ukft

POSITIVE FASHION

CIRCULAR CONCEPT LAB

Circular Manufacturing Report

Circular Fashion Innovation Network

Foreword

I am delighted to present the Circular Manufacturing report, which provides an overview of circular manufacturing in the UK textile and apparel industry. It explores current circular initiatives and practices in the sector and presents actionable steps manufacturers can take to integrate circularity into their products and processes.

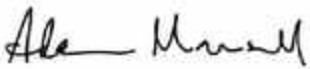
The UK textile and apparel manufacturing sector, with its significant socio-economic contributions, is uniquely positioned to lead the charge in circularity- whether it is with the adoption of circular strategies and low-impact manufacturing processes but also enabling and supporting stakeholders across the supply chain — including designers, brands and retailers — in their circularity goals.

The connection between manufacturers and brands is crucial to ensure that circularity practices are integrated throughout the supply chain. The report shows examples where brands are working to implement circular strategies in collaboration with manufacturers, creating a connected ecosystem, where products are designed and produced with circularity at their core.

The report showcases a series of UK and international case studies that illustrate how textile and apparel manufacturers are successfully implementing circular strategies, focusing on three circularity principles: reduced material impact, optimised product life and closed loop. The report also highlights innovative technologies and cutting-edge tools that are playing a critical role in enabling circularity in manufacturing. These include, for example, 3D and configuration technologies, automation and robotics, design for disassembly solutions, such as heat-dissolvable stitching threads, software-as-a-service platforms to connect textile waste with optimal recycling solutions, among others.

While the shift towards circular manufacturing for textiles and apparel has gained momentum, there remain opportunities to promote more widespread adoption. In the report, we have identified seven priority action areas, which outline the way forward for circularity in the industry for manufacturers to meet circularity goals, including the need for collaboration and partnerships to create a connected ecosystem, staying ahead and compliant with circularity regulations, gaining third-party verification through recognised standards and certifications, upskilling the workforce in circularity principles and digitalisation, working with education and training providers to prevent skills gaps, embracing new technologies and innovations, and staying aware of funding opportunities to enable the transition to circular practices. We hope this report demonstrates the textile and apparel manufacturing sector's potential for innovation, sparks ongoing conversations about transformation and strengthens coordinated efforts to achieve a circular textile and apparel ecosystem in the UK.

This report has been developed through the Circular Fashion Innovation Network (CFIN), an industry-led initiative by the UK Fashion and Textile Association and the British Fashion Council, in partnership with UK Research and Innovation. CFIN aims to accelerate the UK's journey toward a fully circular fashion and textile ecosystem.



Adam Mansell, CEO UKFT

CIRCULAR FASHION INNOVATION NETWORK (CFIN)

UKFT is co-chairing a new circular fashion programme in partnership with the British Fashion Council (BFC), which supports and guides the creation of a circular fashion ecosystem in the UK.

CFIN is funded by UK Research and Innovation (UKRI) via Innovate UK, Arts and Humanities Research Council (AHRC) and Natural Environment Research Council (NERC) and will be aligned to the Institute of Positive Fashion, a partnership between BFC and UKFT. The programme has six main areas of focus: Recycling infrastructure, Sstainable manufacturing, Circular business models, Novel technology, Diverse and future-proof workforce and Green growth.

UKFT's main areas of activity are on **recycling infrastructure** and **sustainable manufacturing**, and will be complemented and supported by a number of practical innovation and research projects to boost the competitiveness of the UK fashion and textile industry.

The programme will explore ways to reduce waste, lower the environmental impact of production and consumption in the UK while creating new opportunities for the UK fashion and textile industry. It will also link to existing projects to harness best practice and develop emerging technologies. UKFT and the BFC will set out their collective roadmap for change over the next few months.

You can read more about CFIN and UKFT's involvement **here**.

Acknowledgements

REPORT TEAM

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FURTHER ACKNOWLEDGEMENTS

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Circular manufacturing

BACKGROUND

The global textile and apparel industry has begun to explore its transition to a circular system in the past decade, and this has been accelerated in recent years. Consequently, we are witnessing a significant rise in innovation of new materials, processes and technologies to reduce environmental impact and reach circularity. New business models and services are also emerging to support product reuse, repair, remanufacture and recycling.

A successful circular textile and apparel system depends on commitment from many different stakeholders in the supply-chain and along the product life-cycle, all working together to identify key challenges and to innovate, test and scale new ways of developing, producing, using and recycling textile-based products.

The development and near-future implementation of a growing number of textile and apparel specific global regulations is providing further impetus for businesses to accelerate their efforts to reach circularity.

In the UK, all stakeholders across the textile and apparel supply-chain must transition from linear to circular to meet circularity targets, and the UK textile and apparel manufacturing sector plays an important role in this transition. A 2021 report by Oxford Economics highlights the significant impact of the UK apparel and textile sector, which contributed an estimated £62 billion in gross value added (GVA) to the UK Gross Domestic Product (GDP). Beyond its direct operations, the industry generates substantial economic impact through purchases from UK suppliers, reinforcing the economy via indirect channels. The industry also supports approximately one in every 25 UK jobs, providing employment across a range of sectors and benefiting key demographics. Specifically, the creating and manufacturing segment alone contributed £6.4 billion in GVA to GDP in 2021, representing 0.31% of total GVA. With these strong economic contributions, the UK textile and apparel manufacturing sector holds a strategic opportunity to lead in innovation and competitiveness by adopting circular strategies. Thus, sustainable manufacturing is a core pillar of the UK's Circular Fashion Programme.

The UK textile and apparel manufacturers are in a unique position to support designers, brands and retailers to design and manufacture, and potentially remanufacture circular products. These manufacturers have the power to, specifically:

- Enable designers, brands and retailers to create products that have been developed and manufactured in line with circular design strategies.
- Support brands and retailers to develop circular business models by offering relevant services to enable the optimisation of product life and end-of-life management (i.e. repair, upcycling, remanufacture and recycling).
- Utilise lower impact and circular manufacturing processes (i.e. minimise and recycle textile and other production waste) and enabling technologies and systems to reduce environmental impact.
- Create positive socio-economic impact by expanding UK manufacturing capacity and creating jobs.

As demonstrated by the EU ecodesign requirements, circular product creation begins during the design process, while textile and apparel manufacturers need to continue and support the process by embedding circularity principles into all manufacturing steps. These principles originate from the three overarching circular economy principles identified by the Ellen MacArthur Foundation, including the elimination of waste and pollution, circulation of products and materials at highest value for as long as possible and the regeneration of nature.

The Foundation further describes that in a circular fashion system, *"products are made from safe and recycled or renewable inputs, used more and made to be made again"*. Building on the Ellen MacArthur Foundation's work, many circular design guides have been developed, and the three key circular design strategies can be summarised as design for:

Reduced material impact

Optimised product life

Closed loop

These circular principles can be equally applied to a textile and apparel manufacturing context, which is further explained in the next page

REDUCED MATERIAL IMPACT

To reduce the environmental footprint of a product, the first step is to minimise the impacts of the raw materials. Textile manufacturers can develop durable and lower impact materials with integrated end-of-life options, while apparel manufacturers can support smaller brands in the purchase of lower impact materials, such as renewable, recycled and recyclable, where possible. To save resources including raw materials, energy and water, both textile and apparel manufacturers can utilise three-dimensional (3D) design and sampling softwares to drastically reduce the need for physical sampling.

Apparel manufacturers can also aim to reduce material waste by utilising minimal waste patterns and deadstock materials. This can be achieved using digital and artificial intelligence (AI) technologies, as well as 3D manufacturing methods, which can often be dropped into existing manufacturing set-ups to achieve significant material savings.

OPTIMISED PRODUCT LIFE

Research and life-cycle analysis has shown that that the environmental impact of reusing garments and extending their lifetime is significantly lower than the production of new garments. Therefore, it is essential that apparel manufacturers support designers, brands and retailers to optimise product lifetime.

This approach does not only require considered material choice, but the ability to extend product lifetime through suitable manufacturing techniques (i.e. stitching and reinforcement), which can support product durability. It is also necessary to explore alternative construction methods to enable easy repair and recycling. In addition, apparel manufacturers can consider whether they are suited to setting up additional services for brands, retailers or consumers, such as professional repair or upcycling services. There is also an opportunity to innovate and create new circular manufacturing methods such as reprocessing of unsold or discarded stock.

CLOSED LOOP

Textile manufacturers can contribute to closed loop products by innovating and adapting materials into existing and emerging recycling technologies, boosting the production of fibre-to-fibre recycled content in textiles. In addition, textile and apparel manufacturers can also consider whether to install in-house recycling facilities or partner with a textile recycling service to convert any production waste into new raw materials.

To support the closed loop concept, garment manufacturers need to work closely with designers and product developers to craft mono-material products, which can be recycled within one system or technology, or integrate feasible disassembly options for multi-material products. This can be helped by utilising a new generation of smart stitches and threads, which can be disassembled through a range of emerging technologies at a product's end-of-life.

Textile and apparel manufacturers can also recycle and reuse beyond textile waste. Water, energy, colour, can be recovered or recycled and brought back into production, closing the loop.

