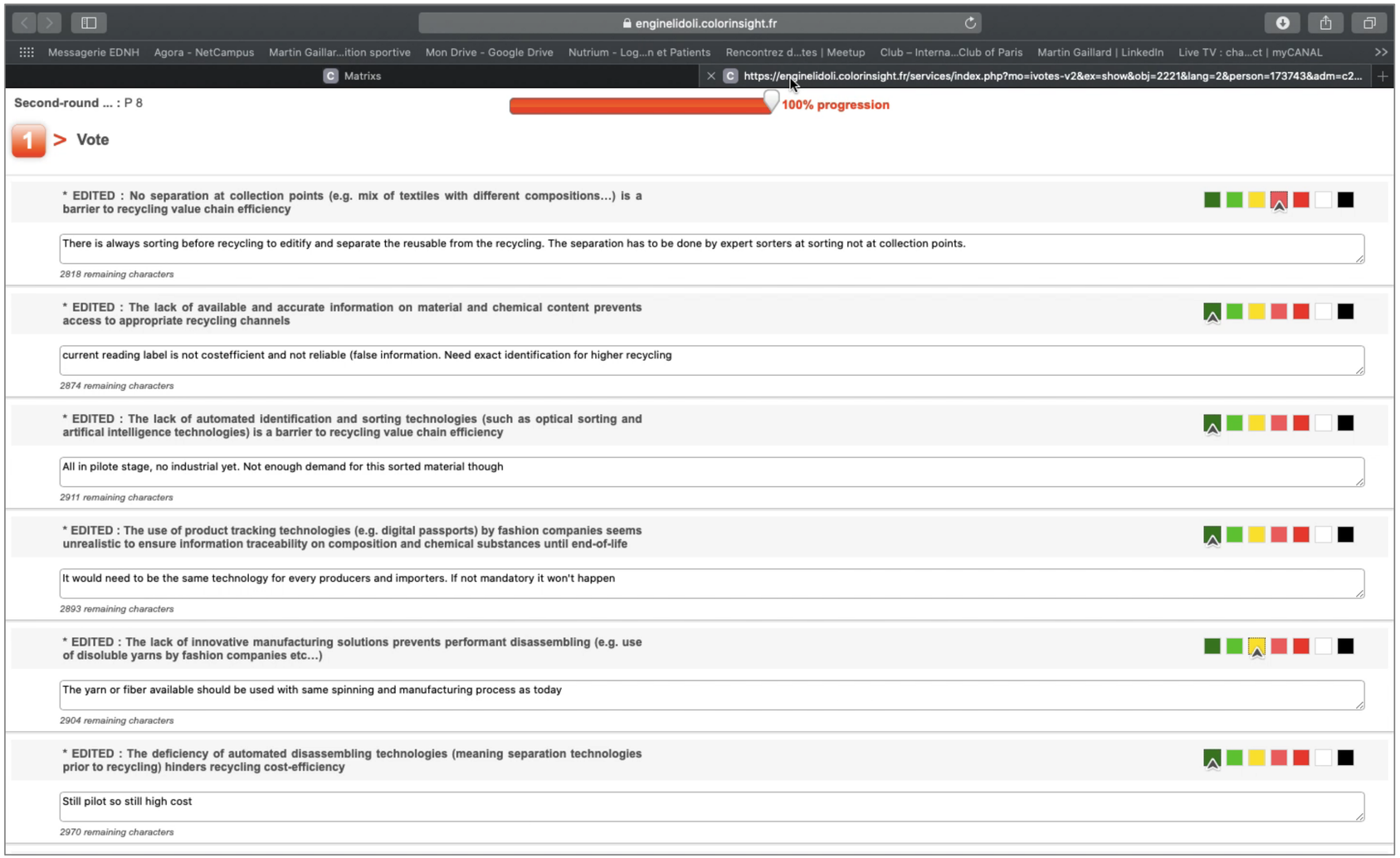
Database of experts built based on professional recommandations and a review process

Contact of each expert with a summary document to gauge interest and availability



