

WE MAKE TOMORROW BEAUTIFUL

OVAM

CIRCULAR PROFESSIONAL TEXTILES

a practical guide

CIRCULAR PROFESSIONAL TEXTILES
practical guide

Is this guide too concise?
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SITUATION

What do ports, railways, airline companies, the police, the Belgian army, supermarkets, the building industry, the chemical industry, the care sector and many other profit and non-profit organisations have in common? They all use professional textiles, such as uniforms, work wear, protective clothing, linen, etc. And they all tend to throw it away.

All these discarded textiles have an enormous impact on the environment. After all, most organisations are unaware of how to choose more sustainable textiles, let alone how to reuse such textiles or how best to use them as raw materials.

Also, when compared with other materials, textiles are less easily recycled. And professional textiles are even more of a challenge. They are created using diverse materials and numerous chemical components. Discarded professional textiles may also be contaminated with, for example, oil, paint, chemical or microbiological components.

That being said, work and protective clothing still seems to be developed or produced in Europe, in contrast to fashion wear for the consumer market. It is an important economic sector, and plays a prominent role for various Flemish product companies. This means there is evidence of greater involvement, from both Flemish producers and end users.

These are the reasons why, in 2017, OVAM instructed Centextbel, the Belgian knowledge centre for textiles, to conduct some research into the main 'hidden' professional textile chains. Using the results from this research, this guide aims to inspire those producing and using professional textiles and encourage them to include their textiles in the circular economy.

Source: Final report – Research assignment into professional textiles, carried out by Centexbel on behalf of OVAM, 2017.

RECOMMENDATIONS

The eco-design guidelines in this guide aim to establish criteria for designing and developing sustainable and circular professional textiles. Besides, they not only target designers and producers, but also all others concerned. The guidelines must therefore be both sufficiently generic to stimulate the creativity of designers, but also suitably specific to allow immediate progress to made. The goal is not to enforce specific restrictions, but to make decision-makers think about the consequences of their decisions related to the development, sales, production, purchasing and maintenance of professional textiles.

There are **eight fundamental design strategies** in this practical 'Circular professional textiles' guide. The collection of information has been aligned with insights gained during the Professional textiles research, carried out on behalf of OVAM.

It is best to consider this collection as rather a qualitative tool, not a quantitative. For each strategy you need to be brave enough to question whether the approach suits your specific product. The guidelines use universal rules of thumb that are unrelated to time and space. This has the benefit of generating results and potential improvements in the short term. In practice we see that qualitative tools are often the most useful for those involved in the design and development phase.

The order of these design strategies is important and is based on:

- the potential impact of the improvement and
- the principle of maximum value retention (aiming for the shortest possible recycling process with high material yields and low energy consumption).



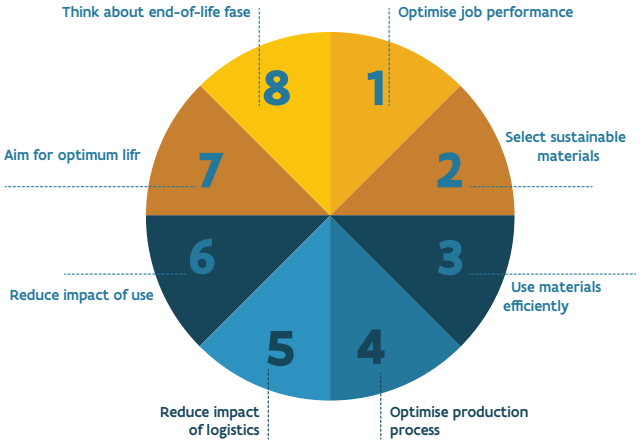






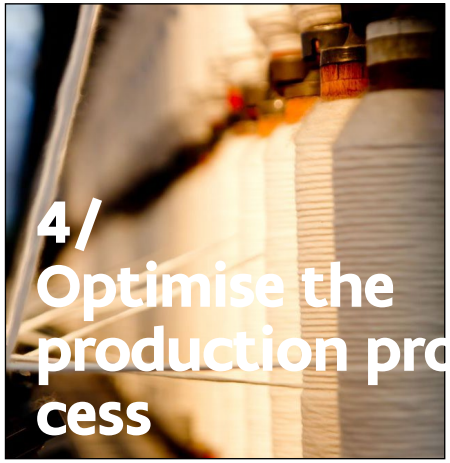
GETTING STARTED?

For professional textiles we distinguish between a series of focus points (strategies), based on the theory of the LiDS wheel*.



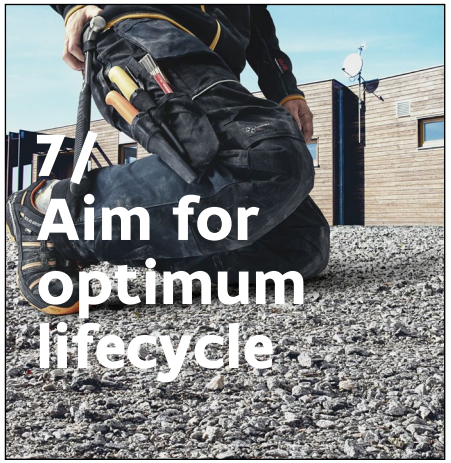
The strategies can be used individually or in combination, in order to develop ecological, sustainable or circular professional textiles. We do emphasise that all players throughout the supply chain should participate and are therefore also best involved in the design of professional textiles. Indeed, such involvement transforms a supply chain into a value chain. By failing to consider the entire chain, initiatives will not reach their full potential. Of course, this is not to say that initiatives started by just one part of the supply chain are worthless. After all, a new approach can inspire others or other companies to get involved in something new, or can highlight new business opportunities.













1/ **Optimise the function**



> WHAT IS THE MAIN FUNCTION OF THE PROFESSIONAL TEXTILES CONCERNED (PROTECTION, HYGIENE, IMAGE, COMFORT, ETC.) AND IS THIS FUNCTION ACHIEVED IN THE MOST EFFECTIVE AND OPTIMAL MANNER?

1/ Optimise the function

WHAT IS THE MAIN FUNCTION OF THE PROFESSIONAL TEXTILES CONCERNED (PROTECTION, HYGIENE, IMAGE, COMFORT, ETC.) AND IS THIS FUNCTION ACHIEVED IN THE MOST EFFECTIVE AND OPTIMAL MANNER?

A piece of clothing is not necessarily end-of-life when an employee leaves the company, as it can still be used by another employee. Therefore, avoid personalising clothing and ensure that this can be adapted in an ecological manner.

Various elements tend to play a role in realising and optimising one or more preferred functions, such as:

- the chosen textile fibres;
- the processes and auxiliary materials used in enhancing these materials;
- the construction or model of the product.



It is usually necessary to use a variety of materials (fibres, coating, finishes, accessories, etc.) to achieve all the required functions of professional textiles. Of course, this makes recycling more difficult.

When different materials are combined in a textile product for functionality reasons, it is important that the various materials have a similar lifecycle and can be maintained in the same way.

For example: if a fluorescent jacket features reflective strips, make sure that these reflective strips will last as long as the fluorescent-coloured fabric.



Designing a particular function can demand specific services, such as labelling or embroidering clothes, washing, sterilising, repairing torn textiles, re-waterproofing, over-dying, distribution, etc.

The essential services required for functionality (e.g. hygiene) or circularity are very important aspects in determining the 'total cost of ownership' (TCO) for professional textiles.

The use of leasing models from companies renting and/or maintaining professional textile products can generate new opportunities.

YOU CAN ALSO USE THE OVAM SIS TOOLKIT WHEN INTEGRATING SUSTAINABILITY INTO YOUR INNOVATION PROCESS.

TOOL

2/ Select sustainable materials



"WHICH MATERIALS ARE THE MOST INTERESTING FOR PROFESSIONAL TEXTILES FROM A FUNCTIONAL AND ECONOMICAL POINT OF VIEW, AS WELL AS FROM AN ECOLOGICAL AND SOCIAL PERSPECTIVE?"

2/ Select sustainable materials

> An important factor when selecting materials or combinations of materials for the production of circular products is the potential retention of these materials' functional properties after recycling over a sufficiently long period.

"WHICH MATERIALS ARE THE MOST INTERESTING FOR PROFESSIONAL TEXTILES FROM A FUNCTIONAL AND ECONOMICAL POINT OF VIEW, AS WELL AS FROM AN ECOLOGICAL AND SOCIAL PERSPECTIVE?"

COTTON

As an organic material, cotton is an example of a fantastic fibre that adds thermo-physiological comfort to clothing, but cotton is also a plant that requires tremendous amounts of water. In addition, cotton plantations require vast amounts of pesticides, herbicides and defoliants. Also, after harvesting, cotton needs many chemicals to achieve the preferred properties (colour, non-crease, etc.). The fact that it is so absorbent (good in terms of comfort) also means that cotton does not dry easily, meaning it requires relatively large amounts of energy for washing and drying. This explains why cotton is not immediately the most interesting fibre from an ecological and social perspective.



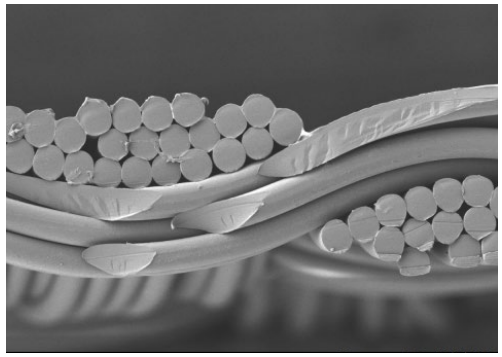
VISCOSE

Viscose is a cellulose fibre and can be used to replace cotton entirely or in part. This fibre is made using wood pulp (biomass), although people have recently been using recycled cotton to produce viscose. When using wood pulp from bamboo, this viscose fibre can also be referred to as bamboo fibre. As well as the bio-basis, the processes used in converting biomass into viscose fibre also play an important role in sustainability. Lots of viscose still comes from Asia and uses a highly-polluting process that also involves carcinogenic substances. Lyocell®, on the other hand, is a fibre that has been developed in Europe and is produced by Lenzing AG using a environmentally-friendly dissolving process whereby the non-toxic solvent is almost entirely recovered (99%) and is reused (closed-loop process). Next to the ecological benefits of Lyocell it has better physical properties then viscose what makes it suitable to be applied in a broader range of products.



RECYCLED FIBRES

It is never sure whether recycled fibres will (always) guarantee the preferred quality after threads unravel that have previously been spun. Recycled fibres made from worn-out textile products are mostly too short and too weak to be re-spun. Recycled fibres can mostly only be used in combination with virgin fibres to create rough threads and these are not suitable for all textile fabrics. There are however already are some good examples of towels and jeans made using up to 50% recycled thread.



R-PET

Discarded plastics such as PET beverage packaging can not only be transformed into new PET bottles, but also into PET fibres. Unfortunately, the current range of thicknesses and thread numbers available in R-PET fibres is still very limited. At present, the transformation of discarded PET beverage bottles into textile fibres tends to be focused on the production of fine fibres for 'fleece' jumpers that are almost always produced in Asia. The textile material for making these fleeces undergoes a roughening process (to create a softer and thicker feel), but this potentially causes R-PET fibres to come loose more easily when washed, and these consequently end up polluting our environment.



CHOOSE MATERIALS THAT CLOSE MATERIAL LOOPS IN THE TECHNOSPHERE.

Synthetic fibres as well as metal and synthetic accessories and all chemical (synthetic) substances such as latex, PVC, synthetic rubber can all be recycled.

ESG (European Spinning Group), is a Belgian spinning company that aims to capitalise on the production of threads based on recycled fibres such as denim clothing and offcuts from the clothing industry.
Jules Clarysse and ESG have developed a towel incorporating recycled cotton. ESG spun thread for Jules Clarysse, based on post-consumer cotton products. Jules Clarysse has been successful in using up to 40% recycled cotton.

http://www.julesclarysse.com/en/pure-products.htm

http://www.esg-group.eu/

Schijvens Corporate Fashion is a Dutch company involved in the design and production of professional clothing. At the beginning of 2017, and after years of development together with its project partners, they launched their 100% recycled professional clothing line. The clothing is made of 50% R-PET (from used PET bottles), on the one hand, and 50% used textiles on the other.

http://www.schijvens.nl

CHOOSE BIO-MATERIALS THAT CLOSE MATERIAL LOOPS IN THE BIOSPHERE.

Natural fibres such as cotton, hemp, flax, wool, etc. as well as 'synthetic' fibres based on bio-materials such as viscose, alginates, etc. which can be decomposed or composted by micro-organisms under certain temperature and humidity conditions.

G-star has developed and produced jeans made from 12% recycled cotton. Despite being a low quantity, the brand has achieved savings of 9.8% on its water consumption, 4.2% on its energy consumption, and 3.8% on its CO2 emissions.

https://www.circle-economy.com/tool/circlemarket/

USE THE ECOLIZER TO CALCULATE THE ENVIRONMENTAL IMPACT OF YOUR PRODUCT!