Case studies

The following pages feature a series of selected case studies, both UK and international, that demonstrate how textile and apparel manufacturers or innovations in this space are implementing different circularity strategies or solutions to stay competitive, reach circularity goals and reduce their environmental footprint throughout the textile and apparel manufacturing process.

Each case study presents the business and their main circularity initiatives, whilst referring to the key circular strategies the case study contributes to: **reduced material impact, optimised product life, and closed loop**. Key partnerships and collaborations are also highlighted throughout, demonstrating the importance of collaboration to find and implement circular solutions.

A review of these case studies reveals that even the most traditional textile and apparel manufacturers are actively participating in driving circularity in the UK and a growing number of start-ups are innovating solutions to help accelerate and boost this transition.

Abraham Moon and Sons Ltd

TEXTILE MANUFACTURER

Name: Abraham Moon and Sons Ltd

Location: Leeds, UK

Business size: Medium-sized (50-249 employees)

Founded: 1837

About: Since 1837, Abraham Moon has crafted premium wool and natural fibre fabrics in Yorkshire. As a vertical mill, the company ensures quality and consistency by using eco-friendly materials. Renowned for beautifully coloured, expertly crafted yarns and meticulous finishing, its British-made collections have brought timeless elegance and innovation to apparel and interiors. Abraham Moon collaborates with brands and designers worldwide, offering exceptional bespoke designs and tailored services.

> **Circularity is an inherent part of our process**

CIRCULARITY AT ABRAHAM MOON

Natural renewable fibre: Moon uses natural, renewable fibres such as wool to ensure that the materials in their products are biodegradable and recyclable.

Durability: The core of Moon's circularity principles is centered on designing out waste and keeping resources in use for as long as possible. The focus is on durable, high-quality textiles that can be repurposed/ returned to the earth at the end of their life-cycle, minimising waste and supporting the circular economy principles of regeneration and reuse. When developing their collections, they prioritise timeless design and a carefully curated colour palettes that encourages longevity. The fabrics are also meticulously engineered for durability, ensuring they stand the test of time.

Waste utilisation: Moon reintegrates a portion of their production waste back into the carding process and overall manufacturing, thereby reducing waste and optimising resource use.

Supply-chain traceability: Moon maintains full control over their supply-chain, ensuring complete traceability from raw materials to finished products. This verticality allows them to closely monitor and optimise every stage of production, enhancing the traceability of wool, reducing waste and minimising their environmental footprint.

Commitment to transparency: The company also tracks its environmental impact, measuring energy use, waste and materials via frameworks like the Higg Index. Plus, partnering with carbon reduction experts, Moon has developed a carbon roadmap to stay on track with its sustainability goals.

ABRAHAM MOON'S 2024 SUSTAINABILITY COMMITMENTS: CHAMPIONING BRITISH WOOL

British Wool farmers face significant challenges due to the long-term decline in wool prices, making it difficult for them to maintain livelihoods. By raising awareness and elevating the profile of British Wool, Moon aims to support the farmers and contribute to the vitality of wool, as a durable and circular fibre.

As part of Moon's 2024 sustainability commitments, they have developed a range of products crafted from 100% traceable British Lambswool, including throws, apparel fabrics and interior textiles.

Moon has also collaborated with the Campaign for Wool, which raises awareness about the sustainability of wool. Moon's collaborations as such have supported in bringing British Wool to a broader audience and reinforcing its versatility across various sectors.

Image source: Abraham Moon and Sons Ltd

Our purpose, 'Heritage re-imagined for a sustainable future', drives our approach to sustainable textile production. In 2024, we have proudly renewed our historic collaboration with British Wool, giving it the platform it deserves within the fashion and interior industries. By embracing this renewable and biodegradable resource, we are supporting local farmers while reinforcing our commitment to a more circular approach. This partnership complements our broader sourcing strategy, ensuring that all the wool we use aligns with our goals of reducing waste and creating products that are both timeless and sustainable

LESSONS LEARNT & RECOMMENDATIONS

Importance of animal fibres: Natural fibres are essential for the future of sustainable textiles. They work within the planet's natural boundaries and help mitigate the impact of harmful plastics and chemicals, on ecosystems.

Collaboration and partnerships: Achieving circularity requires strong, lasting partnerships with suppliers and manufacturers to drive innovation in design and materials. These relationships further support the company's supply-chain transparency and sustainability goals while ensuring compliance with due diligence legislations.

Starting small: Start by challenging existing processes and identifying areas for improvement. Circularity doesn't happen overnight, so begin with small, manageable initiatives - such as reducing waste in production, improving sourcing practices or designing for durability.

Long-term commitment to circularity: Achieving true circularity requires time and persistence. It is a continuous journey of improvement, where immediate results may not always be visible, but the long-term environmental and social benefits are significant.

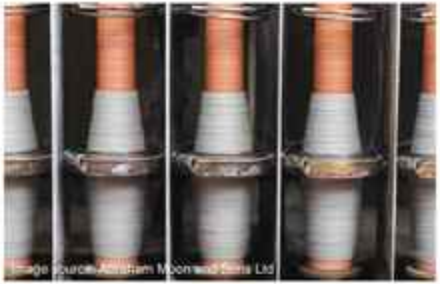


Image source: Abraham Moon and Sons Ltd

Camira Fabrics Ltd

Image source: Camira Fabrics Ltd

TEXTILE MANUFACTURER

Name: Camira Fabrics Ltd

Location: West Yorkshire, UK

Business size: Large (250+ employees)

Founded: 1974 under the name Camborne Fabrics but its heritage goes back to 1783 through various acquisitions.

About: Camira designs and manufactures textiles for every space and sector; from commercial, hospitality and residential, to public transport, including bus, coach and rail. Camira has always been a pioneer of innovation when it comes to a sustainable understanding of textiles and has been producing recycled fabrics for more than 20 years, as well as innovating a new category of fabrics made from natural wool and bast fibres, such as nettle, hemp and flax.

> **Through waste yarn re-processing we divert valuable resources from landfilling, and we put them back into production. Therefore, the output from one process / product is an input for another process and new product**

CIRCULARITY AT CAMIRA FABRICS LTD

Recycled yarn and fabric waste: In 2022, Camira invested in state-of-the-art wool recycling machinery, as they took a majority stake in pioneering UK textile recycling company Unoulio to develop innovative new textile products based on textile circularity. This allows the company to re-purpose their own waste yarn and fabric, which is pulled back to raw fibre, then carded, spun and woven into new fabric.

The first fabric to be launched using Unoulio wool recycling technology was Revolution, comprising 31% recycled content. The company's second fabric ReSKU 2.0, re-imagines a recycled wool fabric from the late 1990s, which was made from recycled army jumpers. Using the same technology, this material vastly increases the recycled content to 79% and adds 21% flax to create an inherently flame-retardant solution.

Camira is also set to launch Wool Circle, a fabric which is based on a take back model, using upholstery offcuts from two wool ranges from furniture manufacturer customers. Wool Circle is made exclusively available to those customers who have provided the waste.

Recycled colour: Camira have developed an innovative method to recycle colour from within original yarns and fabrics, which virtually eliminates the concept of dyeing. This results in the reduction of the use of chemical dye stuffs and celebrates the beauty of recycled yarn and colour.


Image source: Camira Fabrics Ltd


Image source: Camira Fabrics Ltd

LESSONS LEARNT & RECOMMENDATIONS

Recycled fibre and yarn challenges: Processed fibre tends to be shorter and therefore addition of virgin fibre is needed to create durable products. While there is a growing demand for processing unwanted feedstock, there is much lower demand for using the reprocessed yarn and this undermines the successful adherence to circularity principles.

Education: Our customers, as well as the end consumer, require education on the facts around recycled textiles. This includes variability in fibre composition, abrasion and pilling compared to a product with virgin material.

Legislation: There is an urgent need for legislation to facilitate the transition to circularity, this includes transport licences, storing waste in premises for limited time and detailing recycled composition.

Chemical compliance: There are many issues around chemical compliance and unknown substances regarding feedstock from unwanted garments. Garments coming from parts of the world that do not meet the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) requirements will not be compliant with current legislations and therefore unable to be sold within EU / UK / USA etc. In this complex territory, fibre, yarn and textile manufacturers require assistance around meeting compliance issues.

> **The transition is not an easy path and the industry will need to come together with government bodies and other stakeholders to address the challenges**


Image source: Camira Fabrics Ltd

Datini Fibres

upcycling farm きんつぎ

Image source: Datini Fibres

MATERIALS SCIENCE COMPANY, TEXTILE RECYCLER AND UPCYCLING SERVICE

Name: Datini Fibres

Location: Karachi, Pakistan

Business size: Medium-sized (50-249 employees)

Founded: 2021

About: Datini Fibres is dedicated to manufacturing recycled wool fibres and offering upcycling services for post-consumer textiles, transforming them into a range of fashion accessories. The company's core mission is to repurpose and extend the life of global post-consumer wool and cashmere waste through innovative techniques.

To further facilitate this, Datini has launched an e-commerce platform, Upcycling Farm, which is a service-based platform that partners with brands to deliver value-added finished products made from post-consumer waste. Datini believes in the untapped potential of post-consumer wool waste, transforming it into new products while avoiding traditional recycling processes.

CIRCULARITY AT DATINI FIBRES

Textil-to-textile recycling: Datini Fibres offers solutions for textile-to-textile mechanical recycling by transforming discarded fabrics into new, high-quality products.