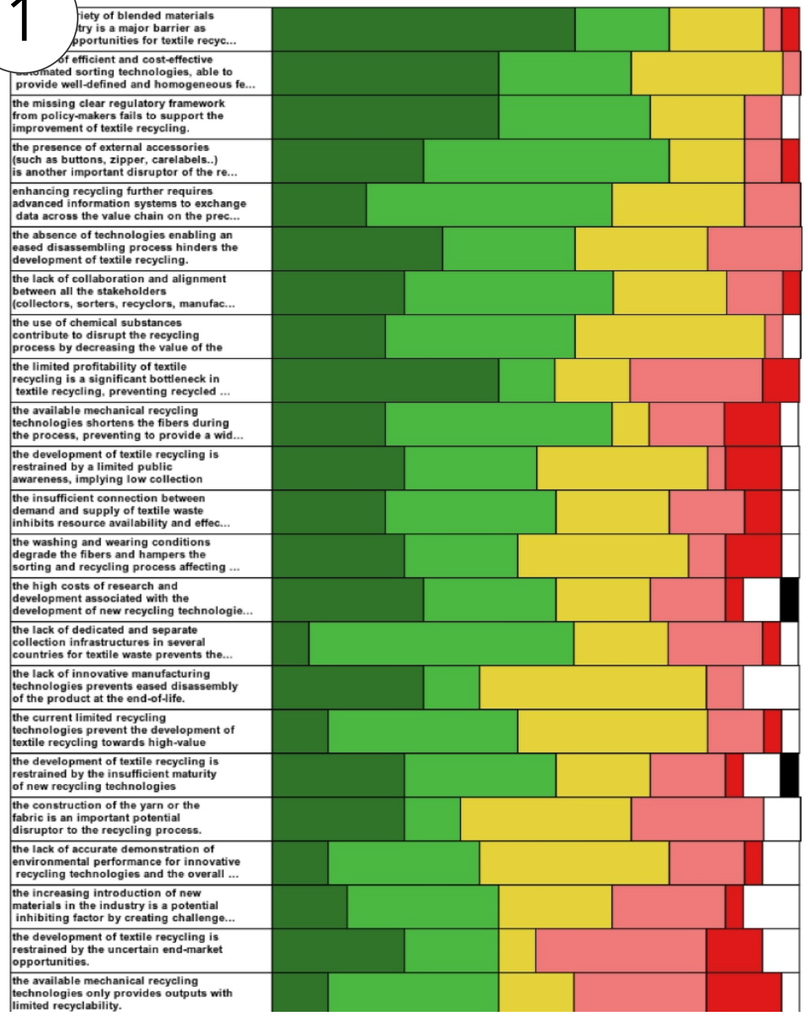
II. Providing feedback: experts' votes and comments

