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RECYCLING OF WASTE ACRYLIC TEXTILES

D6.2: Recommendation on production chain and back logistic

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Abstract	New references on production chain for the management of textile industrial waste and references on back logistic, for the implementation of take-back and rental-services approaches.
Keywords	

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Acknowledgment

** REPORT: Document, report (excluding the periodic and final reports)*

DEM: Demonstrator, pilot, prototype, plan designs

DEC: Websites, patents filing, press & media actions, videos, etc.

OTHER: Software, technical diagram, etc

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CI	Classified, information as referred to in Commission Decision 2001/844/EC	
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EXECUTIVE SUMMARY

This deliverable has been created in the context of the Work Package 6 (LCA and Recommendations) of the H2020-funded project REACT (Grant No. 820869).

The document provides an overview of the work done in the Work Package 1 related to collection, separation and management of acrylic waste and the recommendations for other companies in the same sector or other with same problematics. The document provides indications on how to manage waste generated in the production phases and recovery systems of the material at the end of its life, through the establishment of agreements between suppliers and end users in order to reduce the quantity of material sent to landfill.

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ABBREVIATIONS

1 INTRODUCTION

The results of the project will generate new references on production chain for the management of textile industrial waste and references on back logistic, for the implementation of take-back and rental-services approaches. The production process is designed and set-up with the product specifications, but special modification could be made to enhance waste recovery and sorting, in order to reach higher recycling rates. The perspective is from the end of the production chain, outlining the waste generating steps. These outlined steps and the related solution adopted for waste management could be used by similar enterprises, or adapted to other sectors with similar productive process, thanks to the editing of specific recommendations.

In the textile sector, during the production phase, a quantity of material of about 12% of the incoming material is lost, through an internal system of management and separation of waste it is possible with appropriate processes to reintroduce this material into the production chain avoiding economic losses and bringing added value in the eyes of the consumer, who is increasingly attentive to environmental issues. On the other hand, another large amount of material lost in the textile sector results in the end of life, indeed this is hardly reintroduced into the production chain and disposed of in landfills through payments. This practice involves an economic and raw material loss, which can generate new markets avoiding environmental damage and resource depletion. A good management and information practice of the end of life collection with agreements between suppliers and consumers can lead to good practices that decrease the rate of material in landfills and increase circularity in the textile sector or in sectors with the same problems. These management practices will be covered in this document, introducing management perspectives and rental agreements including end-of-life recovery operations.

2 COLLECTION AND CLASSIFICATION PROCESS FOR ACRYLIC WASTE

The main objective of the React project is to reduce the quantity of acrylic waste coming from the production and from post -consume of awnings and outdoor furnishing fabrics destined to landfills and to the incinerator, and to develop treatments for its reuse. The innovation of the project lies in providing a treatment for the elimination of finishes before fraying and reusing it. The process for elimination of different finishes must be environmentally sustainable (i.e.to avoid to re-introduce the dangerous substances in the environment)

The process involves the collection of waste, the treatment to eliminate the dangerous substances coming from the finishing, fraying, spinning and then weaving and new finishing.

First, we identified the different types of waste coming from the production chain ranging from the fibre to the fabric, selecting them by shape in view of the fraying operation, and by type of finishing, considering the chemical treatments that have to be applied to eliminate the finishing products dangerous for the environment.

In the production chain, we identified four different waste sources/types:

- fibre from carding waste
- yarn coming from spinning and twisting
- selvedges from loom processing and finishing
- fabric from the quality control department and from the processing of awnings manufacture (from customers and from post-consumer)

These 4 types of waste have different finishing and therefore it is necessary to make a further classification according to this parameter:

- fibre/yarn have only the finishing oil applied during the production of the fibre by the supplier
- selvedges
    - selvedges coming from the loom have no additional finish compared to the yarn.
    - selvedges coming from finishing have the different finish used for awnings and beach umbrellas, or for upholstery fabric.
- fabrics that have different types of finishing depending on the final application
    - finishing for awnings and umbrellas with hydro and oil repellent characteristics
    - finishing for waterproof awnings with one side coated with a resin
    - finishing for furnishing fabrics.
    - fabrics with various types of deposits (dirt, smog, etc.) from post-consumer goods

The acrylic fibre for outdoor products is solution dyed and it is produces in dozens of different colours and to simplify we decided to separate only the white colour from all the other colours, whenever it is possible, therefore only for fibre and fabrics. From the fraying operation, two products will be obtained, one frayed white and one frayed melange, which is the result of the fraying of selvedges or multicolour fabrics (grey / beige melange)

This type of selection resulted in a classification of 29 different collected waste. To store and handle such a large number of waste is difficult to implement and therefore difficult to turn into a generalized recovery procedure for the European market.