TOOL

HAVEP is part of the Van Puijenbroek Textiel Corporate portfolio and markets professional and safety wear. In order to satisfy the demand for sustainable professional clothing, HAVEP has launched the 'Rework' product line. This range consists of 100% cotton professional clothing and carries a Cradle to Cradle certificate (Bronze). Berendsen, Lavans and Initial (leasing/maintenance companies) have included the collection in their range and Van Gansewinkel (waste processing company) is to take care of collecting and processing end-of-life outfits.

https://www.havep.com/be-en/sustainability

F-ABRIC textiles from Freitag are made from fibres from hemp bark and flax; resources that are grown on European soil. Thanks to careful use of water and limited transport distances – from France to Zurich – these fibres are able to generate a more limited ecological footprint than, say, cotton.

http://ecodesign.vlaanderen-circulair.be/en/cases/cases-detail/freitag

3/ **Use materials efficiently**

> HOW CAN YOUR PROFESSIONAL TEXTILES BE ASSEMBLED MORE INTELLIGENTLY WITH LESS MATERIAL AND FEWER KINDS OF DIFFERENT MATERIALS?



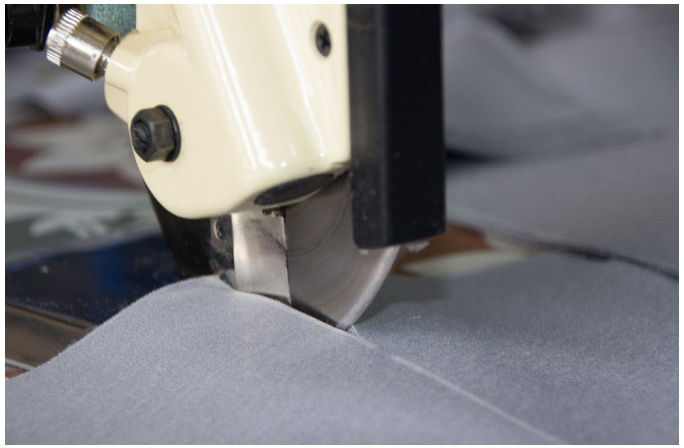
3/ Use materials efficiently

"HOW CAN YOUR PROFESSIONAL TEXTILES BE ASSEMBLED MORE INTELLIGENTLY WITH LESS MATERIAL AND FEWER KINDS OF DIFFERENT MATERIALS?"

Do you really require your functional professional textile clothing to be all-singing and all-dancing?

THINK UP NEW PROFESSIONAL TEXTILES THAT ECONOMISE ON MATERIALS (STARTING WITH THE BASIC USER NEED AND CURRENT FUNCTIONALITY)

Could additional services (e.g. service contract) result in materials/ components being used more efficiently for longer?



AVOID OVER-ENGINEERING: AIM FOR MAXIMUM USER COMFORT AND A MINIMUM AMOUNT OF MATERIAL.

Try to leave out material or redistribute it where it's really needed.

AIM FOR A MINIMUM NUMBER OF DIFFERENT MATERIALS

Use the same type of material as much as possible in complex textile products.



Are the dimensions of hospital sheets the right size for hospital beds?

DIVIDE LARGE VOLUMES INTO SMALLER MODULES (MODULAR CONCEPT) TO BE ABLE TO REPLACE COMPONENTS EASILY

Layered clothing can be used with more versatility in changing weather conditions.

CHOOSE LIGHTWEIGHT MATERIALS

A lower cloth weight in clothing usually leads to improved comfort for wearing and less energy consumption for transportation.

DESIGN AND GROUP COMPONENTS IN UNIFORM MATERIAL CLUSTERS AS MUCH AS POSSIBLE

Sioen, a major Belgian manufacturer of protective clothing, works continuously on 'dematerialisation' and aims to provide a special eco-clothing line. This eco-line consists of simple models in which all extras, such as additional pockets and unnecessary accessories (e.g. zips) are left out.

4/ Optimise the production process



> HOW DO YOU ENSURE THAT ALL PARTIES KNOW AND APPLY THE REQUIRED PRODUCT AND PROCESS INFORMATION?

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"HOW DO YOU ENSURE THAT ALL PARTIES KNOW AND APPLY THE REQUIRED PRODUCT AND PROCESS INFORMATION?"

Process optimisation can reduce production waste, emissions and energy consumption. However, it also requires optimising the size of production batches or production runs, the use of realistic standards, the definition of simple quality requirements related to colour conformity, permissible errors, etc. This is all about product and process information, which all parties must know and apply. Discussions within the entire value chain can lead to quick wins for all concerned.

AIM FOR EFFICIENCY IN THE COMPLETE PRODUCT-SPECIFIC VALUE CHAIN.

The production, distribution, use, maintenance and removal of professional textiles is a chain of different processes that are implemented for various companies such as fibre manufacturers, spinning companies, weaving mills, distribution companies, clothing companies, launderettes, recycling companies, logistics companies, etc.

REDUCE PRODUCTION WASTE, EMISSIONS AND ENERGY CONSUMPTION.

Process efficiency is influenced using the 5M-approach by:

- Management;
- Materials;
- Resources (Middelen);
- Methods;
- People (Mensen).

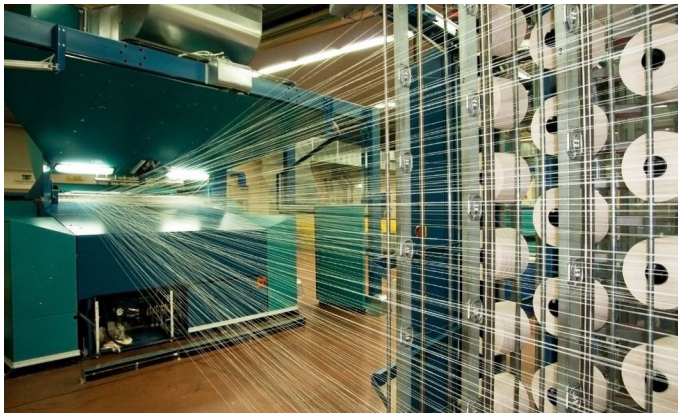


Centexbel has conducted technological research projects on the majority of these new techniques. Do not hesitate to contact them, without obligation, for further information.

PAY ATTENTION TO NEW TECHNOLOGIES AND ANALYSIS TECHNIQUES.

DyeCoo, located in the Netherlands, has developed the first 100% water and chemical-free paint for colouring textiles on a large scale.

http://ecodesign.vlaanderen-circulair.be/en/cases/cases-detail/dyecoo



5/ **Reduce the environmental impact of logistics**



“WHAT SHOULD YOU CONSIDER WHEN WISHING TO REDUCE THE ENVIRONMENTAL IMPACT RELATED TO THE DISTRIBUTION OF PROFESSIONAL TEXTILES?”

5/ Reduce the environmental impact of logistics

WHAT SHOULD YOU CONSIDER WHEN WISHING TO REDUCE THE ENVIRONMENTAL IMPACT RELATED TO THE DISTRIBUTION OF PROFESSIONAL TEXTILES?

Limit transportation distances by integrating vertical production processes and buying, manufacturing, servicing, and/or recycling locally.

SET UP A COLLECTION SYSTEM FOR RETURNS.

Consider organising a returns system combined with the new professional textiles delivery, design a system for grouped pick-ups.



CHOOSE THE MOST ECOLOGICALLY RESPONSIBLE METHOD OF TRANSPORT.

MAKE OPTIMAL USE OF TRANSPORTATION AND STORAGE VOLUME.

Can maximum lorry loads be increased with better route planning or collaboration? Tri-vizor can help you with this.

http://ecodesign.vlaanderen-circulair.be/en/cases/cases-detail/tri-vizor

Also, look at internal transport operations in warehouses. You can reduce the number of internal transport operations simply by reorganising goods in the warehouse.

USE THE ECOLIZER TOOL TO CALCULATE THE ENVIRONMENTAL IMPACT OF DIFFERENT METHODS OF TRANSPORTATION!

TOOL

ALLOW FOR DRY AND HYGIENIC COLLECTION AND STORAGE.



OPTIMISE PACKAGING.

Keep packaging to a strict minimum while still taking the risk of damage and soiling into account.

6/ Reduce the environmental impact of use



“WHAT CAN BE DONE IN THE DESIGN OF PROFESSIONAL TEXTILES TO MAKE USAGE ITSELF MORE SUSTAINABLE?”

6/ Reduce the environmental impact of use

WHAT CAN BE DONE IN THE DESIGN OF PROFESSIONAL TEXTILES TO MAKE USAGE ITSELF MORE SUSTAINABLE?

Can special finishes (dirt-repellent finishes, soil-release, self-cleaning, anti-odour, etc.) reduce the amount of maintenance?

CHOOSE REUSABLE/WASHABLE PROFESSIONAL TEXTILES.

Clear catalogues from manufacturers with explanations about the various CE standards, labels, specifications and certification systems can have a preventive effect by reducing environmental impact of use and maintenance.



ADD EXTRA PROTECTION OR REINFORCEMENT AND REDUCE MATERIAL STRESS.

OrganoClick is a Swedish cleantech company marketing a water-repellent and sustainable textile coating.

https://www.close-the-loop.be/en/tips-tricks/tips-tricks-detail/91/organoclick

Don't forget the matter of microplastics when considering sustainability.

OPTIMISE PACKAGING IN TERMS OF REUSE AND RECYCLING.

- Reduce and leave out as much packaging as possible.
- Choose reusable and recyclable/biodegradable materials.
- Choose a packaging returns system.

Design the product so that only some of it needs servicing (e.g. detachable panels that are used more are better washed separately)

SIMPLIFY MAINTENANCE

For example: the EN 471 standard fluorescent jackets are never normally worn next to the skin. This makes comfort less important so you can choose fibres that don't absorb moisture for these items.



7/ Opt for the optimum lifecycle

“WHICH OPTIONS ALLOW YOU TO EXTEND THE LIFECYCLE, TAKING INTO ACCOUNT THE USER’S REAL USAGE AND MAINTENANCE CONDITIONS?”



7/ Opt for the optimum lifecycle

WHICH OPTIONS ALLOW YOU TO EXTEND THE LIFECYCLE, TAKING INTO ACCOUNT THE USER'S REAL USAGE AND MAINTENANCE CONDITIONS?

Are alternative maintenance processes possible that stress the textile material less (e.g. use scCO2 instead of classic washing)?

ONLY CHOOSE POST-TREATMENT / TEXTILE PROCESSES THAT HAVE A POSITIVE EFFECT ON LIFECYCLE AND RECYCLING.

- Wash the professional textiles at a lower temperature;
- Use other drying techniques;
- Have the professional textiles washed industrially rather than at home by the employee.

'Care4Quality' and 'Care4Safe' are Belgian initiatives uniting textile companies, clothing companies, linen leasing companies and laundrettes that aim to extend the life of washable professional textiles, in terms of both quality and safety. Various other federations and Centexbel are involved as well.

USE MATERIALS WITH A LONG(ER) LIFECYCLE.

OPT FOR MODULAR TEXTILES.



Search for alternatives for the weakest link or make them replaceable and easy to remove.