> **Wool, one of the oldest natural fibres, is a gift from nature. Growing and harvesting wool requires careful stewardship to maintain its value as a precious resource. We believe that re-utilising wool at the end of its cycle is an essential part of this stewardship, supporting a holistic approach to conserving natural resources for future generations**

Upcycling solutions: In addition to recycling, the company upcycles post-consumer textile waste with its service-based platform Upcycling Farm that partners with brands to provide products made from post-consumer waste. Their philosophy is inspired by Kintsugi, the art of embracing imperfection. Datini's goal is to establish a circular vertical solution, offering brands a comprehensive service from waste collection to finished products. For now, this includes upcycling and recycling, all under one roof.

LESSONS LEARNT & RECOMMENDATIONS

It is important to recognise that recycled materials, particularly those derived from post-consumer textiles, cannot be directly compared to virgin materials. Understanding and acknowledging the unique challenges associated with recycling post-consumer textiles is crucial to fostering their broader acceptance and integration into the supply-chain.


Image source: Datini Fibres

Image source: Datini Fibres

Fashion Enter Ltd

Image source: Fashion Enter Ltd

GARMENT MANUFACTURER AND REPAIR & EDUCATION SERVICE

Name: Fashion Enter Ltd

Location: London and Leicester, UK

Business size: Medium-sized (50-249 employees)

Founded: 2001

About: Fashion Enter Ltd (FEL) is an award-winning, not for profit social enterprise, and a centre of ethical garment manufacturing in the UK. Services include sampling, grading, production as well as education and skill development within the apparel and textiles industry. Through their sites in Haringey, Islington and Leicester, the company offers their clients a wide range of manufacturing services, including anything from a one-off sample to 10,000 garments a week.

> **At Fashion Enter Ltd, our circular initiatives demonstrate our commitment to leading sustainable and ethical fashion manufacturing in the UK. Through advanced technologies, lean practices, and community- driven efforts, we are redefining the future of responsible fashion production**

CIRCULARITY AT FASHION ENTER

Waste reduction: By using recycled materials, employing precise digital sampling and optimising production through lean manufacturing, FEL reduces the need for new raw materials and minimises material wastage in production. Utilising advanced digital technologies like Style3D to reduce sampling and waste, the company has minimised its environmental footprint while maintaining production efficiency. Any deadstock or fabric waste generated by the factory is repurposed for educational use in the Fashion Technology Academy.

Upcycling, repair & repurpose: The company ensures that garments stay in circulation longer by offering community-based upcycling classes to teach individuals to repair and repurpose their clothing, and providing repurpose and repair services for brands through their partnership with United Repair Centre. The unique facility, which opened in November 2023 on FEL premises, is the result of a collaboration between social impact companies United Repair Centre, outdoor clothing brand Patagonia and Fashion Enter Ltd. The centre has capacity to perform 30,000 repairs a year by 2025.

COLLABORATIONS & PARTNERSHIPS

FEL's circular initiatives are strengthened through unique collaborations with industry leaders such as the United Repair Centre, Patagonia and Lululemon, and these partnerships have advanced the company's capacity for repair and repurposing services.

In addition, the company has opened a new 3D technology and digital solutions innovation centre at its facility in north London, in partnership with digital solution provider Style3D. The Styleverse Innovation Centre features pioneering 3D design software, virtual sampling capabilities, digital asset management, immersive virtual customer experiences, 2D/3D connect to achieve manufacturing empowerment and AI-generated content (AIGC) capability in the fashion world.

The partnership with Style3D, has been instrumental in advancing FEL's commitment to reducing waste and optimising production through cutting-edge digital tools.

LESSONS LEARNT & RECOMMENDATIONS

- **Investment in digital tools and lean manufacturing techniques** is essential for optimising production and reducing waste, and the company utilise Style3D's design software and virtual sampling tools to support these goals.
- The **integration of circularity** in FEL's core business practices has shown that sustainability and profitability can go hand in hand, reinforcing their position as a leader in ethical fashion manufacturing.
- **Building strong partnerships** with like-minded organisations and **prioritising transparency in reporting** are key to successfully implementing circular practices.
- **Continuous learning and innovation** are essential for staying ahead in the rapidly evolving fashion industry.

> **While FEL has made significant strides in circularity, there is a need for more integrated digital platforms that connect all aspects of the circular supply-chain—from design to production to recycling**

FibreLab

Image source: FibreLab

TEXTILE RECYCLER

Name: FibreLab

Location: London, UK

Business size: Micro-sized (1-9 employees)

Founded: 2021

About: FibreLab operates as a hyper-local textile recycling and shredding service. A custom-built mechanical shredding machine is used to process pre-consumer and post-industrial textile waste into valuable recycled fibres. FibreLab collaborates with businesses across the London area, including garment manufacturers, fashion brands, hotels and entertainment venues. Waste is collected, sorted and shredded on-site at the company's East London studio, where it is transformed into a variety of new products and materials using recycled fibres. The current product range includes PaperTex, a high-end handmade paper made from 100% recycled textile waste, cushions and cushion filling and Fabreco, a composite material that can be manufactured into a board. Brands can buy-back PaperTex fully finished as swing tags, business cards, thank you cards notebooks or other stationary items. All PaperTex products can be continuously recycled through domestic paper recycling bins, transforming a difficult waste stream like textiles into an infinitely circular one.

CIRCULARITY AT FIBRELAB

Localised textile recycling: A significant portion of textiles from the fashion and hospitality industries—too small or damaged to be repurposed—ends up in landfills or incineration. FibreLab is dedicated to transforming these discarded materials into valuable resources, diverting waste from landfills and reducing carbon emissions by addressing the shortage of textile recycling facilities and capabilities within the UK. The long-term goal is to establish closed loop, textile to textile recycling processes that can be facilitated on a small scale, allowing recycling to take place locally, avoiding transportation and export of materials and bringing textile recycling machinery and expertise directly to communities. Their current material and product solutions are open-loop systems, where all natural fibre textile waste is transformed into PaperTex, a high-quality, handmade paper produced entirely in the UK.

Reducing the need of virgin materials: By shredding textiles into recycled fibers, the company reduces the need for virgin materials by prioritising the reuse of existing resources. This approach ensures that product innovations, such as PaperTex swing tags, can be reintegrated back into brands' and businesses' supply-chains, effectively closing the loop and creating a circular waste stream.

Customised recycling: FibreLab works closely with clients to tailor the recycling process to their specific needs, whether dealing with garment manufacturing off-cuts or damaged linens from the hospitality sector. As the demand for responsible recycling solutions grows, FibreLab continues to scale its operations, offering more recycled raw materials and lowering the cost of its services, making sustainable textile recycling more accessible to businesses with tighter margins.

Plugging into existing recycling infrastructure: PaperTex can be continuously recycled through domestic paper recycling bins, allowing textiles to transform into an easily recycled material within existing infrastructure.

> **By re-localising and reshoring recycling processes we have full transparency of the entire supply chain, from the businesses where the waste was collected, to each supplier and subcontractor, to the final brand purchasing that recycled material. This allows us to guarantee we send zero to landfill and zero to incineration**

LESSONS LEARNT & RECOMMENDATIONS

- Establishing a truly circular business is a difficult path, so much of it is research and development, trying to find solutions to every challenge along the way.
- Partnerships and business community are key – having a network of other like-minded businesses is essential to success.
- FibreLab believes that small-scale, affordable machinery is the key to unlocking wider circularity. However, it is so incredibly difficult to source and the main machinery manufacturers do not see any value in developing these. With this type of machinery costing millions of pounds to purchase and set-up, it makes circularity and recycling inaccessible to those who are most keen to help make a difference. More support and investment is needed into small-scale and efficient recycling machinery.

Image source: FibreLab

iinouiio Ltd

RECYCLER

Name: iinouiio Ltd.

Location: West Yorkshire, UK

Business size: Micro-sized (1-9 employees)

Founded: 2019

About: iinouiio specialises in converting post-consumer and manufacturer waste into fibres, yarns and fabrics. It also produces its own brand of yarns and fabrics and offers research and development services from its recycling facility.

In March 2022, iinouiio joined the Camira Group and collaborates with the manufacturer to find circular solutions for their waste materials and some of their customers' waste, converting them back into fabrics for interior furnishings. Under this collaboration, the company is installing the UK's only wool and luxury fibre recycling line at the Camira Yarns site in Huddersfield.

CIRCULARITY AT IINOUIIO

Wool recycling: iinouiio provides wool recycling solutions. The process draws on over two centuries of experience and innovation in wool recycling.

iinouiio offers a specialised service to external organisations by reclaiming unwanted or seemingly unusable materials. These materials are designed and converted back into fibres, yarns and fabrics, giving them a second life and reducing waste.

While most of the company's work is focused on closed-loop recycling, it is also exploring open-loop possibilities in the early stages of development. In addition to extending its own recycling capabilities, iinouiio provides research and development services from its recycling facility, collaborating with organisations to explore innovative recycling and re-spinning processes. This approach not only enhances iinouiio's capabilities but also helps other companies integrate circular solutions into their operations.

