STEED, J., CROSS, K. and WILSON, B. 2023. Collaborating with a Scottish heritage brand towards enhancing and preserving sustainable artisan hand-weaving practices through a knowledge transfer partnership. *Journal of textile design research and practice* [online], 11(1-2): revised papers from the 5th Futurescan conference (Futurescan 5): conscious communities, 7-8 September 2022, Leeds, UK, pages 127-147. Available from: https://doi.org/10.1080/20511787.2023.2234650

Collaborating with a Scottish heritage brand towards enhancing and preserving sustainable artisan hand-weaving practices through a knowledge transfer partnership.

STEED, J., CROSS, K. and WILSON, B.

2023

Collaborating with a Scottish Heritage Brand towards Enhancing and Preserving Sustainable Artisan Hand-Weaving Practices through a Knowledge Transfer Partnership

Josie Steed, Karen Cross and Beth Wilson

Josie Steed is a senior lecturer and a design researcher at Gray's School of Art, Robert Gordon University. She has written several research publications on textile craft and technology and collaborated on several research projects exploring new applications for textiles through smart textile technologies. Josie has a keen interest in fostering design innovation and Knowledge Exchange collaboration and worked as Principal Investigator on Knowledge Transfer Partnerships (KTP) with textile manufacturing businesses in Scotland. She is currently a principal

ABSTRACT This paper discusses a Knowledge Transfer Project (KTP) with a global Scottish heritage brand to develop a year-round sustainable business model through a design-led approach to new product innovation that improves their sustainability credentials. Sustainability in textile production is under increasing scrutiny from the media, governments, regulators, and consumers, all demanding transparency in the supply chain. The company has an excellent track record of sustainable employment in rural communities and sought

Journal of Textile Design Research and Practice
Volume 11, Issues 1–2, pp 127–147
DOI: 10.1080/20511787.2023.2234650

investigator on the RSE-funded Immersive Scotland project, research co-investigator on the AHRC-funded Augmented Fashion project, and principal investigator for an AHRC funded 2-year KTP with Harris Tweed Hebrides. j.steed@rgu.ac.uk

Dr Karen Cross is the Associate Dean for Research in the School of Creative and Cultural Business, Robert Gordon University. Her research interests focus on how fashion and clothing can contribute to the psychosocial well-being of women; the use of immersive technologies within the fashion industry to tell stories of place, provenance, and people; and sustainable practices in fashion and textiles. She is currently a co-investigator on the RSE-funded Immersive Scotland project, which seeks to consolidate the immersive technology research and development activities taking place across Scotland; the AHRC-funded Augmented Fashion project, which involves Scottish fashion and textile SMEs from Lewis, Orkney, and Shetland; and the NPA-funded StoryTagging (Northword) project, commissioning Scottish creative practitioners to bring traditional stories to life through their medium.

Beth Wilson is a woven textile designer with experience working with natural fibres in several Scottish textile mills. She has recently completed a Knowledge Transfer Partnership in the role of Associate, working between Harris Tweed Hebrides and Robert Gordon University developing new products for the Harris Tweed® industry with a focus on heritage and sustainability, that minimise seasonality. Beth is now a full-time staff member at Harris Tweed Hebrides.

through the project to improve their production processes and waste output. Sustainability is a vast topic, where collaboration can help to address these key challenges. The company manages an artisan hand-weaving manufacturing system where yarn production and fabric finishing are regulated by the 1993 Harris Tweed Act of Parliament that protects and restricts production to the Outer Hebrides. The success or failure of the Harris Tweed® industry directly impacts the wider economy of the Outer Hebrides, which is considered "remote, rural, fragile" by UK and Scottish governments and their economic development agencies. The paper describes how academic/business collaboration can positively encourage innovation and help reposition businesses within a changing economic and sustainable landscape that explores these new opportunities. The paper reflects on how KTPs are a mechanism with mutual benefits, where pooling individual knowledge and resources can develop strong, sustainable, and authentic relationships that can provide tangible impacts of new knowledge generation and application within a scholarly and research context that can be clearly aligned to notions of bringing value to the sector, users, and the curriculum.