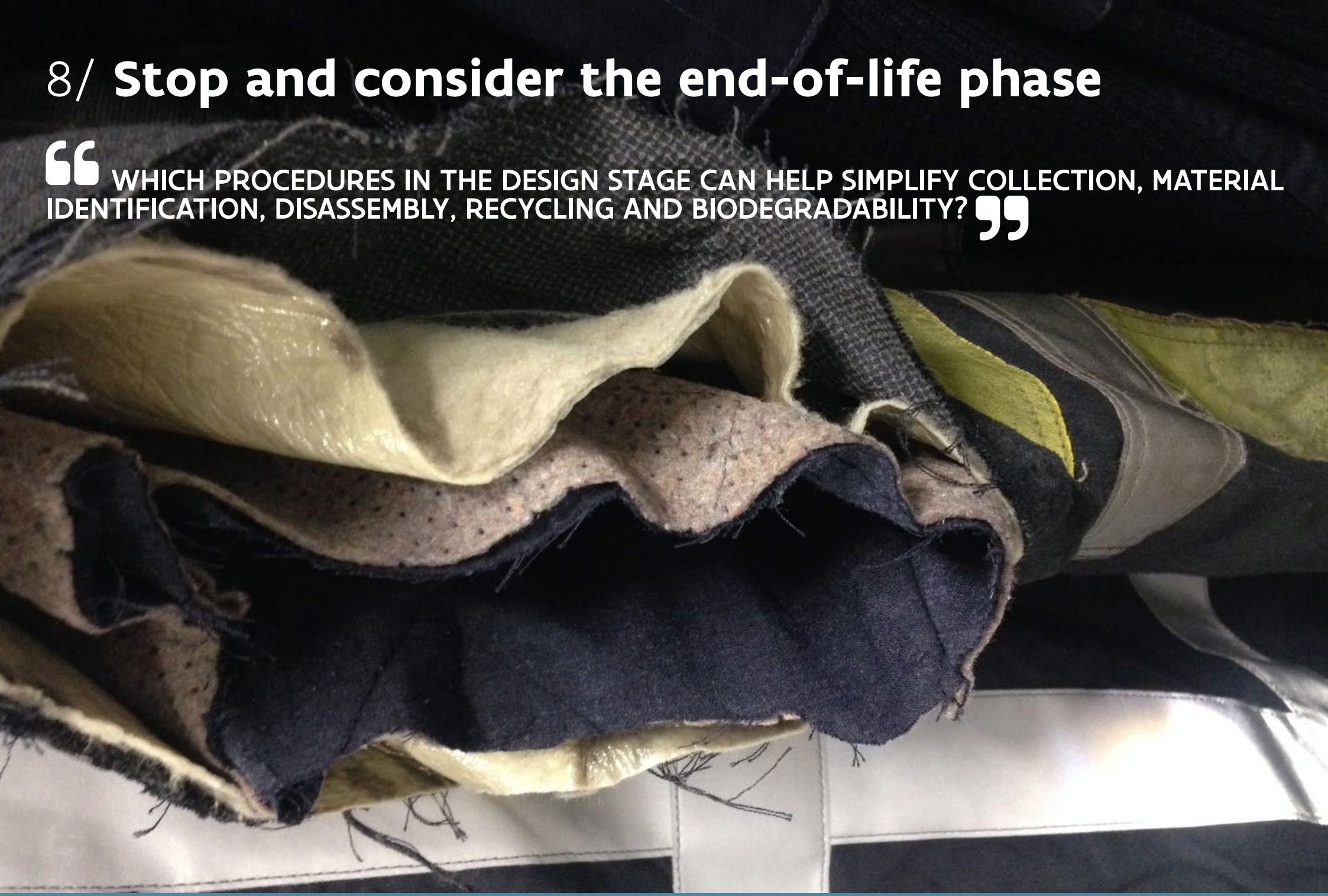
BALANCE TECHNICAL WITH AESTHETIC LIFECYCLE.

Resortecs Smart stitch is a sewing thread that melts at high temperatures and makes disassembly for textile recycling simple and economical. Resortecs makes it simple and cheap to achieve a full circularity in the textile industry. https://resortecs.com/.



Keeping components as simple as possible and limiting them to a minimum reduces the risk of potential defects.

8/ Stop and consider the end-of-life phase



“WHICH PROCEDURES IN THE DESIGN STAGE CAN HELP SIMPLIFY COLLECTION, MATERIAL IDENTIFICATION, DISASSEMBLY, RECYCLING AND BIODEGRADABILITY?”

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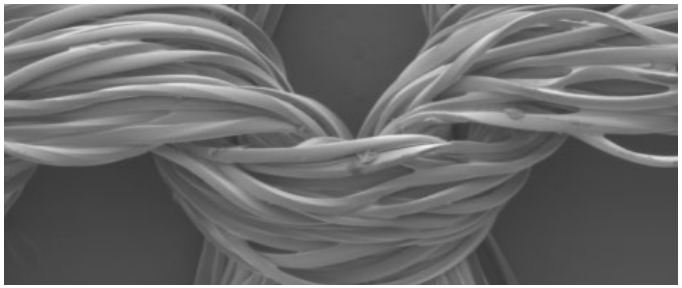
Can special sewing thread, which will disintegrate in microwave ovens, be used during manufacture to allow the various materials (fabrics, reflective strips, buttons, patches, etc.) in complex textile products to be separated and recovered when items are discarded?

DESIGN TO RECYCLE.

- Construct professional textiles using modular elements (interchangeable, re-combinable).
- Minimise the number of different material flows.
- Ensure mono-material flows.
- Aim for the smallest possible number of (different types of) connections between the materials.
- Opt for non-permanent connection points, such as click-in, clamp-on and screw-in connections.
- Ensure easily accessible connection points and identify them for faster disassembly.
- Make (dis)assembly possible with standard tools (or better still: without tools) or with as few different tools as possible.
- Identify all materials so that they can be quickly separated into individual material flows.

CHOOSE A GOOD DESTINATION FOR DISCARDED PROFESSIONAL TEXTILES.

'Discarded' professional textiles can be collected by the user (company or organisation), any leasing company involved or an environmental company, and sorted for possible reuse, recycling or thermal valorisation. (incineration or conversion into fuel)



It can be useful to contact federations such as Fedustria, Creamoda, FBT, go4circle or knowledge centres such as Centexbel to examine potential solutions for certain textile products. For larger end-of-life flows it may be worth considering setting up an innovation project.

Easily detachable personal patches simplify reuse by other users.

More questions? They will be able to help you further!

- Centexbel – Collective knowledge centre for textiles. – **www.centexbel.be**
- Fedustria – Belgian federation for the textile, wood and furniture industry – **www.fedustria.be**
- Creamoda – Trade association for the clothing and clothes-making sector – **www.creamoda.be**
- FBT – Federation of Belgian textile care – **www.fbt-online.be**
- Denuo - Belgian federation of the waste and recycling sector – **www.denuo.be**
- Essenscia – Belgian Federation for the Chemical Industry, Plastics and Life Sciences – **www.essenscia.be**
- Agoria – Federation of the Belgian technological industry – **www.agoria.be**
- Euratex – European Apparel and Textile Confederation – **www.euratex.eu**
- EDANA – International association serving the non-wovens and related industries – **www.edana.org**
- CIRFS - European Man-Made Fibres Association – **www.cirfs.org**
- FEAD – European federation of waste management and Environmental Services – **www.fead.be**
- TEXTRANET – European network of textile research organisations – **www.textranet.net**
- Ellen MacArthur Foundation – Foundation supporting and promoting the circular economy – **www.ellenmacarthurfoundation.org/**
- Circular Flanders – Part of OVAM helping companies and stakeholders in their transition towards a circular economy – **www.vlaanderen-circulair.be**
- Flanders DC – Flanders District of Creativity – part of the Agency for Innovation and Enterprise to support the creative sector – **www.flandersdc.be/nl**

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Connectivity and automation have become increasingly important thanks to the Internet of Things. It is expected that smart materials and ICT will also conquer the world of professional textiles, which will have a negative impact on their recyclability.

There are generally different approaches to making a textile product functional for a specific scope. However, one must not forget that the product in question should also meet the applicable technical specifications, standards and/or laws in terms of safety, quality, environment and health. That limits the possibilities, particularly when using traditional materials, which are always in stock and have well-known properties.

Needless to say, the product's function must also be achieved at market price. The result is that it is financially unfeasible to use certain materials, material combinations or treatments. The economic reality usually limits both the scope and the possibilities. That being said, it's not impossible.

An example:
Textiles can be made waterproof through the application of a (breathable) coating that seals the pores between the threads. This is an affordable solution. In principle, the same result could be achieved by using very fine yarns and creating a tightly woven canvas with a mesh structure so tight that water cannot possibly pass through. This approach requires very expensive yarns and an equally expensive weaving process. In our globalised world, it would be impossible to use this production method for professional textiles, which are purchased or leased in large quantities. Consequently, the textiles used for protective clothing are usually coated, which makes them waterproof and protects the skin from exposure to chemicals.

Various elements tend to play a role in realising and optimising one or more preferred functions, such as:

THE CHOSEN TEXTILE FIBRES:

- hydrophilic fibres like cotton or viscose might be required to produce clothing with the preferred level of thermo-physiological comfort;
- fire-resistant fibres to guarantee the necessary protection against fire and welding spatter;
- anti-static fibres in textile fibres protect the textile from static charging, which is important for textiles used to cover patients in the operating theatre, for example;

THE PROCESSES AND AUXILIARY MATERIALS USED IN ENHANCING THESE MATERIALS:

- 'stain-release' finishes can be applied, for example, to allow fabrics to be washed more easily;
- reducing the 'self-cleaning' properties by applying a special coating, by working with intervals between maintenance sessions or by extending the lifespan of the textile;
- The colour stability of dyed textiles is determined not only by the colouring agents used, but also by the combination with other colours. Work clothing in red-and-white combinations, for example, can soon look worn-out due to an improperly fixed red colouring agent.

THE PRODUCT COMPOSITION OR MODEL:

- clothing can be repaired more easily if the components that are more subject to wear and tear can be easily removed and replaced;
- bullet-proof vests are created by stacking and stitching together various aramid fabrics in different directions, and encapsulating this layered structure in a water-repellent textile cover.

It is usually necessary to use a variety of materials (fibres, coating, finishes, accessories, etc.) to achieve all the preferred functions of professional textiles. Of course, this makes recycling more difficult.

When different materials are combined in a textile product for functionality reasons, it is important that the various materials have a similar lifecycle.

Is this impossible? Then check whether the materials that tend to wear quicker can be easily removed and replaced. Repairability is very important for such products, and naturally, so is owning repair kits. Use sewing threads that disintegrate under certain circumstances to make it easier to remove stitched-on accessories. Alternative assembly systems, such as magnetic systems, could also be used to replace the sewing process. Of course, the search for more wear-resistant accessories must continue to be highlighted because they allow for professional textiles to be repaired less often.

When various materials are used in composite products that require frequent maintenance, it goes without saying that it should be possible to wash and dry all of these materials the same way. However, a different maintenance process for certain components could be necessary to meet a number of hygiene requirements. If the entire product goes through the strictest of maintenance processes, its lifespan will be quite short. However, the textile product could also be designed in such a way that the materials requiring a different washing and drying process can easily be removed. This can be achieved by working with modular products that have removable panels or components that can easily be attached or removed to other parts of the professional textile product through non-permanent systems (hook/loop systems, magnet strips, special glues etc).

An example:
if a fluorescent jacket features reflective strips, make sure that these reflective strips will last as long as the fluorescent-coloured fabric. The lifespan of such clothing, which must always meet the requirements of the EN 471 standard, can be extended by removing the reflective strips once they are no longer compliant due to intense cleaning and replacing them with new strips.

Designing a particular function can demand specific services, such as labelling or embroidering clothes, washing, sterilising, repairing torn textiles, re-waterproofing, over-dying, distribution, etc. In some cases, these services linked to the product may even be more important than the textile product per se. Many of these services ensure that professional textiles remain suitable for the preferred application. Including professional textiles in the circular economy may call for additional services, such as disassembly, unravelling or recycling. However, the activities and processes focused on the circular economy need to be further refined and extended.

The essential services required for functionality (e.g. hygiene) or circularity are very important aspects in determining the 'total cost of ownership' (TCO) for professional textiles.

When developing and optimising the required functionality of professional textiles, the focus should be not only on the technical developments in the field of materials, production and recycling techniques, but also on various services and possible 'product-service' combinations. New business models also need to be considered in this view. The use of leasing models from companies renting and/or maintaining professional textile products can generate new opportunities.

When developing or optimising functional professional textiles it is important to use the concrete demands or needs of the users as a starting point, even though they may not always be equally clear. In this view, it may be very useful to describe the preferred end result as clearly as possible for the end user.

An example:
'maintaining of the thermo-physiological comfort and CE conformity of safety clothing after 50 industrial washes at 60°C'.

In this framework, where products are made functional or adjusted, ecological and social aspects are becoming increasingly important.

How can we create added value for customers and reduce our ecological footprint? Alternative business models are being considered more and more often. The strategy of offering services combined with products (Product Service Systems = PSS), partly or entirely 'dematerialising' the offered solution, is a totally new approach for companies to shape their policies. The focus of the 'product-service' combination is on the value for the customer: the consumer pays for the service the product supplies, not for its ownership.

A SITRA publication describes various combinations for fashion textiles. This publication can also be a source of inspiration for professional textiles.

YOU CAN USE THE OVAM SIS TOOLKIT WHEN INTEGRATING SUSTAINABILITY INTO YOUR INNOVATION PROCESS.

TOOL

Between the sale of a product only and the offering of a service only, we can make a distinction between three product-service combinations, with the focus being more on the product than on the service.

CUSTOMER-ORIENTED	USER-ORIENTED	RESULT-ORIENTED
The customer is the owner of the product and is offered support services.	The producer or leasing company remains the owner of the product (and the customer pays a regular fee for use, maintenance, installation, etc.)	In this case, the focus is mainly on the service. The stakeholders own, manage and decide on the resources used to meet the end user's requirements.
An example: Maintenance and repair of work clothing by a maintenance company. Worn-out components are repaired, allowing for the clothing to be used again.	**An example**: Professional textiles are leased to a company, with the leasing company taking charge of transport, maintenance, adjustments and repairs, as well as the disposal of discarded textiles.	**An example**: All employees have all equipment geared to its use. A thorough customisation to ensure no excess materials or chemicals are used.

The corporate models linked to certain 'product-service' combinations are now managed and controlled by the final owner of the product. But can't the management be entrusted to an organisation representing the entire value chain?