ColorInsight open-source solution



III. Research findings: 1st & 2nd rounds

1



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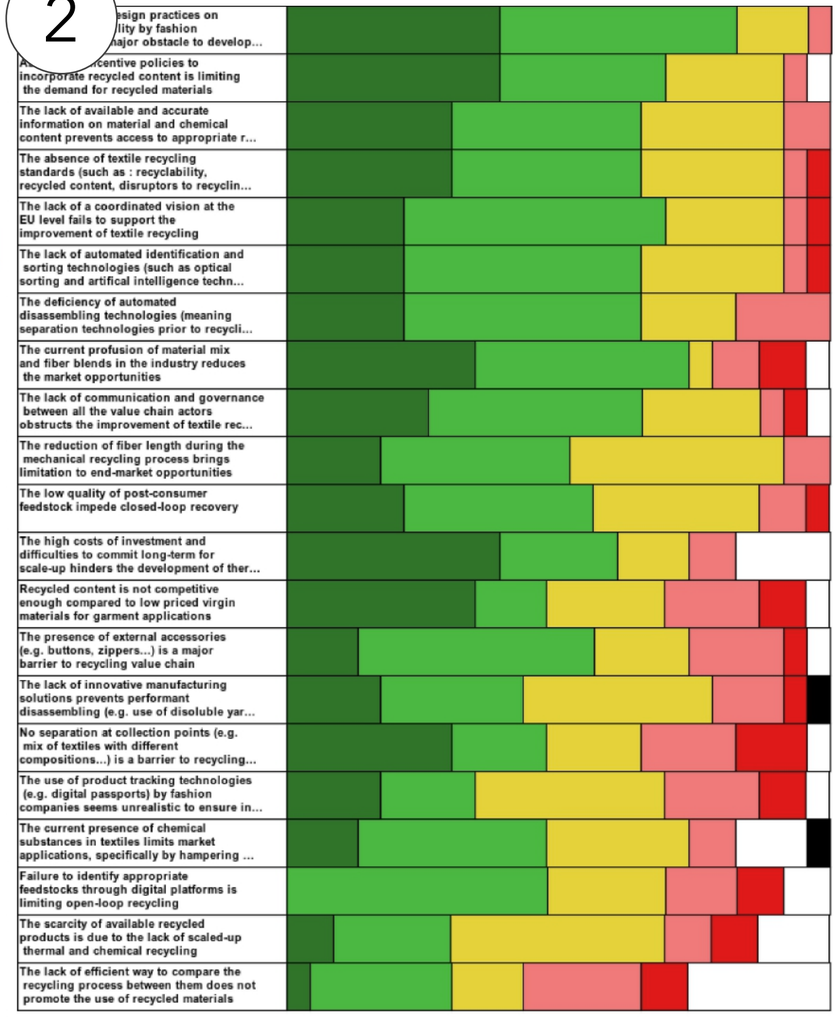

Items matrix (based on Colorinsight classic mode) displaying items from the most