KEYWORDS: Knowledge exchange, collaboration, sustainability, design innovation, heritage

Introduction

Sustainable development within the fashion and textile industry requires businesses to commit to the concept of corporate social responsibility (CSR) described by Haski-Leventhal (2018) that meets the three pillars of sustainability: environmental, social, and economic. The globalised textile industry has created substantial challenges for businesses wishing to authentically communicate their moral and ethical values to their customers. This is in part due to the complexity of global supply chains, where providing ethical assurances and a chain of transparency across production has resulted in a mindfield of misinformation and trustworthy sources (Thorisdottir and Johannsdottir 2020).

Textile heritage businesses that operate on a small artisan, localised scale, such as those that are part of the Harris Tweed® industry in the Outer Hebrides of Scotland are well placed towards moving to a recognised CSR model. It could be argued many of their operations already meet this model, through their sustainable employment within the local rural community and the retention of hand-woven crafted textiles.

The Harris Tweed® industry has an impactful story to tell. Through generations of skilled workers: hand weavers and mill workers, the rich history and folklore associated with the tweed fabric are synonymous with the intangible and cultural heritage of the islands. Due

to Harris Tweed's unique identity fabric production has not overtly been impacted by the "outside" rapid growth of the fast fashion industry. The Harris Tweed® industry does however face other challenges where its values have not always been recognised by the contemporary consumer. Equally, the unique qualities of the cloth by the insular industry can be taken for granted leading to what can be described as a "marginalised mindset" (HTH/HWU 2015).

Textile businesses need to transform their business models from a "take-make-consume-dispose linear model" towards one that can not only generate economic, social, and ecological value but also work towards embedding sustainable and circular practices across their textile production systems (Coscieme et al. 2022). However, this requires significant investment and support in design and innovation where for small-to-medium-enterprises (SMEs), such as the mills operating within the Harris Tweed® industry, they have limited internal capacity and can struggle to generate change management independently. Academic/business collaborations can provide a mechanism for facilitating change management towards new priorities where partnerships with universities and academics can be beneficial to all stakeholders.

This paper discusses how a Harris Tweed® mill was supported to develop their ambitions in embedding sustainability using design-led innovation through an Arts and Humanities funded Knowledge Transfer Partnership (KTP) in collaboration with academics at Robert Gordon University. The paper begins by outlining the project by briefly describing the KTP model, the background to the Harris Tweed® industry, an introduction to the company involved, and the project outline. We then present our project, the methodologies used and discuss the findings that have led to facilitating strategic change within the company, the potential impacts, and benefits to all stakeholders, including the recent textile design graduate who was employed during a 24-month (February 2021–February 2023) industry project and referred to within the KTP structure as "the Associate."

The paper draws on a mixed methods approach including the formalised documentations created during the project: the project plan, four-monthly interim management reports, the impact benefits log, and the final reports. Qualitative methods were used that include captured reflective discussions between the graduate designer and the academic supervisor during the project period. The paper explores how, particularly for textile design subjects, universities can stay current and teach an ever-evolving practice by replicating industry conditions in academia through KTP collaborations. The paper further examines the mutual benefits for both the academics and the textile business when working on an Arts and Humanities KTP that can provide experiential insights into the implicit interdisciplinary nature of commercial design, manufacturing applications and solutions. Reflections are made on the benefits and opportunities for

enhancing academic teaching, research, and career progression for the associate at the early stages of their career development. The paper concludes by speculating on how the findings of the project could bring wider benefits to the global textile industry, particularly within the woven wool sector.

Knowledge Transfer Partnerships (KTPs)

The project was formalised through a KTP. Running for over forty years within the UK, the KTP program supports UK businesses to innovate for their economic development by gaining access to the academic expertise and resources available within the Higher Education sector by de-risking research and development for businesses through subsidized government funding. Three-way partnerships are formed to benefit all parties: a company, a university, and a graduate known as the associate (Figure 1), who work together to deliver a strategic innovation project for the business which they would be unable to achieve independently (UK Government 2022). Although KTPs are about the transfer of knowledge from one party to another it is argued by both Lane and Lubatkin (1998) and Van den Bosch, van Wijk, and Volberda (2003) that knowledge exchange is a more appropriate term where knowledge is exchanged fluidly backwards and forwards rather than as a one-directional transfer that can develop new knowledge for all parties (Fosfuri and Tribó 2008).