This would create maximum value for all parties involved in each stage of the product's lifespan and that of the associated materials. Such a business model does not exist at this stage. Various aspects, including legal aspects like product liability, still need to be tested in terms of feasibility and sustainability.

2/ **Select sustainable materials**



“WHICH MATERIALS ARE THE MOST INTERESTING FOR PROFESSIONAL TEXTILES FROM A FUNCTIONAL AND ECONOMICAL POINT OF VIEW, AS WELL AS FROM AN ECOLOGICAL AND SOCIAL PERSPECTIVE?”

2/ SELECT SUSTAINABLE MATERIALS

"WHICH MATERIALS ARE THE MOST INTERESTING FOR PROFESSIONAL TEXTILES FROM A FUNCTIONAL AND ECONOMICAL POINT OF VIEW, AS WELL AS FROM AN ECOLOGICAL AND SOCIAL PERSPECTIVE?"

When selecting materials, it is important to have access to reliable and comprehensive information on these materials, their durability, toxicity, etc. However, this information is not easy to find. In fact, for 'advanced' and 'functionalised' materials, there are usually very few sustainability details available, and in some cases, none at all.

For professional textiles that require frequent washing and drying, you need to look at their (economic, ecological and social) sustainability in this context.

Over a longer period of time, the environmental impact of maintenance processes for reusable professional textiles cannot be underestimated. Often, they put much greater pressure on the environment during their use than during the production and EOL phase. The environmental impact of the EOL phase should definitely be considered for disposable products that are used only once.
However, social aspects linked to production, use and end-of-life also deserve attention for professional textiles. From a social point of view, reusable professional textiles that are frequently maintained create a lot of local jobs. The volume of discarded professional textiles is also limited. That being said, in certain application fields with a high risk of contamination, the use of disposable products may be warranted.

All too often, bio-based or organic materials are considered the most environmentally sound choice, even though biodegradable or compostable materials are definitely not suited to repeated washing without loss of quality. However, such materials may be interesting for disposable products (e.g. hygiene products), as long as the raw materials used are not produced using crops cultivated on agricultural land calling for excessive use of water or harmful substances during the growth phase, or affecting biodiversity.
Important side note: not all bio-based materials are biodegradable or compostable. For most petroleum-based materials (traditional polymers) there are now also 'bioprocesses' that result in identical materials, but using renewable biomass. These traditional bio-based polymers, whose properties are identical to those of their petroleum-based counterparts, are only available in more limited quantities and are generally also more expensive than their counterparts produced using petroleum or natural gas. There are also petroleum-based polymers like PCL that are biodegradable.

Report no. 1722 by Wageningen University & Research titled "Bio-based and biodegradable plastics – facts and figures" provides additional information on the confusing concept of bio-based polymers, as well as two properties, biodegradability and compostability.

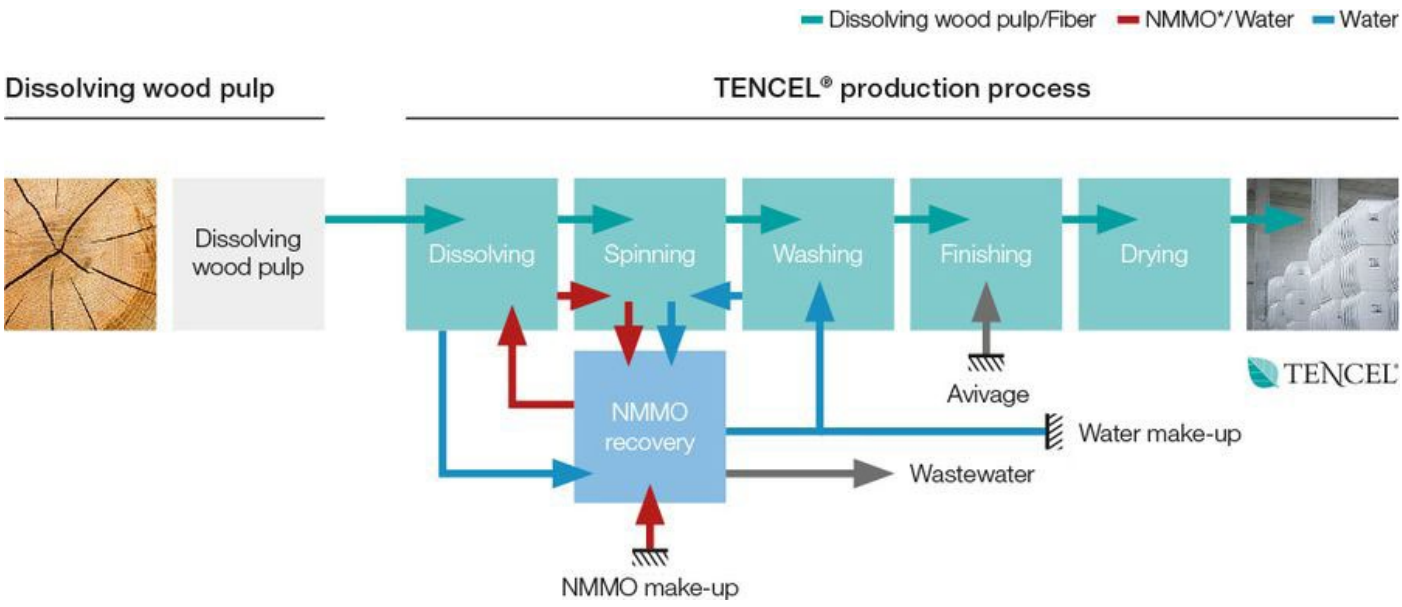
If the production and purification processes, as well as their possible functionalisation, are not taken into account, it can never be claimed that bio-based materials have less of an impact on the environment. Before promoting the possible environmental benefits of such materials, it is important to consult their LCA details.

COTTON

As an organic material, cotton is an example of a fantastic fibre that adds thermo-physiological comfort to clothing, but cotton is also a plant that requires tremendous amounts of water. In addition, cotton plantations require vast amounts of pesticides, herbicides and defoliants. Also, after harvesting, cotton needs many chemicals to achieve the preferred properties (colour, non-crease, etc.). The fact that it is so absorbent (good in terms of comfort) also means that cotton does not dry easily, meaning it requires relatively large amounts of energy for washing and drying. This explains why cotton is not immediately the most interesting fibre from an ecological and social perspective.

VISCOSE

Viscose is a cellulose fibre and can be used to replace cotton entirely or in part. This fibre is made using wood pulp (biomass), although people have recently been using recycled cotton to produce viscose. When using wood pulp from bamboo, this viscose fibre can also be referred to as bamboo fibre. As well as the bio-basis, the processes used in converting biomass into viscose fibre also play an important role in sustainability. Lots of viscose still comes from Asia and uses a highly-polluting process that also involves carcinogenic substances. Lyocell®, on the other hand, is a fibre that has been developed in Europe and is produced by Lenzing AG using a environmentally-friendly dissolving process whereby the non-toxic solvent is almost entirely recovered (99%) and is reused (closed-loop process). Next to the ecological benefits of Lyocell it has better physical properties then viscose what makes it suitable to be applied in a broader range of products.



RECYCLED FIBRES

We can never be sure that recycled fibres will (always) guarantee the preferred quality after threads unravel that have previously been spun. Recycled fibres made from worn-out textile products are mostly too short and too weak to be re-spun. Recycled fibres can mostly only be used in combination with virgin fibres to create rough threads and these are not suitable for all textile fabrics. There are, however, already some good examples of towels and jeans made using up to 50% of recycled threads.

R-PET

Discarded plastics such as PET beverage packaging can not only be transformed into new PET bottles, but also into PET fibres. Unfortunately, the current range of thicknesses and the thread numbers available in R-PET fibres are still very limited. At present, the transformation of discarded PET beverage bottles into textile fibres tends to focus on the production of fine fibres for 'fleece' jumpers that are almost always produced in Asia. The textile material for making these fleeces undergoes a roughening process (to create a softer and thicker feel), but this potentially causes R-PET fibres to come loose more easily when washed, and these consequently end up polluting our environment.

Selecting the most suitable materials remains a critical success factor in the development of environmentally-friendly professional textiles. The OVAM study on professional textiles has shown that at the moment, the most commonly used textile fibres are a thorough blend of cotton and polyester, 100% cotton and 100% polyester. For protective textiles, the most commonly used materials are polyester or polyamide filament yarns instead of spun yarns, but also more advanced textiles, such as para or meta aramids, FR viscose, breathable plastic films etc

For traditional textile fibres, like cotton, polyester and polyamide, there are alternatives like Tencel® or Lyocell®, recycled PET, recycled PA and recycled cotton. Always check the origin of these fibres, and check the authenticity of the claims and the value of the labels and claims used. This will safeguard you from greenwashing.

Many recycled fibres from textiles that were not produced or recycled in Europe pose a clearly higher risk of containing harmful colouring agents, additives, finishes, etc. These fibres do not comply with the REACH legislation and can therefore not be used for the production of textile products to be sold on the European market.

Mono-composed products are easier to recycle than complex products containing multiple materials. To boost the recyclability of a product and turn it into a raw material for new products, it is important for the designer to limit the number of materials in textile products as much as possible. If this is not possible, the designer should focus on the disassembly of the composed products. However, given the currently used assembly techniques (sewing or welding), that is virtually impossible. However, in the near future, alternative assembly techniques could be developed to better include composed textile products in the circular economy.

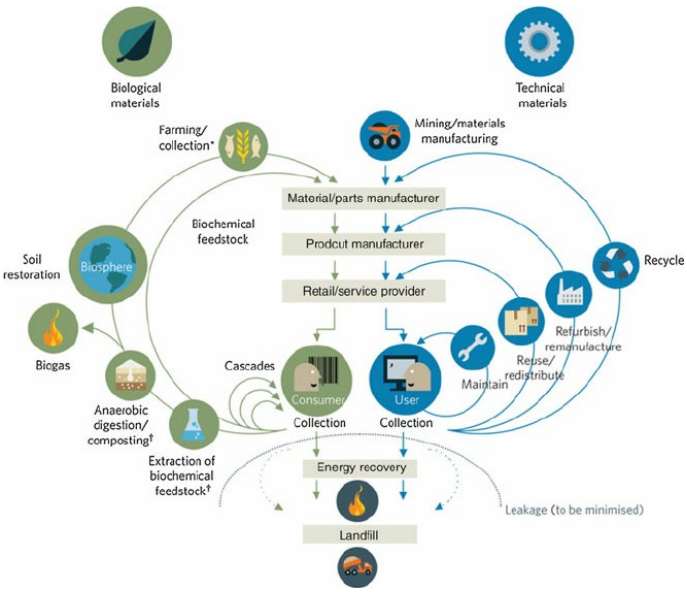
The materials used for the production of professional textiles and its use (including maintenance) can be subdivided into three categories based on the creation of material cycles:

1. **Technical materials** Synthetic fibres, as well as metal and plastic accessories, and all chemical plastics and materials, including latex, PVC and synthetic rubber, that can be recycled as such.

2. **Biomaterials** Natural fibres, like cotton, hemp, flax and wool, as well as 'artificial' fibres based on bio-materials, such as viscose, alginates, etc. that can be broken down by micro-organisms or composted under specific conditions and at specific temperatures and humidity levels.

3. **A mix of materials from both categories (also known as 'hybrid' materials)** A classic example is a mix of cotton and polyester fibres, or cotton dyed with synthetic colouring agents or treated with resin, latex or another polymer dispersion.

Only fully technical materials or biomaterials are considered materials that can close material cycles completely. Completely closing the material cycle may seem like an easy thing to do, but it is extremely difficult with the current textile products. The graph below illustrates these two closed material cycles. Closing material cycles with the commonly used hybrid materials is out of the question.



At the start of a circular product development process, you need to consider these options and consciously choose one. Needless to say, in doing so, you should take account of the set requirements in terms of product conformity and maintenance. This choice will determine whether or not the materials cycle can be closed fully and how the end-of-life materials will eventually be processed. Also, discuss the full cycle with all stakeholders in the product chain, because without their support, your good intentions will be very hard, if not impossible, to achieve.

TECHNO-CYCLE	BIO-CYCLE	MIXED CYCLE
Developed in such a way that at the end of their lifespan they can generally be reused as a fusible polymer for the production of synthetic fibres or plastic.	Made of bioproducts/components whose residues flow back to nature after a cascade of use.	A combination of both cycles, with certain subassemblies, developed either according to a bio-cycle or a techno-cycle.
Polymer fibres like polyester and polyamide, polyester zips, press studs, transfer prints on polyester carriers, etc.	Wool, (organic) cotton, silk, flax, jute, wooden buttons, Lyocell® buttons, etc.	The best-known example is polyester-cotton work clothing.
An example: A 100% polyester tablecloth stitched with polyester yarn and with a polyester label can be recycled, either through mechanical or chemical methods, into another polyester product.	An example: A bed sheet made of 50% cotton and 50% Lyocell®, stitched with cotton yarn and with a Lyocell® label could be composted.	An item of clothing made of 65% polyester and 35% cotton fabric.