consensual item (top) to the least one (bottom)

- Green: the expert strongly agrees
- Light green: the expert agrees
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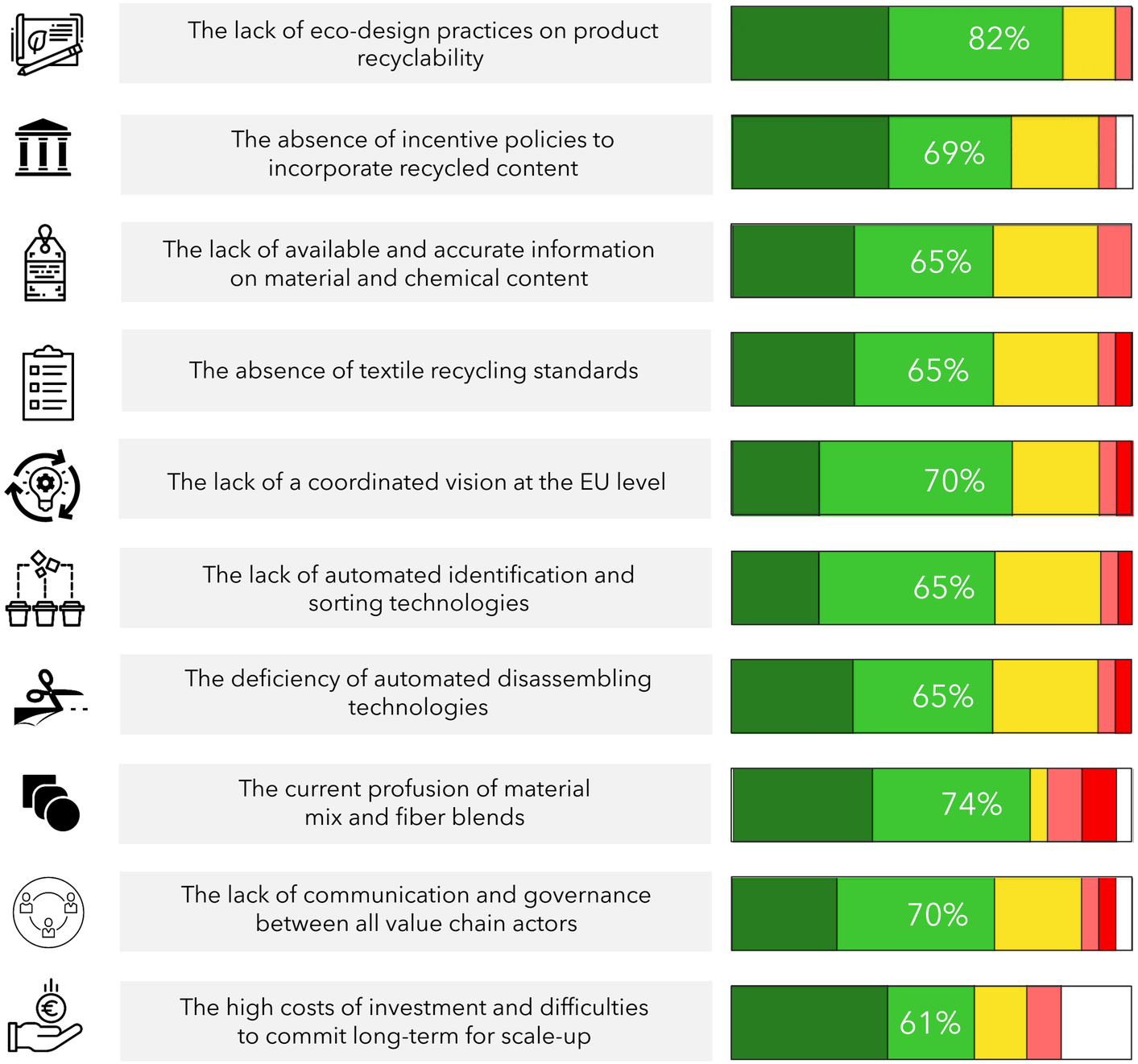
III. Significant alignement on several statements