For each type of waste, it is useful to build a "talking code" to facilitate its identification and to avoid any mistake in the handling and treatment phases.

Legenda	Description	Source
Waste 1	fibre from carding multicolour	spinning
Waste 1W	fibre from carding white	spinning
Waste 2	no-separable multicolour powder coming from suction filters (??)	spinning
Waste 3	fibre from spinning machine multicolour	spinning
Waste 4	multicolour yarn from spinning machine	spinning
Waste 4W	white yarn form spinning machine	spinning
Waste 5	multicolour yarn from winding machine	spinning
Waste 6	multicolour selvedges from weaving dpt	Industrial
Waste 7A	multicolour selvedges of awnings/umbrellas from finishing dpt	Industrial
Waste 7B	multicolour selvedges of coated awnings from finishing dpt	Industrial
Waste 7C	multicolour selvedges of furniture fabric from finishing dpt.	Industrial
Waste 8A	multicolour fabrics for awnings/umbrellas from quality control dpt.	Industrial
Waste 8AW	white fabrics for awnings/umbrellas from quality control dpt.	Industrial
Waste 8B	multicolour fabrics for coated awnings from quality department	Industrial
Waste 8BW	white fabrics for coated awnings from quality dpt.	Industrial
Waste 8C	multicolour fabrics for outdoor furniture from quality dpt.	Industrial
Waste 8CW	white fabrics for outdoor furniture from quality dpt.	Industrial
Waste 8A1	multicolour fabrics for awnings/umbrellas from customers	direct customer/Industrial
Waste 8AW1	white fabrics for awnings/umbrellas from customers	direct customer/Industrial
Waste 8B1	multicolour fabrics for coated awnings from customers	direct customer/Industrial
Waste 8BW1	white fabrics for coated awnings from customers	direct customer/Industrial
Waste 8C1	multicolour fabrics for outdoor furniture from direct customers	direct customer/Industrial
Waste 8CW1	white fabrics for outdoor furniture from direct customers	direct customer/Industrial
Waste 9A	multicolour awnings/umbrellas from end users	post-consumer
Waste 9AW	awnings/umbrellas white from end users	post-consumer
Waste 9B	multicolour coated awnings from end users	post-consumer
Waste 9BW	white coated awnings from end users	post-consumer
Waste 9C	multicolour outdoor furniture covers from end users	post-consumer
Waste 9CW	white outdoor furniture covers from end users	post-consumer

Figure 1. REACT waste collected.

By analysing the data related to the recoverable quantities, the shape and the finishing, it is possible to group 16 different types without compromising the fraying and treatment operations to eliminate the finish.