Which materials should you choose?

https://www.close-the-loop.be/en/phase/2/resources

Innovative materials, an overview!

https://www.close-the-loop.be/en/tips-tricks/tips-tricks-detail/21/be-on-the-lookout-for-innovative-materials

An example:
Dutch aWEARness and its partners sell clothing made of 100% polyester with only minimal degrading during its lifespan, allowing it to be reused time and time again.

During the product development phase, you need to take the energy content of the materials used into account, ensure they are REACH-compliant and they do not have a negative effect on the user's health. Also, consider the decontamination of 'contaminated' professional textiles and the possible reuse of discarded products.

CHOOSE MATERIALS THAT CLOSE MATERIAL LOOPS IN THE TECHNOSPHERE. (AND THAT IN THIS ORDER):

...Have a low energy content

Materials with a low energy content require less energy during the processing stage. The use of environmental indicators, such as eco-indicator values, gives a quick overview of the main environmental issues. An eco-indicator is a figure that shows the impact a material or process has on the environment. This is just a guideline. It is not an absolute value, but rather the relative comparison of materials and processes. One indicator point equals one thousandth of the total yearly environmental pollution caused by the average European. The higher the indicator, the higher the impact on the environment.

USE THE ECOLIZER TOOL TO CALCULATE THE ENVIRONMENTAL IMPACT OF YOUR PRODUCT

TOOL

An example:
polyester has a higher melting point than polyamide 6. When melting these materials into new threads, polyamide 6 will definitely have a lower environmental impact than polyester because it requires less heat – and therefore energy – to melt.

Important remark: the presence of additives and fillers can alter a product's energy content. The extraction of synthetic materials filled with mineral fillers or thermal conductive additives, for example, will be easier and require less energy, because polymers are materials that do not easily absorb energy. The fillers or additives added to the mix will speed up the melting process and reduce the thermal polymer decomposition. That being said, at the moment too little is known about the value of the chemical content of textiles and plastics.

...Are REACH-compliant, at the very least

Avoid the use of harmful substances/additives/fillers as much as possible. Many materials contain additives, like colouring agents, pigments, stabilisers, fire retardants, softeners, fillers, foaming agents, antioxidants, etc. that are not all equally harmless. In principle, textile products manufactured in Europe are REACH-compliant. European textile companies are very familiar with this legislation and they are aware of the fact that only REACH-compliant products can be put on the market. However, textiles produced outside of Europe are not always REACH-compliant. If functionalised fibres from outside of Europe are used in the development of new products, it is important to look into their exact composition and to put systematic checks in place for each product entering the production facility to ensure they are REACH-compliant.
Since the environmental legislation is becoming stricter all over the world, a proactive approach is definitely preferred. Producers who assume their responsibilities and inform consumers of this see a strategic and commercial advantage as a result (in the longer term).

An example:

- Virtually all European producers of PVC-coated textiles, used in hazmat suits and tarpaulin, for example, rely on phthalate-free PVC coatings.

- Stop using fluorine compounds (FC) to make textiles water-repellent because they are not easily degradable. Look for a more environmentally-friendly alternative. If that proves impossible, only use short-chain fluorocarbon compounds. Nowadays, all European producers use 4C-FC products and sporadically 6C-FC, but they have banned all 8C-FC products. The search for alternatives to highly efficient fluorocarbon finishes has proven quite a challenge.

...Contribute to the health of the users

Make sure the professional textiles are ergonomic and keep account of the health of the persons using them. This aspect also contributes to REACH conformity at a later stage. If European professional textiles do not contain any elements that may be harmful to human health, it is highly likely that, in the future, it will not be an issue to reuse these materials effortlessly, in accordance with the REACH legislation.

An example:
opt for materials certified by independent bodies checking the chemical contents of the materials in question. The Oekotex standard 100 Detox will ban a lot of chemicals from clothing that may be harmful to human health. Check which elements certificates focus on before you make your choice.

...Preferably contribute to reuse of products and/or components

The higher the retained value of the discarded professional textile, the better it can be upcycled, which translates into greater potential savings in terms of materials, energy, labour and time, as well as a lower environmental impact.

From this point of view, the optimisation of the product lifespan (see further on) prevails over the reuse of the professional textiles. The reuse of the professional textiles prevails over the reuse of the components and the reuse of the components prevails over the recycling of the materials.
Important remark: due to the personal and sometimes intimate character of many professional textile products, the user may be quite reluctant to reuse the products in full due to hygiene reasons. The use of recycled products is often also still seen as a poor alternative.

An example:
an item of clothing is not necessarily at its end-of-life when an employee leaves the company, so another employee can still use it. Therefore, avoid customising clothing and ensure that it can be adapted in an ecological manner.

...Are preferably 100% clean or at least easy to disinfect after use

During use, professional textiles can be exposed to various sources of contamination. Make sure the material is capable of handling this contamination and that it can easily be removed. This contributes to a minimal loss of quality and an optimal maintenance of the required material properties. Soiling can also result in the recycled material being of inferior quality or even no longer complying with REACH.

The usability of recycled textiles can increase significantly if any impurities, contaminants or harmful chemicals can be removed in an affordable manner. In this framework, it is important to keep abreast of technological developments in this field.

Supercritical (sc) CO_2, a solvent for colouring agents, is an interesting medium (a liquid with gas properties), for example. It can be used for dyeing but also for bleaching various synthetic fibres, like polyester and polyamide. The main advantage of this medium is the gas phase post-treatment because no liquid waste is produced, neither with dyeing nor with bleaching. Needless to say, by bleaching synthetic fibres, the recycled fibres can be used for a wider range of applications. The bleached, recycled fibres can be coloured again in the preferred shade or even printed. Once this relatively new technology can be applied just before or during the extrusion of fibres or yarns, it will be used increasingly to bleach brightly coloured recycled textiles, which, in turn, can be used for the production of new fibres in the preferred colour.

This $scCO_2$ extraction technology can also be used to clean professional textiles contaminated with harmful PAHs. The environmentally-friendly decontamination with $scCO_2$ ensures professional textiles can be used safely and for longer.

ESG (European Spinning Group), is a Belgian spinning company that aims to capitalise on the production of threads based on recycled fibres such as denim clothing and offcuts from the clothing industry.
Jules Clarysse and ESG have developed a towel incorporating recycled cotton. ESG spun thread for Jules Clarysse, based on post-consumer cotton products. Jules Clarysse has been successful in using up to 40% recycled cotton.

http://www.julesclarysse.com/en/pure-products.htm

http://www.esg-group.eu/

Schijvens Corporate Fashion is a Dutch company involved in the design and production of professional clothing. At the beginning of 2017, and after years of development together with its project partners, they launched their 100% recycled professional clothing line. The clothing is made of 50% R-PET (from used PET bottles), on the one hand, and 50% used textiles on the other.

http://www.schijvens.nl/

CHOOSE BIO-MATERIALS THAT CLOSE MATERIAL LOOPS IN THE BIOSPHERE. (AND THAT IN THIS ORDER):

...Are 100% renewable

Opt for a material that has a low impact during the growing phase. Flax and hemp are more environmentally-friendly than cotton, and they can be cultivated locally too, unlike cotton. Certain synthetic fibres are also biodegradable under specific conditions, including Lyocell®, PLA (Poly Lactic Acid) and casein fibre.

...Are locally available (and not scarce)

Cotton is slowly biodegradable but its production in Europe is very limited (Greece and Bulgaria). However, there are alternatives to natural fibres such as hemp, wool and flex, and the synthetic Lyocell®, PLA and casein fibre, which are produced in Europe. When these fibres are used combined in local processing and production sites, the CO_2 emissions due to transport also decrease.

An example:
produce a 100% Lyocell® towel or bed linen, which absorb more moisture than cotton and are biodegradable too. Recently,
LENZING developed 'REFIBRA TENCEL' viscose, which consists of 50% recycled cotton and 50% wood pulp. This new fibre is produced via a TENCEL/LYOCELL® dissolving process in which the solvent is entirely recovered.

...Are fully biodegradable

This means that all substances are fully reabsorbed into the ecosystem. When it comes to biodegradability, a distinction is made between decomposition processes without (anaerobic) or with (aerobic) air (= composting). Check which post-treatments are required and make sure all the components can be processed within one and the same process and timeframe. You want to avoid one component decomposing while the other is still in its original form.
Make sure you consider all the small components (e.g. the elastic in cotton fitted sheets), colouring agents and other finishes. You do not want to find even a minimal residual fraction of non-biodegradable materials in the residue. Microplastics are a major environmental problem because they decompose very slowly.

An example:
use cotton yarns or clothing labels instead of polyester or polyamide ones for disposable textiles.
Make sure the biodegradability is suited to the intended lifespan. If materials degrade too quickly, they cannot achieve their optimal lifespan.

...Do not harm the user's health

Just like for the technical cycle, the health of the user must be safeguarded. Also, make sure the materials do not contain any chemicals that are non-degradable or that can have a negative impact on the environment.

An example:
make sure you don't use any colouring agents that contain heavy metals, because they may be unwarranted when producing an anti-root canvas for agricultural use, for example.

...Do not contain any chemicals that can have a negative impact on the biodegradation process.

Warm and humid environments are perfect breeding grounds for micro-organisms, like the dust mite, which feeds on skin scales and whose faeces many people are allergic to. Make sure there are no finishes that can hamper the biodegradation process. Do not use any products to combat micro-organisms that may negatively affect biodegradability/compostability.

Also, avoid the use of colouring agents that hamper the full biodegradation or composting of the treated material.

An example:
textiles treated with nanosilver to give it antimicrobial properties will not degrade because the nanosilver destroys the bacteria required for this process.

Remarks on the use of bio-based materials that want to go through the bio-cycle.

The use of biomaterials is generally only recommended for a limited number of professional textiles producers. Professional textiles often need to last for very long periods of time, considering their intense use and maintenance. This is in sharp contrast with the biodegradability of many bio-materials. If the professional textile is made using biodegradable textiles, it will probably reach its end-of-life too quickly, boosting its ecological footprint and requiring too much time and energy for composting.

This bio-cycle is mainly suitable for disposable items rather than corporate and safety clothing that needs to be reusable.

If you do opt for materials that can go through the bio-cycle, make sure that, where possible, the materials in question can have an additional purpose during the biodegradation phase. This can be done by turning biodegradable end-of-life materials into functional products, creating extra added value.

An example:
a biodegradable material can be turned into a non-woven root canvas or flower pots to be used in agriculture. This gives the end-of-life material extra added value.



G-star has developed and produced jeans made from 12% recycled cotton. Despite being a low quantity, the brand has achieved savings of 9.8% on its water consumption, 4.2% on its energy consumption, and 3.8% on its CO2 emissions.

https://www.circle-economy.com/tool/circlemarket/



F-ABRIC textiles from Freitag are made from fibres from hemp bark and flax; resources that are grown on European soil. Thanks to careful use of water and limited transport distances – from France to Zurich – these fibres are able to generate a more limited ecological footprint than, say, cotton.

http://ecodesign.vlaanderen-circulair.be/en/cases/cases-detail/freitag



HAVEP is part of the Van Puijenbroek Textiel Corporate portfolio and markets professional and safety wear. In order to satisfy the demand for sustainable professional clothing, HAVEP has launched the 'Rework' product line. This range consists of 100% cotton professional clothing and carries a Cradle to Cradle certificate (Bronze). Berendsen, Lavans and Initial (leasing/maintenance companies) have included the collection in their range and Van Gansewinkel (waste processing company) is to take care of collecting and processing end-of-life outfits.

https://www.havep.com/be-en/sustainability

Remarks on the use of materials from both cycles combined

In specific cases, you can also opt for a combination of both cycles, with certain subassemblies developed either according to a bio-cycle or a techno-cycle. The best-known example is polyester-cotton work clothing. The blend of bio and techno materials can result in specific properties which may be very interesting in specific fields. The blend of cellulose fibres (cotton and viscose) and polyester fibres can be used for the production of comfortable yet sturdy work clothes that are easy to maintain too. The polyester reduces the energy usage during the drying or ironing of washed professional textiles.

Given their potential contribution to the circular economy, it is important for the technical material clusters and the biomaterial clusters in discarded textiles to either be separated easily or to be reused as recycled hybrid materials.