Knowledge can be described as both explicit and tacit (Nonaka and Takeuchi 1995). Explicit or codified knowledge is quantifiable and easily accessible through a formalised system. In contrast, tacit knowledge relates to internalised knowledge that is hidden, lacks visibility, and more difficult to articulate (Polanyi 1966; Nonaka 1991; Dormer 1994). The challenges of articulating the "tacit-ness" of design thinking when working with a heritage textile brand are more complex to transform into product design management frameworks and tools which needed to be developed by the associate (the

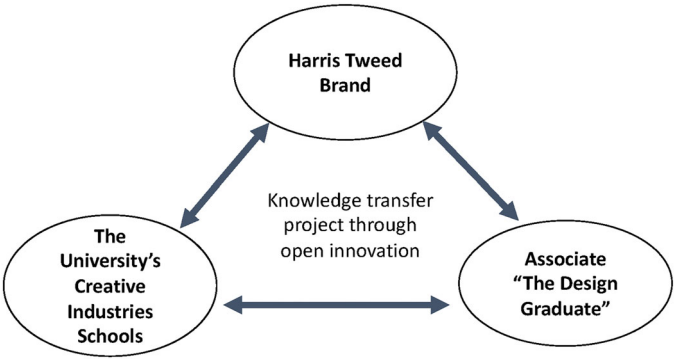


Figure 1
Diagram of the KTP project partnership structure illustrating the fluid exchange of knowledge between parties.

designer), the university, and the company (Ulrich and Eppinger 2008). As most KTP projects tend to be in partnership with STEM academic schools rather than with creative industry schools, there is still limited information available on the impact of design-related KTP projects, particularly within the fashion and textile design specialism. Coulter (2013) recognises that the qualitative measuring and empirical outcomes of non-scientific methodologies are more challenging to measure than within the science disciplines.

Harris Tweed® Industry

Harris Tweed® is renowned as a global leader in luxury woollen textiles that are directly connected to the history of the Outer Hebrides, a group of islands off the west coast of Scotland. The mills support a community of hand weavers and are integral to the region's economy. The fabric is unique and as such production against replication has and continues to be protected by the Certification of Orb regulated by the Harris Tweed Authority since 1909. Due to the unique setup of the Harris Tweed® industry including three separate entities: the self-employed home weaver, privately owned mills, and the Harris Tweed Authority, each party operates independently but requires the others to continue to produce the cloth known as Harris Tweed®. This undoubtedly makes the industry a fragile one that requires communication and balance; however, it does not require consultation between the parties for changes that remain within the realms of the act.

At a time when the concepts of sustainability, heritage, and provenance are central to our lives, Harris Tweed® communicates these values through the tweed cloth and its heritage. The environmental impact of a small pedal powered industry, such as the Harris Tweed® industry is comparably low to those of a greater scale, or which require a greater amount of automated machinery (Figures 2(a,b)). However, our previous research revealed that although the Harris Tweed® industry successfully conveys a sense of place and heritage to their customer, they were not fully capitalising on the handwoven value and sustainable, slow fashion aspects of Harris Tweed® (Cross, Steed, and Jiang 2021).

The Company

The company involved in the project is the largest of three mills based on the Isle of Lewis producing around seventy percent of all Harris Tweed® fabric. Harris Tweed® weavers are all self-employed working from their homes and outbuildings across the Outer Hebrides. The mills work with around one hundred and twenty home weavers who handweave every length of tweed on a treadle loom. Using one hundred percent British wool the fleece is processed in house into colored yarns and warps are then transported across the islands to the weaver's homes. Once woven the cloth is then

Figure 2
(a,b) Harris Tweed® cloth being woven by a home weaver.
Image credit: Lateral North.

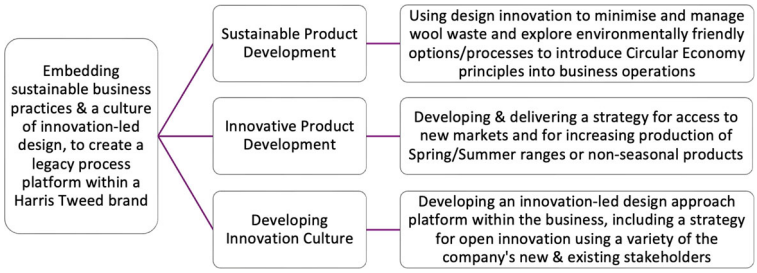
collected and finished at the mill where it is inspected, authenticated, and stamped by the Harris Tweed Authority before it leaves the mill. The company's fabric is sold internationally and used for a wide range of premium products for the interiors, fashion, and accessories markets and has been showcased by major international fashion brands, such as Ralph Lauren, Chanel, Vivienne Westwood, and more recently Thom Brown and Stone Island.