LESSONS LEARNT & RECOMMENDATIONS

- Regardless of all the additional effort needed to manufacture as responsibly as possible, there is little tolerance amongst customers for any increase in price or reduction in quality/ design. This creates a challenge for businesses committed to sustainability.
- There is a lack of materials for recycling and re-spinning that are sorted and prepared at source or by specialist waste handlers. Also, different types of mechanical recycling are not always accessible, and woollen spinning systems designed for processing waste materials are in short supply. These technical limitations often result in longer lead times.
- Beyond the technical challenges, a key factor lies in how businesses adapt their practices to accommodate the complexities and nuances of mechanical textile recycling for re-spinning. This requires a willingness to change traditional methods to align with sustainable production processes.


Image source: Iinoulio


Image source: Iinoulio

> **Since the mid-1990's, the huge West Yorkshire infrastructure for wool manufacturing has almost completely disappeared. Part of Iinoulio's work is to find ways to continue the tradition, skills and practise of mechanical recycling for re-spinning, whilst embracing new technology and encouraging younger generations and educational establishments to be involved**

Iinoulio on a panel at UKFT's Sustainability Conference 2024

LaundRe

CIRCULAR MANUFACTURING SERVICE

Name: LaundRe

Location: London, UK

Business size: Micro-sized (1-9 employees)

Founded: 2024

About: LaundRe is the UK's first sustainable and circular denim finishing hub, dedicated to reshaping the fashion industry through innovative technology and a commitment to environmental sustainability. With a focus on local reprocessing and circularity, LaundRe aims to revolutionise denim production and minimise the industry's environmental footprint. LaundRE offers ReFinishing, ReShoring and ReBorn of jeans. With their unique services, they add a washed finish to jeans and upcycle through laundry finishing. They refinish unsold jeans enabling them to be sold as a new product with a change of wash finish and provide local finishing for onshoring. They help brands and retailers reduce inventories and produce small, responsible quantities of finished jeans in the UK.

LaundRe has a team that has worked in the industry for more than 25 years.

CIRCULARITY AT LAUNDRE

Innovation: LaundRe uses advanced laundry technology. They use laser to add a graphic/ template. Ozone and humidity are used to sterilise and change the shade of the jean and nebulising technology to reduce the water consumption. All their kit is eco-friendly and they have ambitions to develop new technology once they are operational.

ReFinishing service: They provide a new circular solution helping brands to clear their inventories. Refinishing enables brands to sell unsold stocks as a new finished jean at full price, preventing the garment from being discarded.

ReShoring service: Product teams can develop jeans on shore, thereby reducing their carbon footprint whilst building their knowledge of denim finishing. The company enables small production runs onshore for brands who can't meet the overseas MOQ's. Larger brands can trial new finishes and styles in the local denim hub reducing the risk of overbuys. Brands can buy strategically in targeted small drops to reduce over production.

ReBorn service: LaundRe's ReBorn pilots are exploring renewing jeans which are dirty and have been discarded. ReBorn was their innovative research and development (R&D) pilot which they launched at Kingpins in Amsterdam in April 2024. They collaborated with LMB Textiles, ReSkinned and Jeanologia, who have all been incredibly supportive throughout their journey. ReBorn tested rejuvenating discarded jeans and customer returns, transforming them into 'as new' premium-quality garments. This creates a commercial alternative to a newly manufactured pair of jeans by using old, used garments as raw material.

LaundRe aligns with the principles of a circular economy by encouraging the reuse and longevity of textiles through eco-friendly laundry processing. Our machines use low water and energy consumption, minimising the use of harmful chemicals, and offering a low carbon footprint for our customers by finishing jeans on shore. We help extend the life-cycle of clothing and are working towards reducing the need for new textiles. Our business not only cuts down on waste but also fosters a sustainable loop that benefits both the environment and our customers

Image source: LaundRe

LESSONS LEARNT & RECOMMENDATIONS

- The biggest challenge LaundRe faces is assessing used or unsold garments and sorting. Many of the products they will ReFinish will already have had chemical processing and they may not have visibility of this information. They also need to assess the indigo dye stuff and how the yarn has been dyed to optimise efficiencies in processing. Transparency of products to enable future circularity is therefore essential.
- Advanced garment sorting systems are essential for scalability and production efficiency. Current systems utilise technologies like optical sensors, near-infrared spectroscopy and AI to accurately sort textiles by composition, colour and condition. However, further advancements are needed to identify chemical finishes, dye stuffs and more detailed fabric data.
- Denim is a fairly niche market, and therefore LaundRe makes education a key part of their business model. To fully deliver on circular practices, it is important to guide customers on circular journeys, sharing knowledge to help them make more responsible buying and development decisions.
- Building collaborations and partnerships with like-minded businesses is essential.


Image source: LaundRe

RE;CODE


Image source: RE;CODE

REMANUFACTURER, FASHION BRAND AND SERVICE PROVIDER

Name: RE;CODE

Location: South Korea

Business size: Small-sized (10-49 employees)

Founded: 2012

About: RE;CODE is a conscious manufacturer, brand and service provider that upcycles garments from unsold stock to develop new fashion pieces and utilises lower quality industrial materials (i.e. airbags and car seats) to make bags and other small accessories. They actively contribute to further extending product lifetimes through their repair services and additional fashion customisation service MOL: Memory of love, by which consumers can reimagine their personal fashion items with special meanings according to their desired design.

CIRCULARITY AT RE;CODE

Upcycled deadstock and textile waste: A conscious remanufacturer, fashion brand and service provider that designs and produces new collections by upcycling deadstock and using sustainable materials. RE;CODE supports a new creative environment lead by the designers and artisans who utilise the deadstock materials from the company Kolon FnC's warehouses, military waste, and industrial waste which have been deconstructed and washed.

Repair: In terms of their repair, their BOX Atelier offers repairs and refurbishments and encourages a culture of mending and re-wearing.

Reimagine: In terms of their reimagining, their Memory of Love service offers a fashion recustomisation service. Not only does it transform Re;code's old products but also other old personal items with special meanings and stories in accordance with the customer's desired design.

RE;CODE prolongs the life-cycle of garments, by giving them a new life, both through their upcycling, repair and redesign. It avoids textiles going straight into incineration and landfilling, hence, supporting decarbonisation. They saved 31,803 pieces of textiles going straight until end of life until the first quarter of 2024

LESSONS LEARNT & RECOMMENDATIONS

- Upcycling processes change by categories and types of styles. i.e. sportswear, menswear, womenswear and this is something the business must learn and adapt to.
- It is important to make a record and store know-hows and build a system and upcycling flow.
- To reach upcycling, the key team will consist of a pattern maker, seamstress (manufacturing) and designer.

Image source: RE;CODE

Image source: RE;CODE

Re-Fresh Global

Image source: Re-Fresh Global

(RE)MANUFACTURING TECHNOLOGY

Name: Re-Fresh Global

Location: Berlin, Germany

Business size: Small-sized (10-49 employees)

Founded: The business has been in the textile and apparel industry since 2019, starting in Tel Aviv and later founding their company in Berlin in 2021.

About: Re-Fresh Global is a start-up that addresses the difficulty of recycling complex textile blends which traditional methods often cannot handle effectively and provides unique solutions for the circular economy through innovative textile waste management. The company employs advanced biotechnology to convert textile waste into valuable materials and is currently offering three recycled products: nanocellulose, bioethanol, and multifunctional fibres, which have applications across a range of industries. In addition, they have developed the concept of a complete micro-factory manufacturing solution, which will allow collaborating partners and companies to operate their own processing factory in the future.

CIRCULARITY AT RE-FRESH GLOBAL

Through their innovations, the company contributes to circularity by converting textile waste into reusable materials, reducing the need for virgin resources and minimising waste.

Innovative products: Re-Fresh Global has developed three innovative circular products:

1. Re-Nano™ (Nanocellulose): A sustainable material for coatings, electronics, and more, made from recycled textiles.
2. Re-Thanol™ (Bioethanol): A green bioethanol produced from textile waste, used as a renewable energy source.
3. Re-SanPulp™ (Textile Pulp): A versatile, eco-friendly pulp for nonwoven applications like automotive and furniture, created from recycled textiles.

These products help to close the loop in textile waste management, promoting sustainability and reducing reliance on virgin resources.

Decarbonisation: The company's innovations contribute to decarbonisation through an enzymatic hydrolysis and fermentation process that is energy-efficient and operates at lower temperatures, significantly reducing the overall carbon footprint compared to traditional recycling methods, which typically require substantial energy input and emit high levels of carbon.

Furthermore, by replacing virgin materials with recycled alternatives, Re-Fresh Global's technology directly reduces the demand for carbon-intensive raw material production.

COLLABORATION & PARTNERSHIPS

Collaborations are central to advancing Re-Fresh Global's innovations:

- The company is working with Volkswagen Group to replace traditional car interior materials, supporting Volkswagen's goal of climate-neutral mobility and aiming to significantly reduce carbon dioxide (CO_2) emissions.
- Their partnership with textile recycling company SOEX supported the first developments for Volkswagen Group, which produced demonstrator parts for the boot of a current model made from upcycled polyester material, while the next step in their partnership will see the set-up of a micro-factory on SOEX premises.
- Re-Fresh Global's partnership with MEAVO Group focuses on developing sustainable acoustic soundproof office phone booths, utilising the softness and sound-absorbing properties Re-SanPulp can provide.
- The company is also integrating recycled materials into luxury fashion through their involvement with global luxury goods company LVMH's start-up sustainability program.
- Google for Startups provides crucial technical support to develop and scale the company's technology.

