

# Turing-Manchester Feasibility Project

## Funding Application

Please complete and return this form by email to [matthew.harrison@manchester.ac.uk](mailto:matthew.harrison@manchester.ac.uk) by

**23:59 on Thursday 9<sup>th</sup> December 2021**

### Project Title and Duration (max end date 30 Sept 2022)

Title	Start Date	End Date
<b>DRES ME - Data science to Recycle textiles for Environmental Sustainability - Manchester Engagement study</b>	01/04/2022	30/09/2022

### Investigators (budget holder must be UoM staff)

Name	Organization	Role (lead; budget holder; co-author; other)	Email
Alejandro Gallego Schmid	The University of Manchester, Tyndall Centre	Co-author	<a href="mailto:alejandrogallegoschmid@manchester.ac.uk">alejandrogallegoschmid@manchester.ac.uk</a>
Claudia E Henninger	The University of Manchester, Department of Materials	Co-author	<a href="mailto:Claudia.Henninger@manchester.ac.uk">Claudia.Henninger@manchester.ac.uk</a>
Celina Jones	The University of Manchester, Department of Materials	Co-author	<a href="mailto:Celina.Jones@manchester.ac.uk">Celina.Jones@manchester.ac.uk</a>
Sandra Sampaio	The University of Manchester, Department of Computer Science	Lead and budget holder	<a href="mailto:S.Sampaio@manchester.ac.uk">S.Sampaio@manchester.ac.uk</a>
Gianpaolo Vignali	The University of Manchester, Department of Materials	Co-author	<a href="mailto:Gianpaolo.Vignali@manchester.ac.uk">Gianpaolo.Vignali@manchester.ac.uk</a>

Songyi Yan	The University of Manchester, Department of Materials	Co-author	Songyi.Yan@manchester.ac.uk
Alan Wragg	Tesco	Industrial partner	Alan.Wragg@tesco.com

## Project Description

Over 2 tonnes of clothing are purchased in the UK per minute, with less than 5% being recycled<sup>1</sup>. Globally, approximately 134 million tonnes of textiles will be discarded annually by 2030<sup>2</sup>. Challenges with clothing recycling centre on fabric compositions (e.g., fibre blends), which makes it a difficult and expensive process.

This multi-disciplinary project focuses on post-consumer textile waste recycling. A key priority, as currently only 1% of materials are recycled, with most either being landfilled (20%) or incinerated (80%)<sup>3</sup>. TEAC (2019) estimates textile waste to have an economic worth of £140m annually, which shows economic opportunities<sup>4</sup>.

This project investigates:

1. Status quo: recycling practices

Key questions are: what recycling methods are available? What are potential issues with implementing technologies that could identify recycling practices (e.g., *internet of things (IoT)*, or *artificial intelligence(AI)*). (Achieved through systematic literature review).

2. Barriers: implementing technology

Although technologies (e.g., *IoT*, or *AI*) exist, it is unclear why these are not readily implemented. Barriers will be identified through stakeholder interviews, with those that have an invested interest in textile recycling.

3. Data analysis: scale up textile recycling

Scaling textile recycling is challenging due to high economic cost. Key information required to make this process more cost efficient includes, textile composition, performance properties, finishing. Environmental impacts should also be calculated to aid the decision-making process.

Together with Tesco, identification of relevant data sources/sets, data integration, preparation and analysis will be performed. We seek to demonstrate the potential of a data-driven approach to textile recycling, via which better understanding of dependencies and correlations between textile properties, economic costs and environmental impact can be obtained and used to improve decision-making and recycling practices. It is envisaged that such proof-of-concept approach would allow Tesco to identify how garments/textiles should be recycled and predict environmental impact and economic costs.

<sup>1</sup><https://www.oxfam.org.uk/oxfam-in-action/oxfam-blog/new-shocking-facts-about-the-impact-of-fast-fashion-on-our-climate/>

<sup>2</sup><https://www.bbc.com/future/article/20200710-why-clothes-are-so-hard-to-recycle>

<sup>3</sup>[https://wrap.org.uk/sites/default/files/2020-10/WRAP-valuing-our-clothes-the-cost-of-uk-fashion\\_WRAP.pdf](https://wrap.org.uk/sites/default/files/2020-10/WRAP-valuing-our-clothes-the-cost-of-uk-fashion_WRAP.pdf)

<sup>4</sup><https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/1952/report-summary.html>

## Co-creation basis of the proposal

We have managed to secure Tesco as an industry partner, who is also working closely with the Salvation Army. As stated in Tesco's letter of support, Tesco is already looking into recycling practices, yet has faced various challenges:

- 1) The process is very labour intensive and thus costly, which makes it not always viable to keep in the country.
- 2) Technologies currently available may not be accessible and/or are currently not at the stage to be scaled-up.
- 3) There are issues surrounding colourants and machinery being able to identify fibres.