The Project Brief

The two-year project sought to embed sustainable business practices and a culture of innovation-led design within the Harris Tweed® brand, to generate year-round, sustainable business demand for the brand and the home weaver industry on the Isles of Lewis and

Harris. The aim being to explore new markets, minimise and manage wool waste and investigate environmentally friendly processes through the introduction of circular principles that could influence the whole of the Harris Tweed® industry and potentially the woven woollen textile market in the UK.

The project addressed the following three key challenges: Sustainable product development, innovative product development, and the development of an innovation culture within the company.



The project responded specifically to the increasing focus on sustainability in textile production, currently prevalent in media coverage, government, and legislation where consumer demands transparency in the supply chain. While the company had a positive existing story to tell in terms of sustainability of employment in rural communities, their production processes, estate, and location were more challenging to communicate externally. The company had put in place a sustainability strategic plan which highlighted the areas they sought to improve upon over a five-year period.

The company wanted to share their sustainability credentials with their customers using two key messages to communicate and support sustainable textile products. The first to continue creating a quality product that aligns with the values and practices of Slow Design where longevity, localised making, and supporting communities, facilitates change towards "buy less, buy better" where consumers are encouraged to buy a high-quality, long-lasting product over fast fashion alternatives (Strauss and Fuad-Luke 2008). The second being circularity, focusing on how the product is responsibly disposed of at the end of its usable life with minimal environmental impact or recycled into a new product or garment.

Methodology

Textile innovation specifically when working with a circular and sustainable focus requires new dimensions of creativity and innovation (Moorhouse and Moorhouse 2017; Niinimäki 2018). The work described follows tools used in design methodology applicable to new textile product innovation that can be applied to industry and experimentation (prototype) as a practice relevant to woven textiles. Situated within the mill site the application of design methodology in

the creative process was carried out by the associate, a graduate woven textile designer embedded within the company for the duration of the project, supported by academic and industry supervisors. Examples of the methods used by the associate during the two-year project included an initial review of the company's current processes and existing methodologies and technologies. This was achieved by reviewing their existing textiles, undertaking an audit of current manufacturing processes and technology together with a sustainability audit that included a review of their use of resources (wool, chemicals, energy) and waste management systems. A literature review of design trends and technical innovations within non-seasonal wovens and the lighter weight wool fabrics market was undertaken alongside an assessment of the current market and potential routes to new markets. This was then followed by a three-month early product innovation stage that explored sustainable design, manufacture, and waste management by investigating new preparatory and textile finishing systems and processes. Working with mill based hand weavers the associate explored the potential to incorporate sustainable practices, to embed innovation into the product. An evaluation of the current technical systems in place determined what additional equipment might be required to enhance the design and manufacturing processes for a new product range, relative to the markets, industry, and sustainable development whilst also in keeping with the guidelines of the Harris Tweed Act. Physical prototyping working alongside in-house weavers was undertaken that explored a range of variables, including the use of natural wool, lighter weight weave structures, and fabric finishing. In the final phase of product development, new woven product samples were performance tested and user trials through customer focus groups. Feedback evaluations on the product range was also gained from both company and University employees. Staff training at the mill was reviewed to ensure embedding of knowledge and innovations created during the project.

These methods were deemed the most applicable as they contribute to creativity, innovation, and quality for the development of new product textile design that also meets the needs of customers (Helena et al. 2017). Applying design methods, a new model of collaboration by means of an inclusive, iterative, and objectives-driven, performance-based approach was used that focused on the role of design as a management tool within a heritage textile company. The project explored the impact of creative design and design management tools in the exchange of knowledge and new product development that could potentially transform the company's understanding of the value of design towards their economic growth.

The Project Activities

A KTP is designed to bring benefits to all parties within the three-way partnership, the company, the university, and the associate. Here we

describe the different activities which took place during the project and their impact on the different parties.

Sustainable Product Development

A priority for the project for the company was to investigate opportunities to develop new product offerings that align with their sustainability ambitions. Three identified areas were explored: naturally colored product ranges, innovative ways to deal with textile waste, and reducing sampling waste using digital software. The company has traditionally been a seasonal brand producing autumn/winter fabrics. One of the aims of the project was to develop sustainable products which support year-round work for both mill workers and home weavers. For the Harris Tweed® mills, cloth has always been the sole product. Sold internationally to fashion houses, retailers, and clothing and interior furniture makers, cloth is contextualized widely across a diverse range of retail products all with the distinctive Harris Tweed® orb label that distinguishes its unique authenticity to their customers. The project sought to investigate a new range of fabric designs using only undyed wool fibers together with exploring opportunities for minimalizing textile waste through new mill procedures and the introduction of a CAD system to reduce physical sampling.