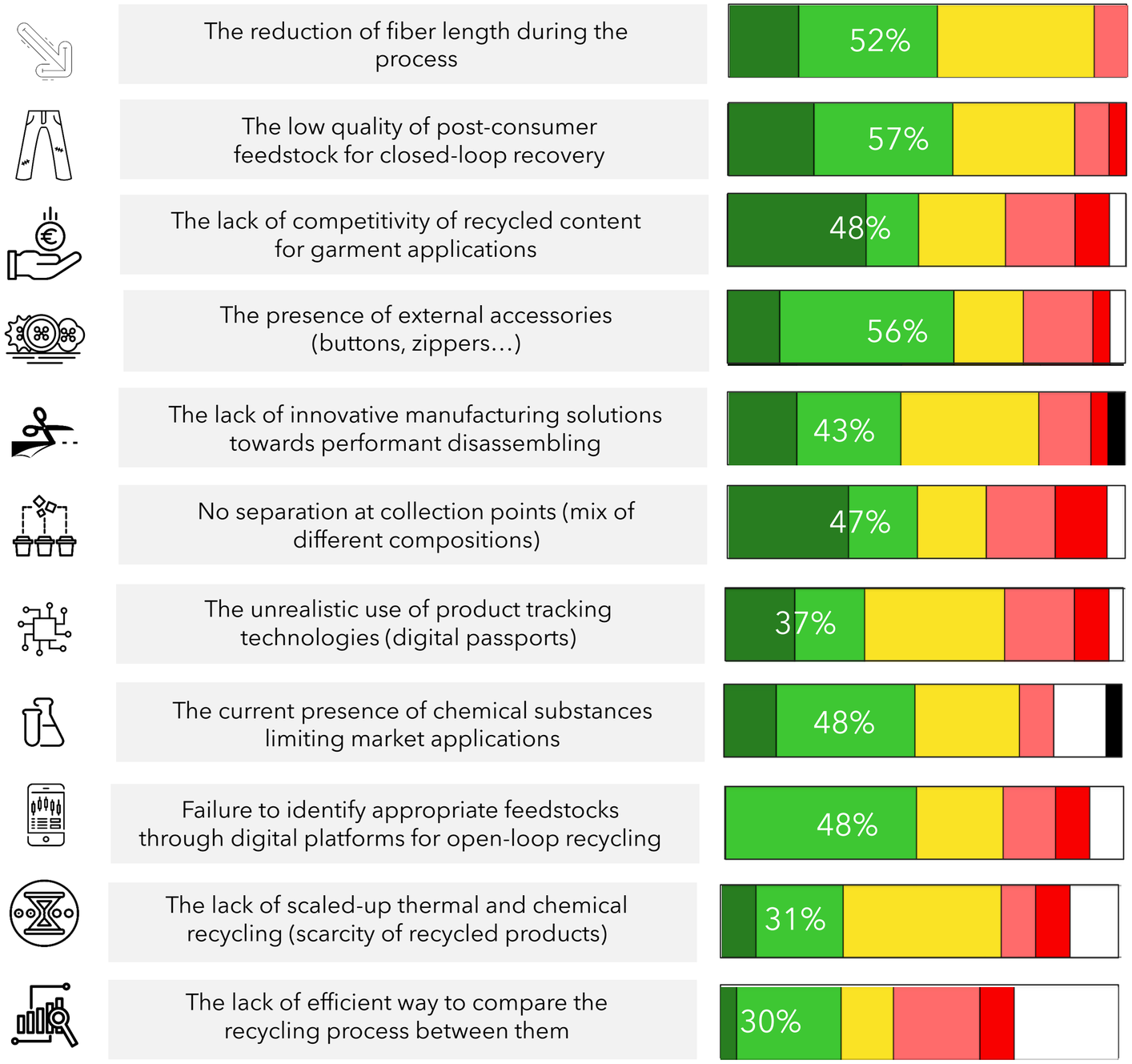
Results of the second round*

Consensus considered reached once 60% of answers in favor (green) or against (red) was observed

III. Persistent disagreements

Results of the second round*

Consensus considered reached once 60% of answers in favor (green) or against (red) was observed



III. Research takeways per key topic

PRODUCT & MATERIAL INPUT

The lack of **eco-design practices** in the sector is a major challenge of textile recycling improvement

The profusion of **materials blends** emerges as the most impactful design features

The impact of the use of **chemical substances** on the recycling process remains unclear

INFORMATION

There is a major challenge regarding **information availability** on the **product components** *(labels cut off, inaccurate, illegible..)*

Information on product components is essential to sort to appropriate recycling routes and to enhance recycling applications

TECHNOLOGIES

The current **manual sorting process** is an important bottleneck as not set up for material composition sorting

The use of **optical sorting technologies** appears more promising than product **tracking technologies**

The deficiency of **automated disassembling technologies** prior to recycling is hindering textile recycling cost-efficiency

Recycling technologies are available for most material streams, but it is rather a challenge of investment and support to reach industrial scale

MARKET

The current state of **demand and economic viability** of textile recycling is inconclusive

There is a need for policies and collective actions to increase demand for recycled content

COORDINATION

The lack of **standards** on textile recycling is failing to promote eco-design strategies

The lack of **coordinated vision** at the EU level and the **lack of collaboration** and **governance** between the stakeholders are also preventing an improvement of textile recycling

III. Key conclusions to enhance textile recycling

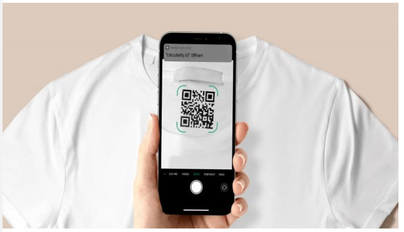
1. The need to enhance eco-design practices with respect to reusability and recyclability

2. The strong need of public policy action and better coordination between stakeholders

3. The necessity to address the deficiencies related to the current manual sorting system

IV. Perspectives & limitations

Numerous potential research avenues



Exploration of **traceability** with regards to **circularity** and especially to investigate the **supporting role of traceability solutions** and other **identification technologies** at the sorting stage

Investigation on **multi-stakeholder initiatives** to provide valuable insights on governance and collaborative challenges associated with such innovative and large-scale management of textile material streams

Exploration of **innovative business models** to analyze the implementation of circular strategies with regards to the tensions between **durability and recyclability**

Some inherent limits of the method

The choice of a **panel-based methodology** necessarily entailing shortcomings – especially the likely unevenly distribution of expertise among the experts

The lack of **consumer's perspective**

The bias associated with the **designed questionnaire**

The use of a **qualitative method** based on expert feedback rather than **statistical analysis**

Thank you for your attention !

Any question ?