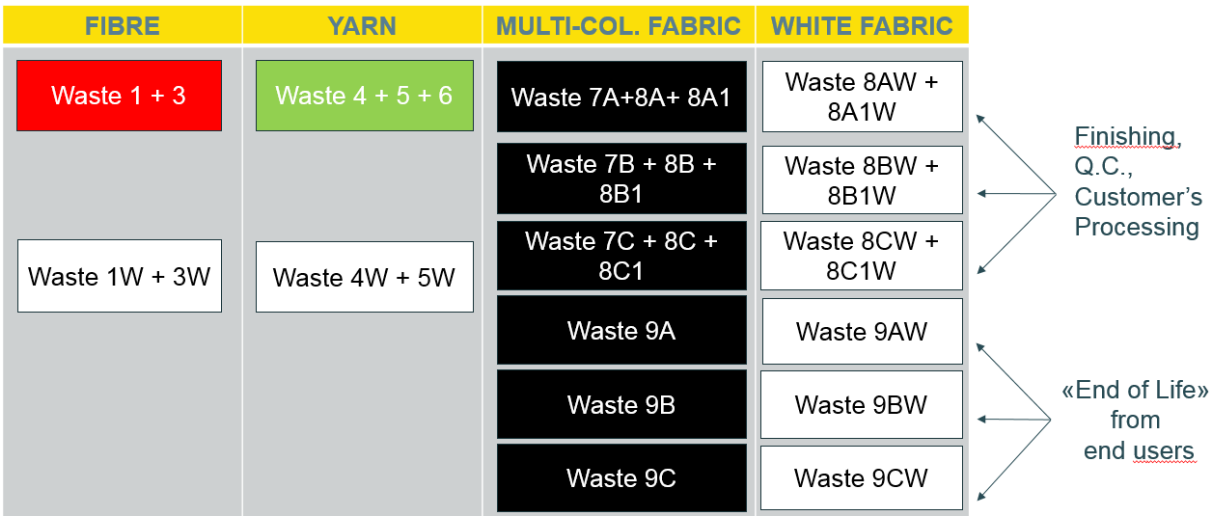

Figure 2. Plan design of waste storage.

Taking into consideration the available quantities, the possibility of fraying together some types of waste, the number of different types can be further reduced to 8, simplifying significantly the management.

In summary:

- Category 1: fibre + yarn coloured
- Category 2: fibre + yarn white
- Category 3: selvages + coloured fabric for awnings and beach umbrellas coming from finishing department, quality control, manufacturing;
- Category 4: white fabric for awnings and beach umbrellas coming from finishing department, quality control, manufacturing;
- Category 5: coated selvedges and coated coloured fabric for awnings and beach umbrellas coming from finishing department, quality control, and manufacturing;
- Category 6: coated white fabric for awnings and beach umbrellas coming from finishing department, quality control, and manufacturing;
- Category 7: selvedges+ coloured fabrics for outdoor furniture coming from finishing department, quality control, manufacturing;
- Category 8: white fabrics for outdoor furniture coming from finishing department, quality control, manufacturing.

3 RECOMMENDATIONS

The management and collection of waste from the yarn and fabric production process by both weavers and manufacturers of awnings or furnishing products can be managed within the same company and in some cases with the re-entry of the waste within the production chain without further processing. A fundamental problem to be addressed is the appropriate separation of materials with well-defined storage systems that prevent possible contamination or management ambiguity. Waste must be catalogued in a distinctive way with easy-to-understand labels and acronyms to avoid the problems described above. A separation between white and coloured fabrics can be implemented according to the type of fibre and the management of the material according to use. In the case of REACT, since the acrylic is solution dyed, the distinction between the two types of colouring can lead to benefits for the material second life even if it doubles the management, storage and separation systems.

If there are no problems from the point of view of the collection of the waste coming from the yarn and fabric production process, some more problems can be found in the recovery phase of the material at the end of life (post-consumer).

The large manufacturing companies of awnings directly supply a large number of installers and customers (who have their own brand recognized by the market) which, in their turn, have countless installers for the positioning of the awnings. The person who carries out the assembly is generally the same installer who collects the old awnings (post-consumer) who very rarely returns it to the manufacturer and then ends up in landfills. An innovative management system that can recover the maximum quantity of fabric should guarantee transparency and knowledge to the entire fabric use chain, informing the final consumer of the possibility of recovering the material at the end of its life. Specific documentation provided to the customer at the time of installation, describing how to return the material, can be implemented as a method to make users aware.

The awnings coming from the post-consumer must be disassembled by eliminating the metal parts (sometimes including the aluminium structures) and the areas of connection of the sheets performed either by sewing with a PTFE or polyester / cotton yarn or by welding. To carry out this operation it would be necessary a special instrumentation that cuts the area of the sheets that would be an obstacle in the subsequent recycling process.

The recovery of fabrics for beach umbrellas is facilitated by the fact that this market is in the hands of a few large producers who already recover the umbrellas of their structures for changing the fabrics, a change that occurs more frequently than the awning because the "style" of the organized bathhouses force these changes to happen more often than awning.

3.1 Proposal for the recovery of the fabrics

Today all the participants in the outdoor world supply chain, from spinning to the end customer, send the waste in different shapes to landfill paying a cost for collection and disposal. In the near future, when the REACT project will have fine-tuned and verified the possible reuse of chemically treated and frayed waste, the following recovery scheme will be feasible. The waste (spinning, weaving, manufacturing companies) and post-consumer materials recovered by the installers could be conveyed to a single Platform-consortium that collects the material free. This Platform perform following tasks:

- disassemble the fabric from any supporting element (aluminium structures, rubber tubes used for mounting the sheets, etc.)
- eliminate the seams / welds of the awnings and seams / zippers from the furnishing fabrics;
- separate the various types of waste into categories and pack for transport
- resell to the companies that will be able to treat it according to the REACT procedure to be then resold as recycled material to spinning mills.