> **Our solution supports circular textile manufacturing by recycling waste into valuable materials, reducing landfill use and conserving resources while minimising emissions through efficient processes**

LESSONS LEARNT & RECOMMENDATIONS

Collaboration: Re-Fresh Global believe in the importance of strong partnerships for scaling impact. Collaboration with other companies and experts in the field to share knowledge and resources is key.

Regulations: It is essential to stay informed about evolving regulations and industry standards and be prepared to adapt if required.

Supporting technologies: The company is still struggling with effective pre-sorting technologies for textile waste and feel that the development of advanced sorting systems that can accurately separate and categorise diverse textile waste before recycling would significantly enhance their circularity efforts.

Image source: Re-Fresh Global

Image source: Re-Fresh Global

> **We are not alone in this effort; collaboration and compliance are key to maximising our effectiveness**

the materialist

Image source: the materialist


Image source: the materialist

SERVICE + DIGITAL PLATFORM

Name: the materialist

Location: London, UK

Business size: Micro-sized (1-9 employees)

Founded: 2023

About: The materialist is a business to business (B2B) digital marketplace for trading high-quality deadstock fabrics, connecting suppliers with buyers. It offers a platform for suppliers and manufacturers to sell their excess fabrics and for fashion brands to source these deadstock fabrics at competitive prices, thereby offering a fully circular solution. The catalogue includes over 35,000 varieties and 4 million metres of high-end excess fabrics.

CIRCULARITY AT THE MATERIALIST

Reuse and re-circulation of excess stock: the materialist works with textile manufacturers to find channels to responsibly handle excess stock, mainly through resell but also donation and recycling schemes. By utilising surplus materials, the company not only reduces environmental impact but also effectively addresses the challenge of excess inventory.

Limiting production and minimising waste: Deadstock is a key driver of waste in the fashion industry. Through its platform, the materialist focuses on recirculating high-quality surplus materials. By doing so, it ensures that existing materials are utilised effectively, thereby reducing waste and minimising the need for new fabric production.

Traceability: the materialist provide certification to support the authenticity of deadstock fabrics (ReLiveTex®), including origin and full composition. This environmental certification is the first of its kind approved by the International Organisation for Standardisation (ISO) under UNI EN ISO 14021:2021, demonstrating that surplus fabrics have been rescued from destruction and repurposed. Buyers of ReLiveTex® certified fabrics receive a 'reclaimed materials' certificate that ensures traceability, detailing the composition and origin of the fabrics.

> **80% of brands who visited the materialist showroom are now planning to regularly source deadstock materials**

Image source: the materialist

LESSONS LEARNT & RECOMMENDATIONS

- It is important for manufacturers to monitor their material inventory to identify excess fabrics, optimise resource use and build a more sustainable production process.
- Around one-third of visitors at the materialist were unfamiliar with deadstock fabrics, highlighting the need for education and outreach to engage new manufacturers and brands in adopting circular practices.

Weffan Ltd

Image source: Weffan Ltd

MANUFACTURING TECHNOLOGY

Name: Weffan Ltd

Location: London, UK

Business size: Micro-sized (1-9 employees)

Founded: 2020

About: Weffan's 3D whole garment weaving method reinvents garment manufacturing by merging textile and garment production into a single step, using existing onshore loom technology.

CIRCULARITY AT WEFFAN

Design driven: Weffan believes the majority of a garment's environmental footprint is decided at the design stage and therefore takes a design approach to reducing material impact at the design phase by creating 3D woven garments woven on loom for maximum material and resource efficiency.

Waste reduction: The 3D garment weaving process eliminates the fabric production stage, reducing waste by at least 50% and cutting lead times by two months. The company monitors and calculates waste reduction on each garment from design through to production, to provide information on how any design modification will affect the outcomes.

Recyclability: The technology manufactures for disassembly and recycling by using a mono-material approach. This means that specific parts, such as shirt collars and cuffs, can be constructed as one mono-material piece, therefore eliminating the need for fused interlining and enabling easy recycling at the product's end-of-life.

> **Weffan believes 3D garment weaving is the future of garment manufacturing; creating low waste, low-impact and onshore production**

LESSONS LEARNT & RECOMMENDATIONS

Importance of testing: Innovators need to test their technology or solution in the market as early as they can.

Collaboration: A successful supply-chain solution depends on working collaboratively and leveraging the deep expertise that exists in the industry. Weffan's collaboration with the 3D Weaving Innovation Centre (3DWIC) at the University of Leeds and their partner textile mills have been invaluable.

Reliance on supporting technologies: It is essential to identify missing innovations which could advance new technologies or solutions, such as purpose-built design software.

> **A product can't just be circular, but should also be desirable to find a market. Weffan aims to produce garments that are innovative and well-crafted, as well as circular**

Simplifyber

Image source: Simplifyber

Name: Simplifyber

Location: North Carolina, US

Business size: Small-sized (10-49) employees

Founded: 2020

About: Simplifyber has created a first-of-its-kind, additive manufacturing process that uses plant-based fibres to create entire 3D-shaped soft goods, such as clothing and footwear, in a single step.

The company's proprietary material is injected as a liquid slurry of fibres and water into specially designed moulds and dried. This process eliminates the need for spinning, weaving/knitting and greatly reduces the need for sewing, therefore keeping costs competitive with plastic and polyester.

CIRCULARITY AT SIMPLIFYBER

Waste reduction: The company's novel approach to clothing, footwear and accessory manufacturing cuts out 60% of the traditional manufacturing steps and reduces the 35% of materials in the fashion supply-chain that usually end up as waste. Their process eliminates fabric waste altogether and allows for on-demand production and stock-free service.

Renewable and recycled materials: Simplifyber's process allows for the use of a wide range of natural inputs; from Forest Stewardship Council (FSC) certified wood to recycled textiles, to agricultural and post-consumer waste, to hemp and cotton. They have collaborated with cotton textile recycling company Renewcell (now renamed Circulose) to produce a collection of materials, which were showcased at Future Fabrics Expo in London in 2024.

Product end-of-life options: The company's cellulose formula is 100% natural, derived from a combination of wood pulp and other plant-based material and non-toxic additives, so the result is a fully biodegradable product that can be easily returned to nature, recyclable as paper and as clothing.

> **Simplifyber's entire business is a circular initiative, the technology we have created was designed to address the need for circularity**

LESSONS LEARNT & RECOMMENDATIONS

Crafting communication is key when launching new consumer-facing innovations. As Simplifyber addresses several issues at once, they have learned that it is difficult to communicate complex, unfamiliar ideas to the public. The company are still trying to figure out how to navigate this—for now, they focus on communicating only the points which are the most obvious and least nuanced.

Creating unique solutions helps to differentiate your products from your competitors' products.

Flexibility is essential for progressing from pilot to scale-up stage. While Simplifyber's journey began with a material innovation, the company are open to expand on this with sales of machines and various slurry types (i.e. combination of water with different types of fibres) for use with the machines. This means product manufacturing can be localised to any geographic region and will make a real difference to commercial success and positive environmental impact on the fashion industry.

More innovation is needed for circular/sustainable componentry (i.e. soles, closures, padding, internal structural elements on clothing and accessories), as well as coatings, dyes (in hues other than black) and treatments.

> **Try to solve the problems that nobody is solving yet**

Enabling technologies & digital platforms

Emerging technologies and digital platforms play a crucial role in supporting a transition towards circular textile and apparel manufacturing. Better planning and monitoring, zero-waste technologies, transparency and traceability, among others, can be achieved through the digitalisation of supply-chains.

Technologies and digital platforms help optimise resource use, reduce waste and promote the reuse and recycling of materials. They also facilitate data sharing and industry collaboration, driving the adoption of circularity in supply-chains. By adopting these tools, manufacturers and brands can foster a more circular manufacturing approach.

The following pages provide a snapshot of digital technologies and tools, which have the potential to shape apparel and textile manufacturing processes in the future to support the circular transition.

Key definitions

TERM	DEFINITION
3D Design and Configuration Tools	Software that allow designers to create, visualise and modify garments in 3D, enabling them to configure styles, colours and fabrics before production. These tools streamline the design process and customisation options.
3D Sampling	A virtual process where digital 3D models of garments are created to simulate real-life samples. This eliminates the need for physical prototypes, reducing waste, lead times and costs in the sampling stage.
AI-Powered Body Scanning Technology	Advanced technology that uses artificial intelligence to scan and analyse a person's body dimensions. This helps create personalised sizing and better-fitting garments, improving accuracy in both design and production.
Automation	The use of technology to perform tasks/ processes efficiently, in textile and apparel manufacturing. For example, automated cutting systems use computer-controlled blades or lasers to cut fabric with precision and speed. This eliminates the need for manual cutting and reduces fabric waste.
Blockchain	A secure, decentralised digital ledger that records transactions across multiple computers. In manufacturing, blockchain is used for tracking materials, verifying authenticity and ensuring transparency in the supply-chain.
Digital Product Passport	A digital record embedded in garments or products that contains detailed information about their materials, origin, manufacturing process and sustainability credentials.
Internet of Things (IoT)	A network of connected devices that communicate and exchange data to optimise production processes.
RFID Tag	A Radio Frequency Identification tag is a small device attached to garments that stores information and can be read remotely. RFID tags are used for tracking inventory, reducing theft and streamlining supply-chain operations.
Robotics	A branch of technology that involves the design, construction and operation of robots for carrying out a series of tasks autonomously or semi-autonomously, often mimicking human or animal behaviour.
Smart Stitch and Disassembly	Sewing techniques or technologies that use specialised threads or methods designed for easy disassembly of garments at the end of their life. This promotes circularity by facilitating recycling or upcycling of materials.
Smart Threads	Threads with embedded technology, such as sensors or conductive materials, that can perform functions like monitoring wear or providing data on garment usage. It can also aid in easy disassembly for recycling.
Software as a Service (SaaS)	A cloud-based software delivery model where users can access applications over the internet on a subscription basis. SaaS solutions can provide tools for design, inventory management and supply-chain optimisation without the need for heavy infrastructure investment.