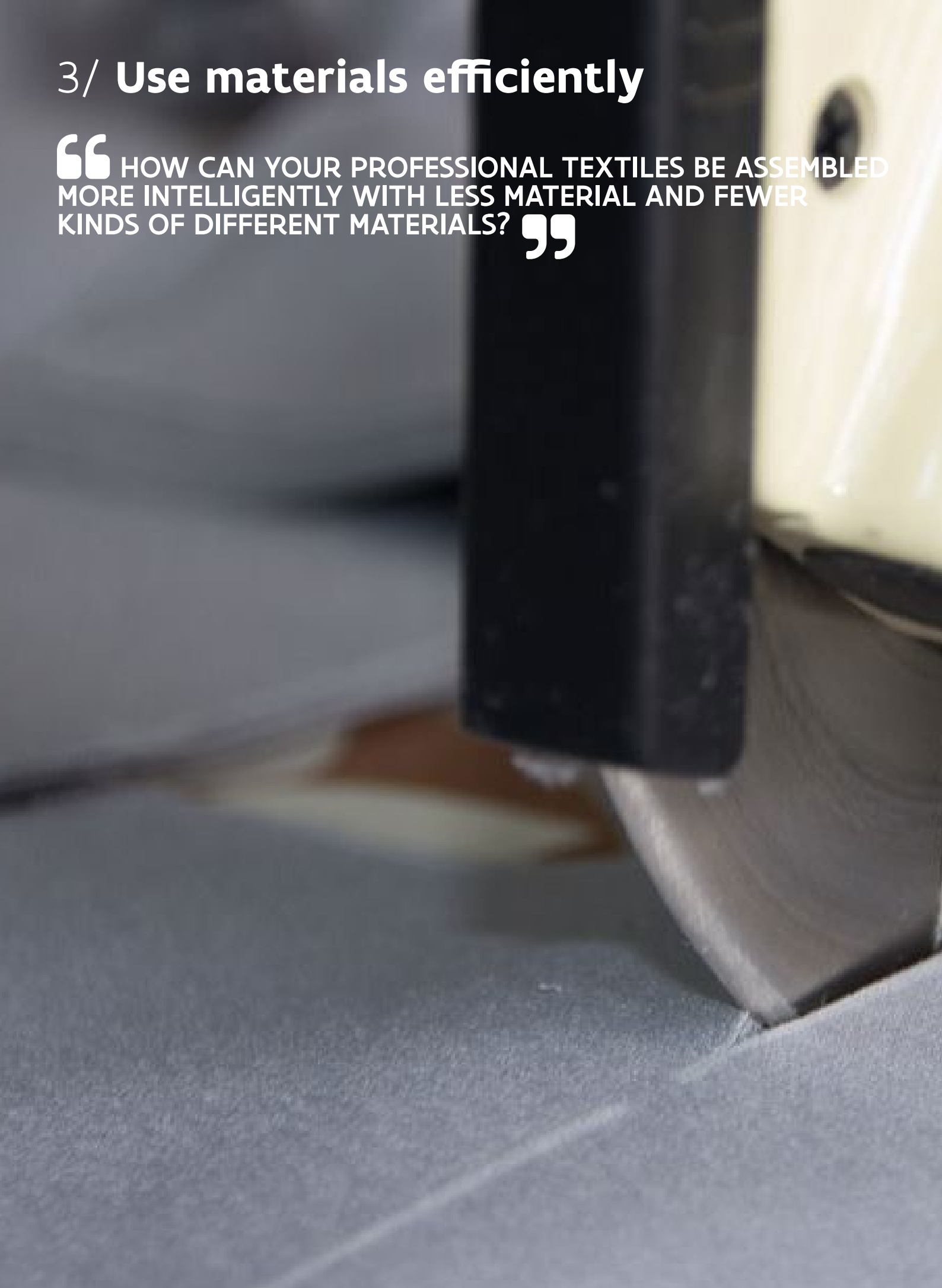
The separation of hybrid materials in bio and techno materials is usually technologically feasible, but it is not always economically and energetically justifiable. One way to separate polyester/cotton blends, for example, is to selectively dissolve one of both materials or to enzymatically break down cotton. These separation or destruction techniques are difficult to defend considering the potential to make new, useful products using recycled fibres containing both materials.

Hybrid materials that do not easily or quickly break down biologically can also be used in their blended form, to produce new mixed products.

A frayed jute/polypropylene carpet, for example, could be used for the production of durable WPCs (Wood Plastic Composites). The cellulose fibres in the PP matrix limit the creep behaviour of PP (polypropylene).

Mixed cotton/polyester fibres can be used effortlessly without being separated from one another for the production of various non-wovens. These can be used as thermal or acoustic insulation material, as fillers for cushions or mattresses, or as a filtering medium.

3/ **Use materials efficiently**



> HOW CAN YOUR PROFESSIONAL TEXTILES BE ASSEMBLED MORE INTELLIGENTLY WITH LESS MATERIAL AND FEWER KINDS OF DIFFERENT MATERIALS?

3/ USE MATERIALS EFFICIENTLY

"HOW CAN YOUR PROFESSIONAL TEXTILES BE ASSEMBLED MORE INTELLIGENTLY WITH LESS MATERIAL AND FEWER KINDS OF DIFFERENT MATERIALS?"

THINK UP NEW PROFESSIONAL TEXTILES THAT ECONOMISE ON MATERIALS (STARTING WITH THE BASIC USER NEED AND CURRENT FUNCTIONALITY).

Could additional services (e.g. a service contract) result in materials/components being used more efficiently for longer? Can we come up with new concepts for professional textiles that offer the same level of comfort, albeit with the use of (significantly) less material? Could additional services (e.g. a service contract) result in materials/components being used more efficiently for longer?

By law, professional textiles that are regularly subject to maintenance should be washed by professional dry cleaners and not by the users at home. Unfortunately, in practice, these textiles are still washed at home, which results in a much higher water and energy usage than strictly necessary. If all professional textiles were washed industrially, measures could also be taken to optimally reduce the release of micro or nanofibres during washing. The installation and maintenance of special filters could prevent the detached fibres to be discharged into the environment. Last but not least, industrial washing could also extend the lifespan of a lot of professional textiles.

AVOID OVER-ENGINEERING: AIM FOR MAXIMUM USER COMFORT AND A MINIMUM AMOUNT OF MATERIAL.

Try to leave out or redistribute the material based on where it is really required. Where could we leave out material in a specific product? Do you really require your functional professional textile clothing to be all bells and whistles? Are the dimensions of hospital sheets properly aligned with the width of the hospital beds?

Take proper measurements and avoid loose-fitting products and models.

Can the preferred thermal insulation of protective clothing be achieved by using less but better-insulating fibre material (e.g. by using hollow fibres instead of traditional fibres) or through special finishes (e.g. PCM-phase transitional materials) that can guarantee a better level of thermal comfort?

Clothing for surgeons or sheets to cover patients in the operating theatre are usually made using coated textile fabric. The question is whether the entire product should contain coated material. Can the back of the protective clothing, which has a low risk of being contaminated, be produced using a fairly open, non-coated textile instead, which would also make it more comfortable to wear?

AIM FOR A MINIMUM NUMBER OF DIFFERENT MATERIALS.

Use the same type of material as much as possible in complex textile products. Using fewer types of materials results in a less complex production process and fewer steps to be taken once the materials have been discarded (disassembly – material separation). Moreover, it boosts the volume of a limited number of material streams, allowing for more efficient recycling. A mass-driven process like recycling only becomes truly interesting when the volumes that can be processed together increase.

An example:
use polyester zips, PET lining, yarns and labels in clothing with an outer fabric made of PET. Once the entire product is discarded, it can be reduced in size and the recycled PET material can be reused for the production of plastics or textiles.

DESIGN AND GROUP COMPONENTS IN UNIFORM MATERIAL CLUSTERS AS MUCH AS POSSIBLE.

Uniform material clusters make any material separation that may be required less complex, thus limiting the time needed for disassembly and separation of the various materials to be recycled. Also, check whether you can leave out or combine any materials.

CHOOSE LIGHTWEIGHT MATERIALS.

Using more lightweight materials in clothing makes them more comfortable to wear and reduces the energy required for transport, which has a positive economic and ecological impact.

DIVIDE LARGE VOLUMES INTO SMALLER MODULES (MODULAR CONCEPT) TO BE ABLE TO REPLACE COMPONENTS EASILY.

Making professional textiles modular makes them easier to handle during transport, disassembly and material separation once discarded. Layered clothing with layers (lining, insulation, outer fabric) that can easily be connected or separated are more versatile to use in changing weather conditions.

Sioen, a major Belgian manufacturer of protective clothing, works continuously on 'dematerialisation' and aims to provide a special eco-clothing line. This eco-line consists of simple models in which all extras, such as additional pockets and unnecessary accessories (e.g. zips) are left out.

4/ Optimise the production process

> HOW DO YOU ENSURE THAT ALL PARTIES KNOW AND APPLY THE REQUIRED PRODUCT AND PROCESS INFORMATION?



4/ OPTIMISE THE PRODUCTION PROCESS

"HOW DO YOU ENSURE THAT ALL PARTIES KNOW AND APPLY THE REQUIRED PRODUCT AND PROCESS INFORMATION?"

AIM FOR EFFICIENCY IN THE COMPLETE PRODUCT-SPECIFIC VALUE CHAIN.

The production, distribution, use, maintenance and removal of professional textiles is a chain of different processes that are implemented for various companies such as fibre manufacturers, spinning companies, weaving mills, textile-finishing companies, clothing manufacturers, launderettes, recycling companies, logistics companies, etc.

As a result, you need to strive for efficiency in the full product-specific value chain. The better the various stakeholders know and understand all the processes, materials and ancillary products involved, the easier it becomes to achieve efficiency for the entire chain. Internal and external information, which is required to manage and control all these different processes, is also key.

REDUCE PRODUCTION WASTE, EMISSIONS AND ENERGY CONSUMPTION.

It is important to know the key environmental aspects and effects of the various processes, both in normal and abnormal conditions, and in case of emergencies.

Normal conditions are situations that allow for stable processes, with everything running smoothly. Abnormal circumstances are process start-ups, product transitions, machine maintenance, the application of new materials, deviating process parameters, new technologies or machines. An emergency situation includes serious process disruptions that do not allow for the known process controls to be applied, internal or external incidents, including fires, explosions that may cause serious environmental problems or damage to people or the infrastructure.

Process efficiency is influenced using the 5M-approach by:

- **Management:** the management decides on the policy to be followed and determines which resources, people, materials, methods and machines must be used/applied and how.
- **Materials:** different materials (virgin or recycled), material variations and excipients generally require different process parameters or additional checks.
- **Resources** (all of the machines and infrastructure required to carry out the processes): the condition of the resources, the set-up and adjustment options, and the degree of automation.
- **Methods:** procedures and work instructions with regard to scheduling, interventions during processes, quality controls, environmental measurements, registration of process data, tracking, etc.
- **People:** knowledge, skills, attitudes and continuous training of staff members.

These management and control elements must be periodically audited and assessed, with a clear focus on possible improvements.
The current 5M elements should not only be questioned in terms of quality guarantees, environmental management and safety, but they should also be geared to the sustainability of products and possible linked services, as well as their role in the circular economy.

Gearing these elements to sustainability and the circular economy also makes it easier to discuss partnerships with suppliers and customers. It is important to consider which details the parties involved are allowed to or must share.

An example:
the production schedule is very strongly influenced by how fast and accurately order and delivery details are passed on and processed.

Process optimisation can reduce production waste, emissions and energy consumption. But it also requires optimising the size of production batches or production runs, the use of realistic control limits, determining of clear quality requirements in terms of colour conformity, acceptable error margins, etc.
All of this is linked to product and process information, and it should be known and applied by all stakeholders. Discussions within the entire value chain can lead to quick wins for all concerned.

The efficiency of existing processes can be improved by:

- reducing the number of product variations in terms of composition, finish, colour, size, etc.;
- standardising raw materials and excipients as much as possible;
- introducing checks on recycled materials and critical raw materials as soon as they enter the production facility;
- working with ISO 9000- and 14000-certified suppliers;
- maximising the production batches or production runs – needless to say, this should be done based on orders received and stocks levels to be maintained – and by optimising the production schedule;
- setting realistic control limits based on the materials used and machine capability – applying statistical process control (SPC);
- carrying out detailed risk analyses (FMEA – Failure Mode and Effect Analysis);
- automating processes;
- making changes trackable – process monitoring;
- periodically analysing process monitoring data and setting up improvement projects;
- introducing an operational change management system that allows for any changes to materials, products, methods, machines, etc. to be discussed and approved;
- training and coaching operators;
- meeting any arrangements made on preventive maintenance;
- carrying out a thorough assessment into the causes of waste, quality issues, deviant consumption levels or emissions;
- consulting with both suppliers and customers – setting up cross-company teams focusing on improvement processes.

PAY ATTENTION TO NEW TECHNOLOGIES AND ANALYSIS TECHNIQUES.

It goes without saying that to improve processes and boost their sustainability, new technologies and analysis techniques must be considered.

1. **Digital printing**: this textile-printing technology has meanwhile proven its worth. It is used not only for the production of prototypes, but also in industrial production runs. This technology has made the production and cleaning of templates totally obsolete.