In the way the waste producers recover the disposal costs, the platform recovers their costs for the disassembly by reselling the material to be treated to the company, which will make a profit from the sale of the recycled material after the planned treatments.

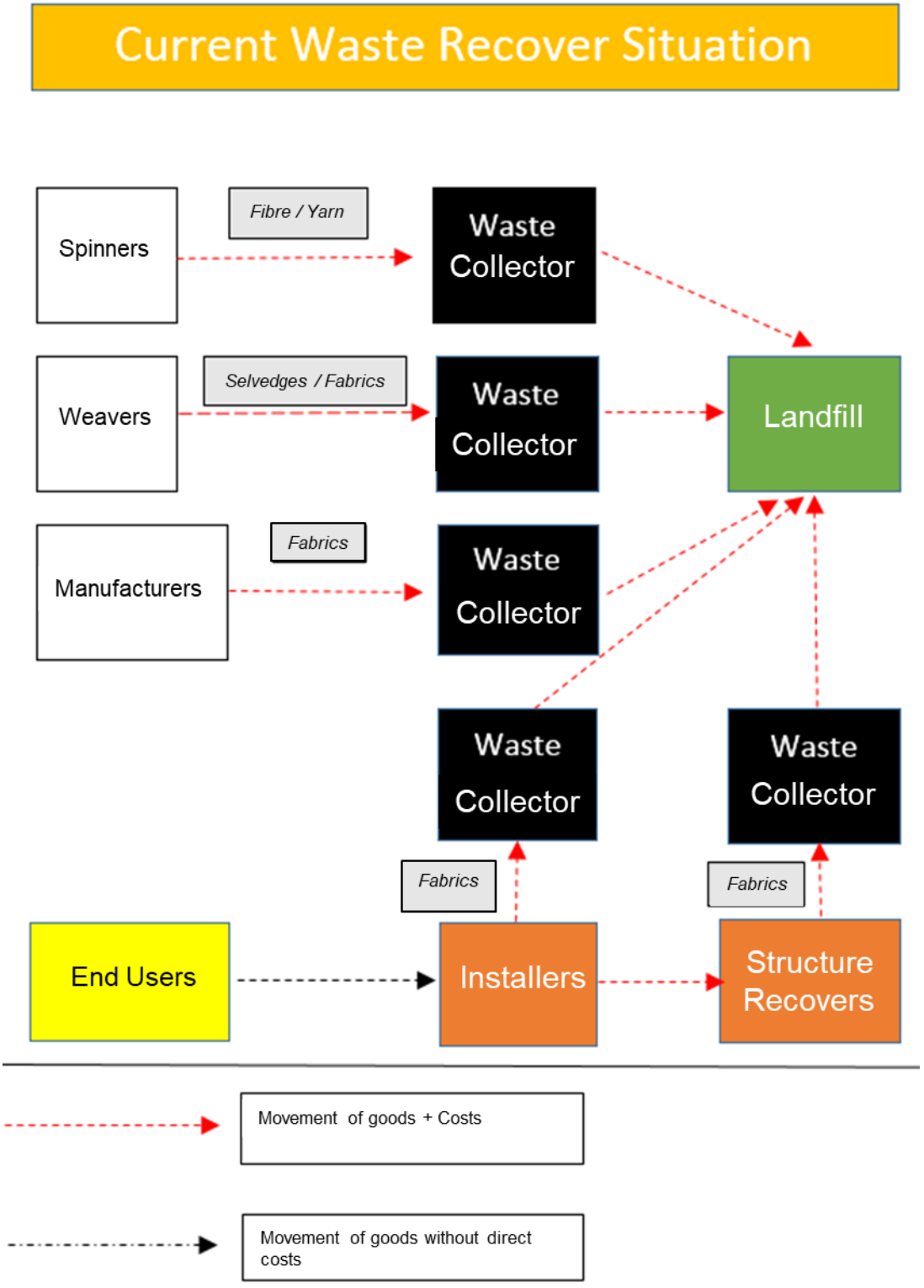

Figure 3. Block diagram of current waste management.