3D Look

Mobile Tailor provides instant, accurate body measurements and 3D models using patented AI-powered body scanning technology. With just two photos from any smartphone, the solution delivers over 80 precise body measurements, streamlining the manufacturing process.

Step 1: Quick and Easy Scanning
Two photos, 30 seconds, instant results.

Step 2: Integration Options
Connect scan to pattern systems, 3D design and configuration tools and order management systems.

Global Circular Network

The Global Circular Network (GCN), is an Extended Producer Responsibility (EPR), Digital Product Passport (DPP) solution that enables extending product life through repair, resale, rental, redesign, and remaking, as well as efficient recycling by assisting sorting to create safer recycling feedstocks.

The company's innovation RFID THREADS® is the world's first radio frequency identification tag and is housed in a single, 15 cm long washable thread. The thin metallic thread is embedded with a chip and can be inserted into new or recovered products (i.e. retro-fitted). The thread can also be removed manually or magnetically, to be reset and reused.

The unique quick-response (QR) code created by the RFID THREADS® tool allows businesses across the product life-cycle to connect with each other to enable the identification, sorting, and categorisation of products. All stakeholders, including sorters and recyclers with a RFID reader, can connect to communicate, collect life cycle assessment (LCA) data and share traceability information, increase return on investment (ROI), enable efficient returns, foster circular partnerships and connect to AI, blockchain, IoT, robotics.

GCN have already carried out RFID THREADS® trials with companies including H&M, Levis, Decathlon, Marks & Spencer, Ralph Lauren, PVH and Tommy Hilfiger. Their DPP was also included as a listed supplier on Cirpass, a collaborative initiative to develop piloting and deployment of a standards-based DPP aligned with the requirements of the Proposal for ESPR.

Hyran Technologies

Hyran Technologies is an AI-powered platform designed to enhance supplier collaboration, helping brands and manufacturers improve supply-chain agility, minimise waste, and boost profitability.

Hyran's solution for manufacturers collects supplier data to increase transparency around capacity, production progress, lead times, and raw material inventory. On the brand side, Hyran offers a solution divided into three key components: planning, making, and tracking.

In the planning module, Hyran uses AI to assist brands in pre-positioning raw materials and securing capacity, reducing operational friction while minimising the risk of excess material liability and delivery delays.

The making module presents dynamic production scenarios to brands, estimating delivery times based on material availability and capacity. For instance, if excess material at the supplier could be used as a suitable substitute, this option is flagged, helping brands reduce waste, costs, and lead times. Recycled materials may also be suggested at this stage.

In the tracking module, brands can monitor their production process in detail (e.g., knit, dye, or sew stages) and track the utilisation of materials and capacity. This real-time tracking allows brands to adjust production in response to shifting consumer demand without disrupting workflows or generating waste. For example, if a brand notices SKU123 is performing well in blue but underperforming in red, they can check the tracking tool to see if the latest batch has been dyed. If not, they can easily switch colors, preventing markdowns, overproduction, and reducing waste throughout the fashion value chain.

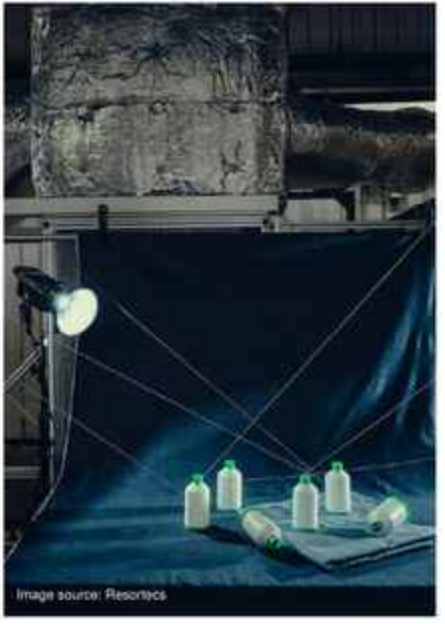


Image source: Resortecs

Resortecs

Resortecs is a start-up that develops Design for Disassembly solutions to ease disassembly, sorting, and textile waste management, enabling high-quality textile recycling on an industrial scale through a mix of proprietary patented technologies and an extensive network of partners. By fostering recycling, Resortecs halves CO_2 emissions and reduces textile waste by up to 80%.

With 78% of all clothes being difficult to recycle due to disassembly challenges, the company offers a unique solution that disassembles up to 15 times faster and recovers up to 2 times more materials than conventional methods. This solution is delivered through a three-part approach:

- A range of 16 heat-dissolvable stitching threads, Smart Stitch™, empowers brands to design textile products for disassembly and recyclability at end of life.
- The world's first thermal disassembly system, Smart Disassembly™, automatically eliminates trims that block recycling.
- A seamless material transfer process ensures that sorted materials are sent to the most relevant recycler, promoting closed-loop recycling.

Image source: Reverse Resources

Reverse Resources

Reverse Resources is a Software-as-a-Service (SaaS) platform, which addresses key challenges in textile recycling, such as limited access to high-quality waste, incomplete market data, inflated prices due to inefficient waste handling and supply-chain barriers. The platform connects textile waste with optimal recycling solutions, enabling predictive transparency and building data-driven supply-chains.

Verification and traceability are central to the platform's functionality, allowing it to facilitate the global scale-up of textile-to-textile recycling by standardising processes and disrupting traditional waste-handling methods. The platform enhances market transparency by tracking waste flows in real time and verifying the quality of materials throughout the recycling process. This data-driven approach uncovers new business opportunities for waste handlers, manufacturers and brands; restructures supply-chains; and ensures full transparency, while also engaging with policymakers to address industry challenges.

Reverse Resources offers four distinct roles on the platform: manufacturers, waste-handlers, recyclers, and brands. Waste handlers, who process and prepare waste before it enters recycling, play a crucial role in ensuring that the material meets the quality standards required for high-value recycling. The platform's data verification capabilities support waste handlers in making informed decisions about collaboration and optimising waste processing. Each stakeholder has a private data room, enabling secure data sharing and collaboration.

The company works closely with over 50 brands and 15+ major textile-to-textile recyclers, tracing waste from hundreds of factories in real time to ensure a transparent and verified supply-chain. However, engaging informal waste handlers and promoting data transparency remain significant challenges.

Silana

Silana offers the complete automation of the sewing process. Silana has created the first and only robot capable of fully automating the traditional, labour-intensive, and costly sewing methods—addressing the last major step in fashion production that hasn't been automated yet.

This breakthrough allows for the automation of the entire value chain, from the roll of fabric to the finished garment, with no human intervention required. As a result, clothing can be produced sustainably, swiftly and cost-effectively right at the point of sale—even in high-wage countries.

Brand/ retail examples

Our report has highlighted various case studies of textile and apparel manufacturers, innovations and technologies that support circular manufacturing practices. In addition, the connection between manufacturers and brands and retailers is critical for the transition towards a more sustainable and circular fashion industry. By prioritising collaboration with manufacturers and innovations, brands can integrate circularity into the production process, transforming their role from mere retailers to active participants in manufacturing and remanufacturing, to strategically influence supply-chain circularity. Ultimately, the partnership between brands and manufacturers is crucial for creating a connected ecosystem.

The following pages highlight selected examples of brands/retailers influencing supply-chain circularity.

Image source: Mulberry

Mulberry's lifetime service centre

Sustainability has been integral to Mulberry's ethos since the brand's inception, and in 2021 the Made to Last Manifesto outlined their commitment to becoming regenerative and circular across all aspects of the business. In recognition of this purpose-driven approach, Mulberry achieved B Corp Certification in August 2024, joining a global community of like-minded organisations focused on transparency and accountability.

Mulberry's Lifetime Service Centre has been rejuvenating thousands of cherished bags for over 35 years, utilising an extensive leather and hardware archive that spans decades. Understanding that customers value and care for their Mulberry bags, the brand supports this dedication by offering accessible artisanal repairs. The team at The Rookery, Mulberry's flagship Somerset factory, are masters of restoration, breathing new life into over 10,000 pre-loved Mulberry pieces annually. They attempt to repair all leather goods, from replacing locks to conducting full restorations.

While the luxury industry is still far from prioritising 'use and reuse' to the same extent as new products, Mulberry is embedding these services as a core part of its future business plan and customer experience.