Color Wool Dyeing

The textile industry not only utilises large quantities of water for their processes but also uses vast quantities of chemicals and dyeing agents. These processes also create a large amount of waste in terms of energy and other chemical substances which will directly or indirectly impact the environment to varying degrees (Lellis et al. 2019). Although it is well understood that the use of harmful dye chemicals needs to be replaced by more environmental and ecological practices, putting this into operation within a global textile industry is complex (Lara, Cabral, and Cunha 2022). This is largely due to the requirement of not only reproducible quality throughout the industrial dye systems but also the need to minimize the costs whilst also maximising profit (Mahapatra 2016).

In the UK all companies are required to meet Control of Substances Hazardous to Health (COSHH) regulations. COSHH requires employers to control substances that are hazardous to health. These regulations ensure that chemicals imported and used within the UK meet legal requirements and are handled to a high safety standard. COSHH certificates are most commonly held by the company importing chemicals or the UK based supplier. UK chemical standards are changing regularly to move towards sustainability however these standards are specific to chemicals and until an accessible, stable dye is available that can be bought and applied in the volumes required the alternatives are few and far between. It is also worth mentioning that if new dyes require new application processes

this could pose considerable additional costs to companies. Very few mills in the UK are fully vertical, able to carry out each stage of production in house. For most UK woven textile companies, yarn is bought in for fabric production which is then sent out to specialist companies for finishing. This is not possible for Harris Tweed® as the Harris Tweed Act of 1993 states that all processes must be carried out in the Outer Hebrides.

Eco-friendly wool dyeing is challenging for a woven fabric, such as Harris Tweed®. A recent scientific report by Lin et al. (2022) investigated wool fibre dyeing using biodegradable natural dyes that recognised the industrial limitations in relation to producing an extensive color range and seasonal availability. A lack of dye stability and wash color fastness was recorded particularly when using a single natural dye where more research is necessary using a range of mixed natural dyes to resolve technical issues for industrial applications.

In response to the need to explore future alternatives to current dyeing processes, the associate undertook research to investigate alternatives that could in the longer-term help to inform the company's coloration systems towards sustainability. One of the areas the associate investigated was bio-inspired textiles that are informed by nature that can replicate for example optical microstructures to mimic natural color. One of the benefits of the KTP project partnership is the opportunity for the company to investigate speculative design-led research they would not normally have access in their day-to-day operations. Through the agency of an associate with a design background, the company gains access to new textile thinking, such as in the field of biomimicry that has relevance to the KTP project and can embed new innovative thinking that can have an impact for years to come.

Cloth—Natural Woven Yarn Collection

Harris Tweed® designs are inspired by the natural landscape of the Hebrides (Figure 3(a)). This has always been a key aspect of the tweed's unique heritage and remains vital when designing new fabric designs. However, the least sustainable process in the mill is fiber dyeing, where both acid and reactive dyes are used to color wool which requires vast volumes of water during the process of chemically binding the dye pigments to wool fiber. Each yarn is a blend of two to nine fiber colors creating a variety of unique mélange shades, woven together to produce fabrics bursting with color.

To address this a new "naturals" collection (Figure 3(b)), using undyed wool to reduce chemical use was developed and trialed for the commercial market.

Weave structures and selections of natural wool fibers inspired by the local environment were created to produce a small range of undyed and recycled weaves, to offer customers a sustainable fabric option whilst also supporting the company's image and marketing strategy towards its sustainable development ambitions. This was a