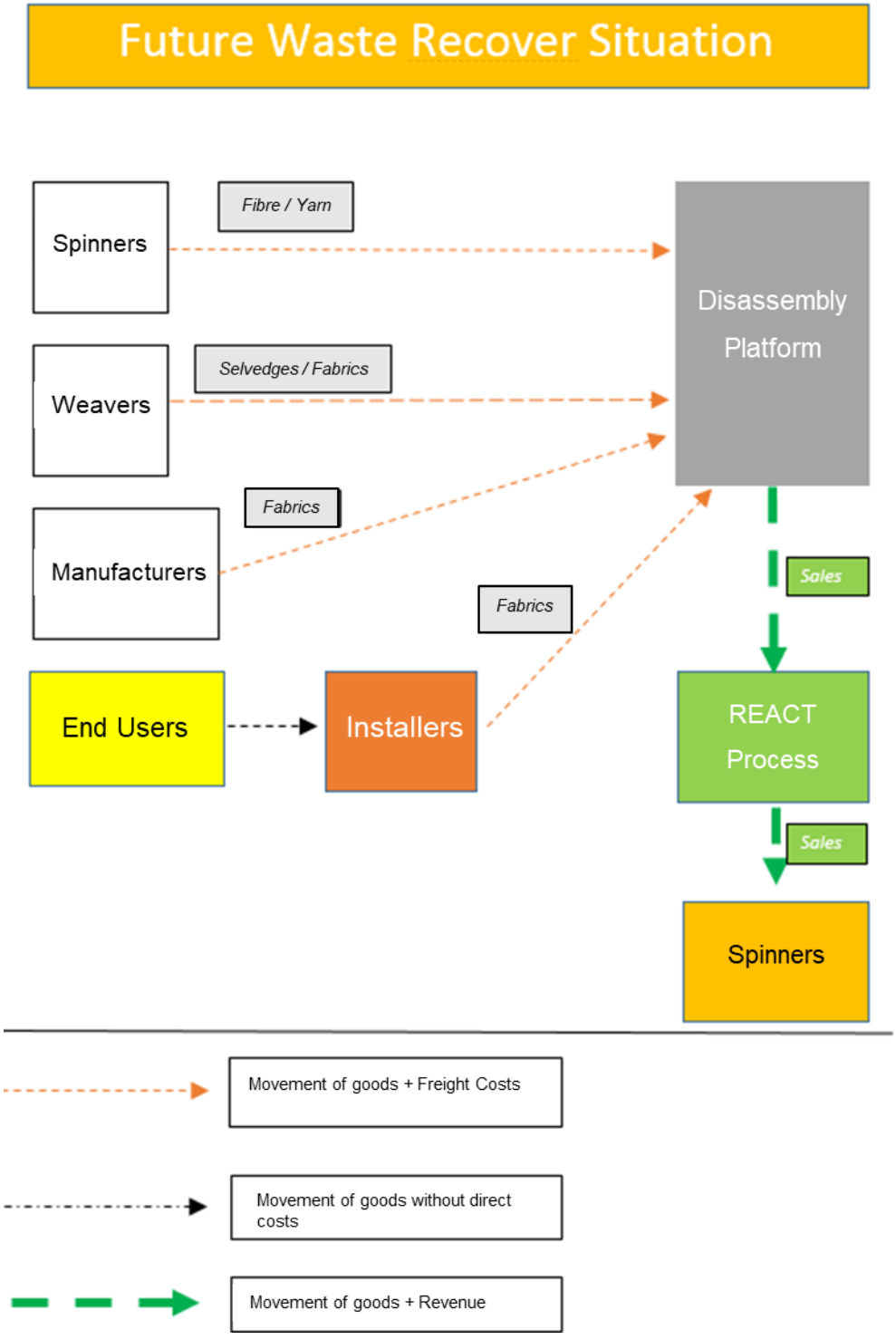

Figure 4. Block diagram of proposal waste management.

The success of the project, once the chemical treatment and fraying process will be in place, will depend on the amount of recovered materials and on the cost of treatments.

3.2 Rental-service proposal

There is currently no rental-service proposal in the world of outdoor fabrics. This service would allow installers to build customer loyalty at the time of installation by ensuring the recovery of acrylic material

to be treated and therefore to be recovered to be reworked. Given that the awning is guaranteed for 8-10 years and the fabric for outdoor furniture for 5-6 years, the installer could guarantee a replacement of the fabric at the end of the warranty period with a possible discount on the market price, guaranteeing the withdrawal of the used and the commitment to recycle through the recovery in the Platform-Consortium.

In a vision of growing need of sustainability, this could be a way to ensure the recovery of a substantial amount of the acrylic fabrics at the end of their life.