John Smedley: The circular jumper

John Smedley, the world's oldest manufacturing factory, has been crafting high-quality, durable knitwear in England since 1784. Specialising in luxury garments made from the finest natural fibers, their production processes minimise waste through fully fashioned designs and optimised machinery. However, recognising that some waste is inevitable, John Smedley has partnered with iinouiio, a Yorkshire-based textile recycling mill, to develop a recycled merino yarn. This innovative process utilises their extrafine merino waste, which is collected, shredded, and blended with virgin merino to create a unique, chunky yarn that is 50% recycled.

The resulting yarn boasts a distinctive colour derived solely from the recycled fibers, with no additional dyes, ensuring each batch is one-of-a-kind. By embracing this sustainable approach, John Smedley not only supports the UK textiles industry but also revives traditional recycling methods historically known as "shoddy" manufacture.

Their latest collection features five unisex garments made using whole garment manufacturing, eliminating the need for additional components such as threads or fasteners. This design choice facilitates easy recycling at the end of the garment's life, effectively closing the loop on their sustainable practices. By combining heritage craftsmanship with modern innovation, John Smedley exemplifies how knitwear production can be both responsible and beautiful.

> **"All decisions taken during the development of this regenerated yarn have been to reduce the environmental impact of the production**

Image source: Decathlon X Resortecs

Decathlon X Resortecs

French sporting goods retailer Decathlon and Belgian disassembly start-up Resortecs have joined forces to develop a fully recyclable swimwear collection.

To balance performance, functionality with recyclability, Decathlon developed Negombo, a fabric ensuring elasticity without the use of elastane. However, creating swimwear with a recyclable fabric alone is not enough to meet the required performance and comfort, for which elastic bands are needed. Currently, these elastics are not processable by recyclers and make the recycling of swimwear impossible without disassembly.

Resortecs' Smart Stitch™, combined with Smart Disassembly™, enable the efficient separation of the elastic bands from the main fabric at the end of the garment's life-cycle. Utilising this process ensures the product's maximum recyclability rate and the technology allows for fully automatic disassembly, without any manual intervention, at a scale of up to 10 tons a day. This results in a 63% increase in material recovery, which is 10 times faster than conventional methods.

Ganni X Simplifyber

Danish BCorp certified fashion brand Ganni and US material innovation start-up Simplifyber recently launched a plant-based, 3D-moulded shoe collection at the Ganni Spring/ Summer 2025 show in Paris.

The manufacture of this unique collection utilises Simplifyber™ Fybron™, a cellulosic material that starts as a liquid and is poured into a 3D mould using Simplifyber's patented additive manufacturing process. As this process eliminates spinning, weaving, or knitting and reduces the need for sewing significantly, environmental impact is reduced by up to 33x compared with conventional shoe uppers.

The material can be derived from natural sources like wood, paper, or recycled textiles, and this collection utilises FSC-certified wood fibre and up-cycled Ganni salvage denim. In addition, the collection features sustainably derived sugarcane in-soles and upper padding and bamboo charcoal linings, as well as foam made from 87% bio-based content and an outsole containing 30% recycled rubber.

The collaboration between the companies is part of Ganni's 'Fabrics of the Future' initiative, set up in 2019 to research, test and scale innovative, lower-impact materials made from renewable resources and waste. This partnership marks Simplifyber's public debut and first collaboration with a fashion brand.

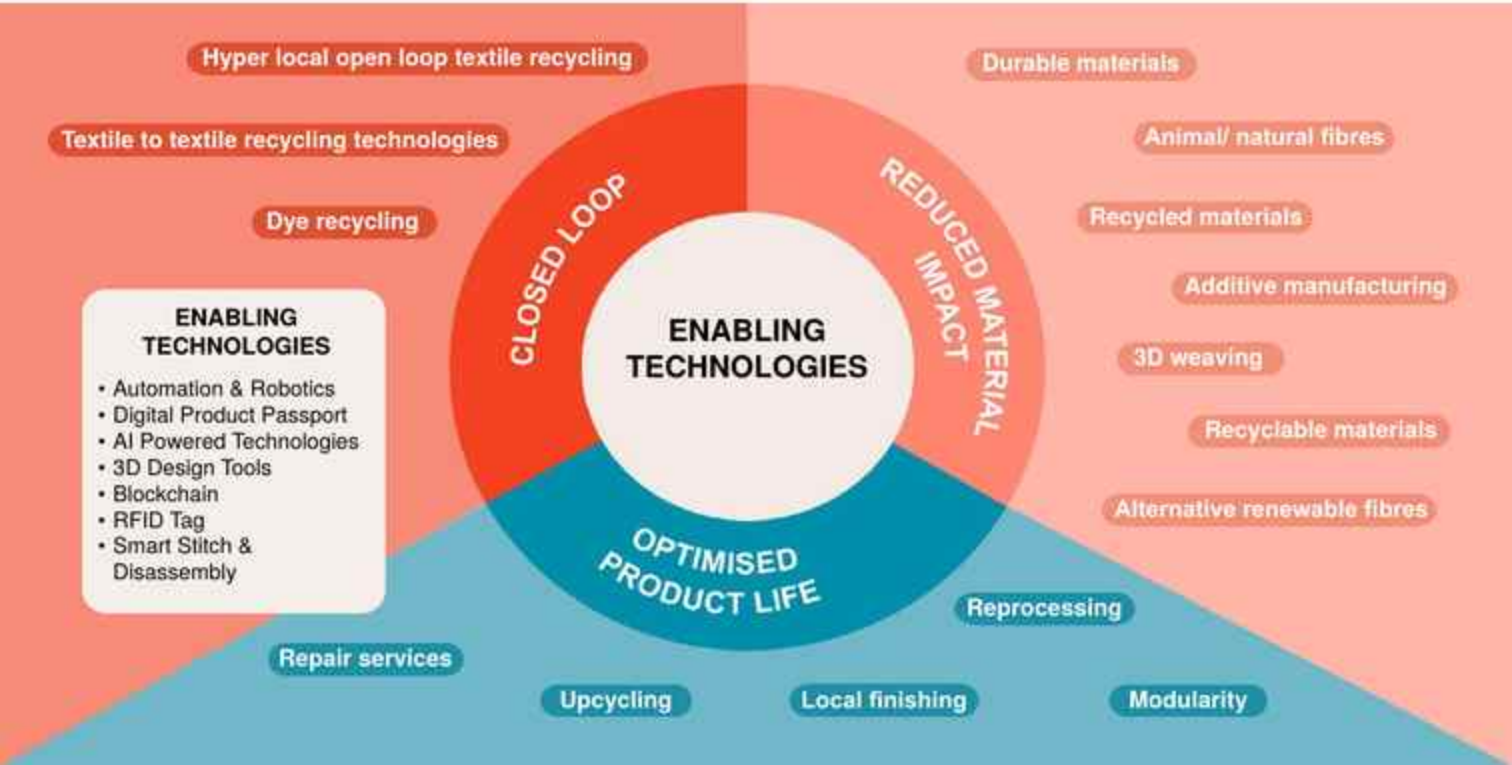
Image source: Ganni X Simplifyber

The way forward

As the fashion industry increasingly recognises the urgent need for sustainable practices, the shift towards circular manufacturing for textiles and apparel has gained momentum. However, despite notable innovations and advancements, significant opportunities and enablers remain to promote widespread adoption.

This section explores the current innovation landscape, while identifying key enablers necessary for further advancement and action forward for the manufacturing sector to accelerate circularity.

Towards a circular manufacturing innovation landscape



Realising circular manufacturing: The landscape

In order to realise circular manufacturing, there are seven key landscape elements that can support and accelerate the shift

COLLABORATION & PARTNERSHIPS

In order to reach a circular supply-chain, industry stakeholders tap into collaboration to exchange knowledge with like-minded textile and apparel manufacturers and build strong partnerships to support or manage circular strategies. Circularity at scale can only be reached if businesses across the supply-chain come together and we create a connected ecosystem.

REGULATORY LANDSCAPE

Businesses in the fashion and textile industry are facing increasing pressures from the regulatory landscape to transition towards circularity. Whilst staying ahead and compliant with all of the upcoming regulations and measures is a challenge for many, who need support to stay compliant, the regulatory landscape presents an opportunity to support this transition among textile and apparel manufacturers.

INNOVATION: ROLE OF TECHNOLOGY

Innovative solutions can be transformative for the circular transition of textile and apparel manufacturing. Technology plays a key role in driving this transition. Whilst the innovation landscape is flourishing, there are still innovation gaps.

SKILLS & WORKFORCE

The UK textile and apparel manufacturing sector is already facing skills shortages with an ageing workforce, and there is an opportunity to attract new workforce and bring new talent. New talent will have to be 'circularity and technology ready' and new roles that will drive circular textile and apparel manufacturing will add value to the business (i.e. working closely with AI technologies to plan production efficiently, manage repair labs in the factory settings).

EDUCATION & TRAINING

There is an increasing need for academia and training programmes at different levels to be closer to the textile and apparel industry, to understand where there are skills gaps and how students can be industry ready once they graduate. Sustainability and technology education can present an added value to their professional skills.