These challenges raise a number of questions, including the following:

- To what extent can recycling processes be automated? And what technologies could be used to achieve an *appropriate* level of automation?
- What negative economic, social or environmental impact can automation bring in the short, medium and long term (e.g., job losses, increase in energy consumption and costs, etc.)?
- What challenges to scalability and sustainability do currently employed recycling mechanisms create? And how could these challenges be overcome?
- What information about textile properties can be used to improve textile recycling practices and processes?
- How easily can data associated with textile properties, recycling processes and practices be found? Or how easily could additional data be collected/generated?
- What data science methodologies and techniques are suitable for processing and analysing the data?

This interdisciplinary project seeks to address some of these challenges by means of the following:

(i) Discovering relevant sources of data relating to textile properties, recycling processes and practices: our initial interaction with Tesco has suggested the availability of rich sources of data describing the composition and other textile properties of garments, resulting from 20 years of collection and storage of results from chemical testing on textiles, as well as information about the limitations of current recycling practices and technologies, e.g., for identifying fibers.

(ii) Investigating the suitability of methodologies and techniques for data preparation/pre-processing and analysis, to obtain insightful information that can be used to aid decision making and improve recycling processes: an initial investigation suggests the availability of a multitude of publicly available sources of data pre-processing and analysis pipelines, including Kaggle<sup>1</sup>, GitHub<sup>2</sup>, and data.world<sup>3</sup>, among others.



White paper	Challenges/barrier to implementing technology to identify recycling practices										
Proof-of-concept (methodology)											
<b>18-24 months</b>											
Proof-of-concept (methodology)											
Conference attendance											
Stakeholder mapping and power dynamics											
Curriculum development 1 <b>Materials</b>	<b>Example Units</b>										
Curriculum development 2 <b>MACE</b>											
Curriculum development 3 <b>Computer Science</b>											
Funding bid	Currently under consideration: ORA8, Innovate UK (Scale up of algorithm assessment)										
<b>24 months onwards (2023-2024)</b>											
Paper development from conference											

The team will continue to work together on issues surrounding technology and the implementation in the recycling process, especially within sorting and analysing garments. The systematic literature review (outcome of Turning bid) will be refined and submitted for publication in a Q1 journal (e.g. *Journal of Cleaner Production*) and will act as a baseline for the white paper, which will be presented to stakeholders, and could act as a policy brief.

Results from the methodology will further be transformed into a research paper, to be submitted to *Nature* (Q1). It is envisioned that there will be a spin-off company that could be discussed with The University of Manchester Innovation Factory.

Focusing also on The University of Manchester's sustainability goals, this project will be used to inform teaching and update the curriculum with up-to-date research (e.g., MATS11201; MACE30262; COMP60711). Curriculum developments can be evidenced across three different departments.

### Funding Requested

Please use your RS Hub to provide costings. Only direct costs will be eligible under this grant (recoverable at 100% fEC).

Cost Type	Description	Cost (£)

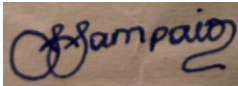

Directly incurred staff costs	4 months PDRA (not including overheads)	£ 16,699.15
Travel		
Consumables	Depending Covid-19 restrictions – face-to-face interviews (might require travel)	£500
	Laptop (high specs to run methodology)	£2,500
Other costs		
Total		£19,699.15


The PDRA is required full-time for 4 months to develop the methodology indicated in the project. Depending on the candidate recruited for the position, there may be a need to upgrade their current laptop/desktop to one that can run different programs, which requires higher specs.

Additionally, all members of the team will provide in-kind contributions of their own research time to conduct interviews and also complete a systematic literature review for the status quo (Objective 1).

Please also note that ethical approval for conducting stakeholder interviews is already in place: Ref: 2021-12072-19839. Thus, the project is not only ambitious, but also feasible. Depending on Covid-19 restrictions interviews can be conducted both face-to-face or online via zoom.

**Signatures** (electronic is fine)

Principal Applicant	Dr Sandra Sampaio 
Co-Applicants	Dr Alejandro Gallego Schmid 

Co-Applicants	Dr Claudia Henninger 
Co-Applicants	Songyi Yan <i>Songyi Yan</i>
Co-Applicants	Dr Celina Jones <i>Celina Jones</i>
Co-Applicants	Dr Gianpaolo Vignali 