2. **Additive manufacturing**, also known as 3D printing: this technology allows you to create or directly print 3D objects (buttons, press studs, etc.) on textiles, and as a result, they no longer need to be sewn or welded on. There are currently quite a few (functionalised) polymers that are suited to this process. The production speed is still limited, but it is quickly evolving, which will increase the share of this technology in the future.

3. **Plasma treatment of textiles**: at the moment there are both vacuum and atmospheric plasma systems to change the surface properties of materials. Both hydrophilic and hydrophobic properties can be achieved. In the plasma phase, you can also add special chemicals to achieve special properties, such as biocidal properties. Plasma is a dry application technology that can replace a number of wet finishing treatments, thus reducing the use of water, chemicals, etc. However, the equipment needed is very expensive and textile companies are not sufficiently trained to use this technology, which is why it has not caught on.

4. **Application of supercritical CO2 (scCO2)**: given a specific pressure and temperature, CO2 gas can become supercritical, giving it special properties. CO2 then becomes a liquid with gas properties, which can easily dissolve dispersion colourings and other products. This medium is ideal for dyeing polyester and for washing textiles (to remove dirt). It limits water usage for washing and dyeing. This technology is also useful for the extraction of colouring agents from dyed polyester (bleaching) and for dyeing or bleaching other textile fibres. However, knowledge on the latter is still limited. The dyeing equipment and washing machines are discontinuous high-pressure machines, which are still relatively expensive.

DyeCoo, located in the Netherlands, has developed the first 100% water and chemical-free paint for colouring textiles on a large scale.

http://ecodesign.vlaanderen-circulair.be/en/cases/cases-detail/dyecoo

5. **Airlaid non-woven technology:** unlike the needle-felt technique, which is often used in Belgium, the airlaid non-woven technology is still relatively unknown. It eliminates the need for discarded textiles to be unravelled into individual fibres. EOL textiles can be chopped, cut or shredded and be used as dispersion materials for the production of airlaid non-wovens. The material, which has been reduced in size, is pneumatically dispersed and deposited onto a conveyor belt until the preferred layer depth has been reached. These loose materials are then pressed under pressure and at a specific temperature into a non-woven or sheet. In order for the loose materials to bind together, they need to be partially melted. Special melting fibres or powders can also be added to bind them all together. The resulting non-wovens or sheets are suitable for various applications, including building insulation, mattress fillers, draining mats, filtering systems, etc. This technology also allows for mixed material (e.g. polyurethane foam flakes and pieces of coated textile) to be crushed and pressed together thermally. Of course, this technology can also process new fibre materials.

Centexbel has conducted technological research projects into the majority of these new techniques. Do not hesitate to contact them, without obligation, for further information.

5/ Reduce the environmental impact of logistics

“WHAT SHOULD YOU CONSIDER WHEN WISHING TO REDUCE THE ENVIRONMENTAL IMPACT RELATED TO THE DISTRIBUTION OF PROFESSIONAL TEXTILES?”



5/ REDUCE THE ENVIRONMENTAL IMPACT OF LOGISTICS

WHAT SHOULD YOU CONSIDER WHEN WISHING TO REDUCE THE ENVIRONMENTAL IMPACT RELATED TO THE DISTRIBUTION OF PROFESSIONAL TEXTILES?

SET UP A COLLECTION SYSTEM FOR RETURNS.

Consider organising a returns system combined with the delivery of new professional textiles; design a system for grouped pick-ups.

Within the circular economy, a returns system may be useful for certain products, but bear in mind that the introduction of such a system in a small area is not always feasible and can actually disrupt the market. The take-back obligation creates opportunities for local producers, who can cash in on their efforts in terms of design-for-disassembly.

CHOOSE THE MOST ECOLOGICALLY RESPONSIBLE METHOD OF TRANSPORT.

Various factors (transport options and distance, accessibility, volume, time-frames, etc.) determine which mode of transport is the most suited, both from an economic and ecological point of view.

Limit the number of consignments (incoming & outgoing) and reduce distances. Combine consignments if this can boost efficiency levels and reduce the environmental impact, both in terms of delivery and collection.

Also, look at internal transport operations in warehouses. You can reduce the number of internal transport operations simply by reorganising goods in the warehouse.

Limit transport distances through vertical integration of production processes and local sourcing, production, maintenance and/or recycling.

An example:
if you want to shred, melt, spin, weave or process discarded professional textiles to produce new professional textiles, make sure the EOL volumes are sufficiently large to be stored and processed, preferably locally. It is not economically and environmentally justified to ship waste to the other side of the world, only to return and pick up the new product once finished.

USE THE ECOLIZER TOOL TO CALCULATE THE ENVIRONMENTAL IMPACT OF DIFFERENT METHODS OF TRANSPORTATION!

TOOL

MAKE OPTIMAL USE OF TRANSPORTATION AND STORAGE VOLUME.

But how can you keep volumes as low as possible without compromising on material quality? Can bulky professional textiles (bodywarmers, quilts from care homes, etc.) be vacuum-packed? Can the weight of sewing yarns and spools be increased? Can the spool length of the fabrics be increased to save on sleeves?

Can maximum lorry loads be increased with better route planning or collaboration? Tri-vizor can help you with this.

http://ecodesign.vlaanderen-circulair.be/en/cases/cases-detail/tri-vizor

ALLOW FOR DRY AND HYGIENIC COLLECTION AND STORAGE.

If humid or soiled materials are collected, there is a risk of cross-contamination and loss of value for the EOL materials.

OPTIMISE PACKAGING.

Keep packaging to a strict minimum while still taking the risk of damage and soiling into account.

- Use thinner materials and if possible, avoid secondary packaging.
- Make the product as small and light as possible, and package it as compact as possible.
- Check whether you can join any existing recycling systems, such as Val-I-Pac.

6/ Reduce the environmental impact of use



"WHAT CAN BE DONE IN THE DESIGN OF PROFESSIONAL TEXTILES TO MAKE USAGE ITSELF MORE SUSTAINABLE?"

6/ REDUCE THE ENVIRONMENTAL IMPACT OF USE

"WHAT CAN BE DONE IN THE DESIGN OF PROFESSIONAL TEXTILES TO MAKE USAGE ITSELF MORE SUSTAINABLE?"

CHOOSE REUSABLE/WASHABLE PROFESSIONAL TEXTILES.

To promote sustainability, opt for reusable/washable professional textiles, rather than disposables that can be used only once. That being said, for certain applications, such as hygienic and medical uses, disposables are sometimes recommended. Still, producers of disposables often exaggerate when considering the risks of medical contamination and they underestimate the social costs of destroying these textiles.

Of course, it is important to prevent the inappropriate and careless use of professional textiles. In this view, it is important to draw up and give easy access to accurate instructions for use and maintenance. And do not forget to consult with other stakeholders when purchasing or leasing to find out which professional textiles best meet your needs. Decision-makers and users are not always aware of the possibilities of the different types of professional textiles and as a result, they end up purchasing or leasing the wrong type, or they maintain it the wrong way. Clear catalogues from manufacturers with explanations about the various CE standards, labels, specifications and certification systems can have a preventive effect by reducing the environmental impact of use and maintenance.

Virtually all producers of professional textiles have a greater impact on the environment that merely linked to the production and sale of their products. Consequently, it is important to carefully consider the maintenance instructions of these products and to reduce the environmental impact of maintenance processes as much as possible. The goal should be to wash them at low temperatures, using the lowest amount of water and chemicals possible. It must be said, however, that this is not an option for certain textile products. Professional textiles for hospitals must always be subjected to thermal processes to optimally kill any harmful micro-organisms.

SIMPLIFY MAINTENANCE

Make sure the maintenance of professional textiles is a smooth process and discuss this aspect with the stakeholders. Many fibres that absorb moisture in professional textiles result in higher maintenance costs because they require more water and energy, for example. In this framework, check whether the professional textiles really need these moisture-absorbing fibres for their intended use.

An example:
the fluorescent vests that must be in accordance with EN 471 hardly ever come into direct contact with the skin. This makes comfort less important, so you can choose fibres that don't absorb moisture for these items.

Don't forget the matter of microplastics when considering sustainability. Virtually all textile fibres (both natural and synthetic) are polymer products. In their lifespan, polymers can disintegrate (partly), releasing an uncontrolled amount of micro or nanoparticles into the environment. The release of micro and nanoparticles due to the use and maintenance of textile products depends, among others, on their yarn structure, fibre width and length.
Twisted yarns with long and coarse fibres, for example, release fewer micro or nanoparticles. Textiles made of continuous filament yarns (rather than spun yarns) lose even fewer fibres. Because of their limited fibre loss, continuous filament yarns are used to produce protective textiles for clean-room applications, among others.

To further reduce the possibility of fibre loss, the seams of this professional clothing are usually covered with a special tape that keeps the yarns in place during maintenance. The coating of textiles can also significantly reduce the release of micro or nanoparticles, but it also makes these textiles harder to recycle.

ADD EXTRA PROTECTION OR REINFORCEMENT AND REDUCE MATERIAL STRESS.

Components that are subject to faster wear during use or maintenance can be protected or reinforced. Also, consider repair kits for these components, which will allow you to delay discarding torn professional textiles.

An example:
the handle of a fabric bag can be reinforced with extra lining and stitching to prevent it from tearing. Also, consider the design of the handle. There might be better and more sustainable options than a simple fabric string.

OrganoClick is a Swedish cleantech company marketing a water-repellent and sustainable textile coating.

https://www.close-the-loop.be/en/tips-tricks/tips-tricks-detail/91/organoclick

OPTIMISE PACKAGING IN TERMS OF REUSE AND RECYCLING.

- Reduce and leave out as much packaging as possible.
- Choose reusable and recyclable/biodegradable materials.
- Choose a packaging returns system.

7/ Opt for the optimum lifespan



> WHICH OPTIONS ALLOW YOU TO EXTEND THE LIFECYCLE, TAKING INTO ACCOUNT THE USER'S REAL USAGE AND MAINTENANCE CONDITIONS?

7/ OPT FOR THE OPTIMUM LIFESPAN

"WHICH OPTIONS ALLOW YOU TO EXTEND THE LIFECYCLE, TAKING INTO ACCOUNT THE USER'S REAL USAGE AND MAINTENANCE CONDITIONS?"

The visual and tactile properties of professional textiles are important elements that may encourage users not to discard them too soon.

Are there any treatments that can limit the appearance of visually annoying creases to ensure the textile looks good for longer? Can other materials be used to boost its visual qualities and limit creasing?

How can we optimise and extend the product's lifespan? What are the main reasons for discarding the professional textiles (wear, trends, colour loss, a loss of conformity with safety regulations, stains, detaching of trimmings or trimming errors, etc.)? How can we maintain the added value of new textiles as long as possible?

In this optimisation process, it is important for the producer and the customer to build and maintain a good relationship. This allows both parties to continue their search for options to further extend the product's lifespan, keeping in mind the end users' real usage and maintenance conditions.

USE MATERIALS WITH A LONG(ER) LIFECYCLE.

Switching from an ownership to a leasing model offers more possibilities to use high-quality materials. As a result, professional textiles or their components can be used for longer.

Determine the preferred quality level for each component of the professional textile item, so that all components will reach their end-of-life simultaneously. If this is not possible, make sure that the components that need to be discarded sooner can be replaced easily and affordably, without undermining the wearer's image.

An example:
you can produce a jacket with a very good zip an outer fabric that lasts very long, e.g. 70 wash cycles. However, if the lining used has low-strength seams and non-textured filaments are used, as well as low-density yarns, it is very likely that the lining will tear really quickly. So, make sure all components are of comparable quality.

Also, have a look at point 2. Select sustainable materials.

BALANCE TECHNICAL WITH AESTHETIC LIFECYCLE.

Apply more durable (permanent) finishes that can handle multiple washes. Professional textiles with timeless designs that do not keep account of current fashion trends need to be replaced less often. Using trendy fashion colours can push users to consider the textiles as EOL because they are no longer aesthetically pleasing. Discarding a product too soon is a pity, considering the energy needed to produce the material and considering the material in question is still usable.

OPT FOR MODULAR TEXTILES.

Replace the panels that wear quicker with stronger textile fabrics or protect them with coatings.

Make sure all components have the same lifespan or create subassemblies with different lifespans that can easily be detached. Search for alternatives for the weakest links or make them replaceable and easy to remove.
To boost the lifespan of clothing make sure the style can be adapted, (functional) upgrades can be made and the item in question can grow along with its user and be used even in different working conditions.
Keeping components as simple as possible and limiting them to a minimum reduces the risk of potential defects.

Use a modular base with replaceable components if you expect that the technical base will survive the design (or colour trends). Consider designing professional textile items in such a way that the components with longer lifespans can be reused (preferably by the same user or a colleague). Easily accessible components that can be smoothly replaced can help make the maintenance and repair process more efficient.