TRANSITION FUNDING

There is a cost to adopt. Sustainable transformation in the textile and apparel manufacturing sector requires investing in R&D, testing new products or processes, dedicating resources to build and strengthen collaborations and more importantly, investing in new technologies and machinery if solutions are to be scaled, and in skilled workforce. Textile and apparel manufacturers need funding opportunities to level up. This requires less complexity and softer requirements to apply for innovation funding, and capital investment for new circular solutions, as well as financial support to improve existing machinery to perform more environmentally efficient/ beneficial.

STANDARDS & CERTIFICATIONS

Whilst other environmental impact reduction areas have clear standards and certifications (i.e. chemicals, carbon footprint), textile and apparel manufacturers find it challenging to understand how circular they need to be, and lack of clear standards and certifications to support their actions.

The 10th of July 2024, UKFT, together with Circular Concept Lab, held a workshop with more than 20 UK textile and apparel manufacturing stakeholders to gather insights on circularity in textile and apparel manufacturing in the UK. The circularity enablers arose from the workshop's insights.

Key priority areas for textile and apparel manufacturing

This report has identified seven key actions for textile and apparel manufacturers to reach circular manufacturing

ACTION 1.

Embrace and integrate new technologies and innovations

Manufacturers need to remain open to new circular technologies and innovations and be willing to experiment with them. This readiness will not only enhance their manufacturing capabilities but also drive the market towards sustainability.

Key actions:

- **Pilot Programs for Technology and Innovation:** Encourage the adoption of new technologies and innovations by running small-scale experimental programs and R&D projects, and supporting fit for purpose solutions.
- **Investment in Digital Tools and Technologies:** Invest in tools and technologies and collaborate with supply chain stakeholders to digitalise supply-chains and improve data availability.
- **Traditional skills:** Utilise traditional skills (e.g. mechanical recycling of wool) to inform the development of innovative circular solutions for the industry.

ACTION 2.

Embed transparency for circularity

Transparency from the textile and apparel manufacturing stage is essential for circularity. The facilitation of data such as manufacturing location, manufacturing process, fibre composition, trims, dyes and finishes, as an example, is key for circularity stakeholders.

Key Actions:

- **Transparency standards:** Develop protocols for full disclosure of material origin, composition, and chemicals used, among others.
- **Traceability solutions:** Adopt traceability solutions like blockchain for product transparency, including tracking origin, composition, and chemical use. Alternatively, input data to traceability solutions embedded by clients when asked to do so, to facilitate decision-making in regard to sustainability.

ACTION 3.

Circular business models and solutions

Textile and apparel manufacturers can innovate their business models to maximise resource efficiency, optimise product life and create long-term value, which can also create new business opportunities and revenue streams.

Key Actions:

Some examples of circular business models that can be incorporated in textile and apparel manufacturer business offer include:

- **Repair and Refurbish Services:** Offer in-house or partnered repair and refurbishment services.
- **End-of-Life solutions:** Create solutions that support recycling operations, both for own and external waste.

ACTION 4.

Upskilling

There is also an opportunity to upskill the current workforce in circularity and digitalisation. This applies to all skill levels, including C-suite.

Key Actions:

- Invest in internal workforce training (i.e. CPD course developed alongside University of Huddersfield on 'Sustainable Practices in the Textile and Fashion Industry'). For more information, e-mail: **sustainability@ukft.org**
- Work with academia to inform the development of future-proofing curriculum.
- Work with education and training providers to enhance students work experience in the manufacturing sector.

ACTION 5.

Gateway to funding, research and development

To support research and development, textile and apparel manufacturers should stay aware of funding opportunities and potential research partners to enable this transition.

Key Actions:

- **Government Research bodies funding**
- There are several textile research centres and research programmes in the UK, including centers at universities and other institutions to consider as a gateaway for funding and research development:
  - **Leeds Institute of Textiles and Colour (LITAC)**: A research institute at the University of Leeds that focuses on textiles, color, and fashion. LITAC works with industry, charities, and NGOs to develop new materials, processes, and manufacturing methods.
  - **Technical Textiles Research Centre**: A research center at the University of Huddersfield that focuses on high-performance technical textiles. The center brings together expertise in a variety of fields, including engineering, digital technology, and textile processing.
  - **Textiles Circularity Centre (TCC)**: A research center that aims to develop new supply chains and textile production methods for post-consumer textiles, crop residues, and household waste. The TCC is led by Professor Sharon Baurley of the RCA and Professor Phil Purnell of the University of Leeds.
  - **Advanced Textiles Research Group (ATRG)**: A research group at Nottingham Trent University that focuses on advanced textiles research and designing electronically active wearable technology.
  - **Fashion and Textile Research Centre**: A research center at Nottingham Trent University that studies the values, meanings and associations of fashion and textiles.
  - **UAL Fashion, Textiles and Technology Institute**: A research institute at UAL that offers theoretical and practice-based research programs. **Centre for Sustainable Fashion, London College of Fashion.**
  - **The Robotics Living Lab (RoLL)** led by Susan Postlethwaite, Professor of Fashion Technologies and Director of RoLL, Manchester Fashion Institute, Manchester Metropolitan University, is a new fashion research facility to help support micro-scale and SME fashion businesses to develop high value, low volume garment production using agile collaborative robotic technologies for more sustain-able production. Opening in February 2025, the RoLL was awarded £3.8m by the Arts and Humanities Research Council (AHRC) to build and equip the new facility as part of the CResCa World Class Lab series.
  - **Textile Engineering and Materials (TEAM):** TEAM Research Group at De Montfort University was established in the early 1990s to undertake research in textiles. TEAM researchers have a wide range of specialist knowledge and expertise, currently focusing on the research to develop innovative eco-friendly textile processes and sustainable textile materials.

ACTION 6.

Foster cross-industry collaboration

Circularity at a scale can be reached only if businesses across the supply-chain come together and create a connected ecosystem. Hence, for a circular supply-chain, textile and apparel manufacturers must collaborate and exchange knowledge with stakeholders and build strong partnerships to support or manage circular strategies.

Key Actions:

- **Partnerships and alliances:** Partner with suppliers, recyclers and innovators, to co-develop innovative fibres, recycled yarns, and circular strategies.
- **Stakeholder networks:** Take part in industry-wide forums to exchange best practices, share insights, and co-fund sustainability initiatives.
- **Cross-industry approach:** Work with other industries (e.g., automotive or packaging) to find alternative solutions for circular textiles.

ACTION 7.

Proactive approach towards the evolving sustainability and circularity policy landscape

As sustainability regulations continue to evolve in the UK, EU and globally, manufacturers must stay ahead of upcoming policies and requirements. This is particularly crucial for circularity-related legislation, as it directly impacts products and business operations.

Key Actions:

- **Research the policy landscape:** Stay updated on domestic and international sustainability laws and guidelines. Refer to resources like the **UKFT Sustainability 101 Series** for a clear and comprehensive overview of current and upcoming regulations.
- **Standards and certifications:** Recognise that many sustainability legislations require third-party verification through credible standards and certifications. Manufacturers can use this as an opportunity to adopt recognised certifications for products, materials, fibers, processes and services. Refer to the **UKFT Sustainability 101** guide on Standards and Certifications for guidance on applicable certifications that can strengthen your business's commitment to circularity.

For more information, e-mail:
sustainability@ukft.org

Conclusion

As the UK aims to enhance its competitiveness through onshoring, sustainable transformation and digitalisation are crucial requirements for the textile and apparel manufacturing industry. Manufacturers stand at a pivotal crossroads, with significant opportunities to minimise their environmental impact while innovating towards circularity. By embracing circular principles, they can bridge the gap between concept and reality, making circularity a tangible outcome.

The UK's commitment to establishing a circular ecosystem necessitates that manufacturers take an active role in reducing material impacts, optimising product lifespans, and closing the loop. Our review highlights the growing momentum behind circular manufacturing both domestically and globally. Innovation within the existing manufacturing process, as well as additional services and business opportunities are flourishing, and this includes traditional manufacturers who have long championed high-quality and durable products.

This report exemplifies the potential of reinvention. The understanding of materials and processes is evolving; manufacturing processes are transforming, and waste is increasingly recognised as a valuable resource rather than a by-product.

While every innovation has its limits, this marks the beginning of a transformative journey. A successful transition requires commitment to change, continuous education, and the development of a skilled workforce that blends traditional craftsmanship with innovation. Together, these efforts will drive the UK textile and apparel industry towards a sustainable, circular future.

Abbreviations

TERM	DEFINITION
3D	Three-dimensional
3DWIC	3D Weaving Innovation Centre (University of Leeds)
AI	Artificial Intelligence
AIGC	AI-generated Content
B2B	Business to Business
CO_2	Carbon Dioxide
DEFRA	Department for Environment, Food and Rural Affairs
DPP	Digital Product Passport
EPR	Extended Producer Responsibility
FEL	Fashion Enter Ltd
FSC	Forest Stewardship Council
GCN	Global Circular Network
GDP	Gross Domestic Product
GVA	Gross Value Added
IoT	Internet of Things
ISO	International Organisation for Standardisation
LCA	Life Cycle Assessment
NGO	Non-Governmental Organisation
QR code	Quick-Response Code
R&D	Research and Development
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RFID	Radio Frequency Identification
ROI	Return on Investment
Saas	Software as a Service
SME	Small to Medium-sized Enterprise
T2T	Textile-to-Textile
TRL	Technology Readiness Level
WRAP	The Waste and Resources Action Programme

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