An example: a raincoat with a removable bodywarmer. If it's cold but not raining, the bodywarmer can be worn without the coat. If it's raining in summer, the raincoat can be worn without the bodywarmer. Temporarily removing components also boosts the clothing's breathability. You can even go one step further and make the fluorescent part modular. If the raincoat still protects its user from the rain, but no longer meets the high-visibility standards, the outer layer, which may be made from knitted mesh, can be replaced. This knitted mesh can be composed in such a way that it can also be worn on a T-shirt. This also reduces the need for materials and chemicals.

ONLY CHOOSE POST-TREATMENT / TEXTILE PROCESSES THAT HAVE A POSITIVE EFFECT ON LIFECYCLE AND RECYCLING.

- Wash the professional textiles at a lower temperatures;
- Use other drying techniques;
- Have the professional textiles washed industrially rather than at home by the employee.

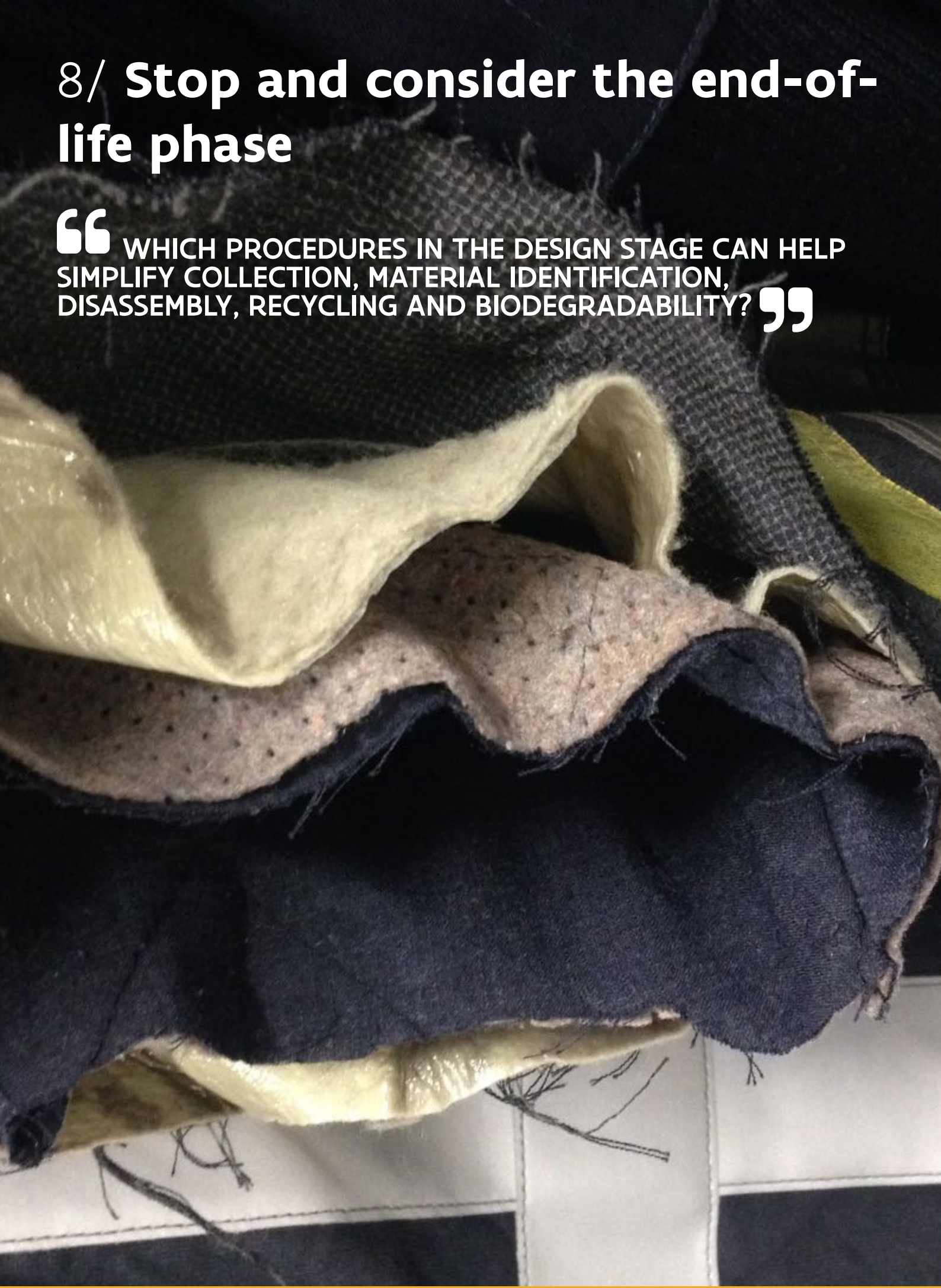
Post-treatment and textile enhancements can significantly extend the lifespan of textiles, but they can also downgrade the materials in terms of recycling and affect their biodegradability.

**Resortecs Smart stitch is a sewing thread that melts at high temperatures and makes disassembly for textile recycling simple and economical. Resortecs makes it simple and cheap to achieve a full circularity in the textile industry.
https://resortecs.com/**

'Care4Quality' and 'Care4Safe' are Belgian initiatives uniting textile companies, clothing companies, linen leasing companies and laundrettes that aim to extend the life of washable professional textiles, in terms of both quality and safety. Various other federations and Centexbel are involved as well.

8/ Stop and consider the end-of-life phase

“WHICH PROCEDURES IN THE DESIGN STAGE CAN HELP SIMPLIFY COLLECTION, MATERIAL IDENTIFICATION, DISASSEMBLY, RECYCLING AND BIODEGRADABILITY?”



8/ CONSIDER THE END-OF-LIFE PHASE

"WHICH PROCEDURES IN THE DESIGN STAGE CAN HELP SIMPLIFY COLLECTION, MATERIAL IDENTIFICATION, DISASSEMBLY, RECYCLING AND BIODEGRADABILITY?"

Both the quality of the textile product and the market demand for the item in question play a key role in its possible reuse. Boost the chances of it being reused by repairing it, cutting it and reworking it into a different product, adjusting the model, adding accessories, etc. From a financial point of view, however, this is generally only an option for relatively expensive items. Many professional textile products cannot be reused for safety reasons or to prevent possible fraud or damage to the user's image. Such products must demonstrably be destroyed or rendered unusable.

If direct or indirect reuse of professional textile products is impossible, the different recycling options should be considered. Here too, you must take into account economic laws in the framework of the circular economy that might change over time. Do the recycled materials still have residual value and can they be used for the production of new products? Are the recycled materials in actual demand? Are any additional treatments required before using the recycled materials?

What are both the benefits and the costs of the recycling process? All of this should be considered to come to the best decision. There is currently very little independent data on the economic, ecological and social aspects of various recycling and upcycling processes (mechanical, chemical, thermal) for professional textiles.
Knowledge on the processing of EOL professional textiles determines to which extent the subsectors concerned are capable of making these textiles more sustainable and giving them a prominent role in the circular economy. It is highly likely that in the next few years, this knowledge will get a significant boost.

Textile treatment companies and leasing companies are generally the main partners in the supply and maintenance of professional textile products. In principle, they could also become key players in the reuse and recycling of discarded professional textiles. In the long term, this makes these specialised service providers the ideal partners for the collection of sufficiently large and continuous material flows (sometimes mono-material flows) that can be converted into high-quality recycled materials in a profitable manner. However, most producers of professional textiles need to carry out additional research to allow them to process their waste streams sustainably, resulting in high-quality raw materials.

DESIGN TO RECYCLE.

A few key rules to facilitate the disassembly of composite products containing techno materials.

1. Develop the professional textiles using modular elements (exchangeable and easy to recombine). This allows the users themselves to disassemble the textiles, allowing for the different components to be collected separately.

2. Minimise the number of different material flows. This results in higher processing volumes and makes it easier to disassemble and separate materials. Watch out for stickers, price labels and other contaminating elements, which can seriously disrupt the processing. Also, reduce the number of different material types and if possible, use the same material as the one used for the label or sticker carrier, etc. This eliminates the need for material separation.

3. Ensure mono-material flows. The advantage of mono-materials is that they eliminate the need for disassembly and material separation, which are time- and labour-intensive processes. They also boost chances of the material being recycled in full, resulting in high-quality end products.

4. Aim for the smallest possible number of (different types of) connections between the materials. This makes it easier to disassemble/separate the materials with a minimum number of different tools. Opt for non-permanent connection points, such as click-in, clamp-on and screw-in connections. Try to develop the professional textiles in such a way that there is no need for glue or stitching yarn. This boosts the possibility of clean material separation with a minimal loss of quality due to contaminants like glue... Use quickly and easily attachable and detachable connections.

5. Make sure the connection points are easy to reach and identify the connection points for quick disassembly.

6. Make (dis)assembly possible with standard tools (or better still: without tools) or with as few different tools as possible.

7. Identify all materials so that they can be quickly separated into individual material flows. Use markers in the materials to help you easily identify them in the EOL phase.

CHOOSE A GOOD DESTINATION FOR DISCARDED PROFESSIONAL TEXTILES.

'Discarded' professional textiles can be collected by the users (the company or organisation), the leasing company (if any) or a waste collection company to be sorted for reuse, recycling or thermal valorisation (burning or converting them into fuel).

The user will often need to pay for further processing, but can also ask for compensation for the collected textiles. The market will determine the positive or negative residual value. If you have large quantities of professional textiles (in terms of items or composition) or you can offer them frequently, it is definitely worth looking into valorisation processes. Clustering and sorting of waste flows in collaboration with other companies or waste collection companies may be required to reach sufficiently high volumes.

The possible **reuse** of the collected textile products depends not only on whether or not it can be reused as such, but also on whether it needs to be repaired or cut, whether custom logos need to be removed, whether the materials have specific properties, etc. Certain professional textile items, like uniforms, corporate identity clothing or protective clothing that is no longer compliant cannot be reused as such and must be demonstrably destroyed. The value and reusability of a textile product as such depends on how worn it is, its composition, colour, etc. Moreover, the value can differ between the local market and the export market, where different laws and customs may apply.

Whether or not professional textiles can be **recycled** can be determined in advance based on whether or not they can be recycled, their market value and the usability of the recycled materials for certain applications, as well as their form (fibres, powders, granulates, etc.).

- Whether or not professional textiles can be recycled depends on, among others, the composition and structure of the textile offered (e.g. coated textiles cannot be unravelled), the energy required for the recycling process (shredding, unravelling, chopping, etc.) and its profitability, as well as the impurities and non-textile items present, such as metal zips and press studs.
- The market value of recycled textiles depends, among others, on the price of the 'virgin' textile, the fibre composition (natural, synthetic or mixed fibres), the chemical content (if colouring agents or finishes are present, this usually has a negative impact on the market value of the recycled materials) and the form in which the recycled material can be supplied, e.g. textile shreds or flakes, individual fibres that still need to be spun, etc.
- The usability of recycled textiles is determined by, among others, the

processing methods that can be used (spinning, needle punching, airlaid processes, filling, extruding, injection moulding, etc.) and the possible uses of the material in new textile products, non-wovens (thermal or acoustic insulation, filtering, etc.) or plastics. Loose textile materials can also be used as cushion fillers and to absorb oil or solvent spillages.

Thermal valorisation is always possible but often quite expensive. For soiled, contaminated or complex composite materials that cannot be purified or recycled in an affordable manner, at the moment, burning (possibly with energy recovery) is the only sensible solution. Another option is to turn them into fuel.

It can be useful to contact federations such as Fedustria, Creamoda, FBT, Go4Circle or knowledge centres such as Centexbel to examine potential solutions for certain textile products. For larger end-of-life flows it may be worth considering setting up an innovation project.

More questions? They will be able to help you further!

- Centexbel – Collective knowledge centre for textiles. **www.centexbel.be**
- Fedustria – Belgian federation for the textile, wood and furniture industry – **www.fedustria.be**
- Creamoda – Trade association for the clothing and clothes-making sector – **www.creamoda.be**
- FBT – Federation of Belgian textile care – **www.fbt-online.be**
- Denuo - Belgian federation of the waste and recycling sector – **www.denuo.be**
- Essenscia – Belgian Federation for the Chemical Industry, Plastics and Life Sciences – **www.essenscia.be**
- Agoria – Federation of the Belgian technological industry – **www.agoria.be**
- Euratex – European Apparel and Textile Confederation – **www.euratex.eu**
- EDANA – International association serving the non-wovens and related industries – **www.edana.org**
- CIRFS – European Man-Made Fibres Association – **www.cirfs.org**
- FEAD – European federation of waste management and Environmental Services – **www.fead.be**
- TEXTRANET – European network of textile research organisations – **www.textranet.net**
- Ellen Mac Arthur Foundation – Foundation promoting and supporting the circular economy – **www.ellenmacarthurfoundation.org/**
- Circular Flanders – OVAM team that helps companies and stakeholders in their transition into the circular economy – **www.vlaanderen-circulair.be/nl**
- Flanders DC – Flanders District of Creativity – falls under the government agency Flanders Innovation & Entrepreneurship, which supports the creative sector – **www.flandersdc.be/nl**