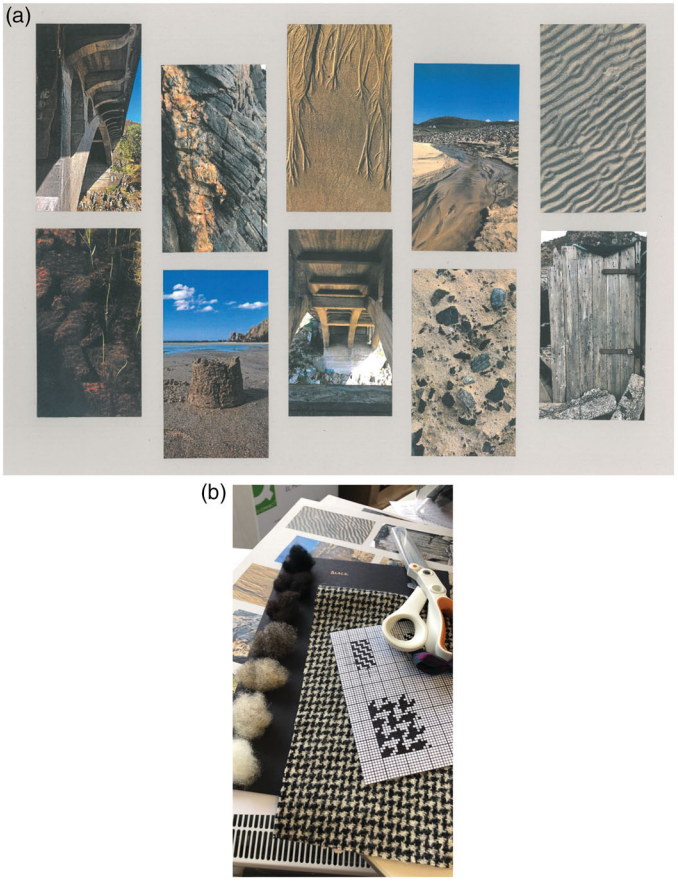


Figure 3
(a) Inspiration from the Outer Hebrides to develop the natural woven yarn collection. Image credit: Beth Wilson. (b) Prototyping weave structure, patterns, and yarns for the natural woven yarn collection. Image credit: Beth Wilson.

new product development for the company and the first of its kind for the Harris Tweed® industry introducing a new sustainable product option for customers. A small selection of mill-based weavers were consulted for their initial feedback on the KTP and working with natural yarns. None expressed strong opinions here other than the importance of the project ensuring a constant work stream for the island's home-weavers. Further feedback will be undertaken with weavers to inform future product developments.

Natural color consistency is the biggest challenge in the production of an undyed collection where customers expect product consistency for re-orders. Unfortunately, it is impossible to control the color of a raw natural product where each batch created could potentially vary in shade. This in turn also creates an opportunity to purchase a unique product with sound sustainability credentials.

The development of undyed product options has been a very specific alternative to dyed products, but it will never replace them. Color

contributes about eighty percent to the consumer's buying decisions and consumer demand will continue to play a large part in the direction of the industry.

Though an undyed collection of fabrics will not cater to everyone, a minimal color pallet of similar shades is one option moving towards finding sustainable solutions within the textile industry. The natural collection is anticipated to be launched in the summer of 2023 alongside the company's annual Autumn/Winter collection.

Decomposition of Dyed Wool—The Effect of Dye on the Biodegradability of Wool

During the project, the associate identified a gap in existing research on the affect of chemicals used in production on dyed wool, biodegradability, and negative environmental impacts. Wool is a natural fiber with several positive environmental credentials that include being naturally renewable, biodegradable, and easy to care for. It has been used in textile manufacturing for centuries and has proven to be popular with consumers as it produces breathable and insulating garments. The fashion industry has a significant environmental footprint, however, very little is known about how chemical processing impacts a product's end of life. One of the main selling points of wool is that it is fully biodegradable. The company was concerned that using this statement without more information on the decomposition of dyed wool could be misleading and perceived as a form of greenwashing. Preliminary research carried out indicated that there was a knowledge gap in the wool sector. This resulted in a further research project between the company and the University involving the School of Engineering. This additional work is in the early stages of development where it is anticipated that the findings could influence several production processes including wastewater, types of dyes used, and recycling processes for fibre, yarn, and fabrics. The work could also inform business decisions, strengthen the company's sustainability strategy and improve marketing to environmentally conscious consumers. There may also be benefits to the wider textile industry including wool suppliers, garment designers/manufactures, brands, marketing, and sales teams, to properly inform consumers of the circularity of woollen woven products, providing recommendations for products end of life and to make better informed future production decisions.

Customer Design

Being able to offer an inhouse design service allows flexibility and customisation. However, the company still produces physical samples for these customers which requires time to warp and weave a sample loom solely for this purpose. Digital technology investment was explored, to reduce physical sampling and waste, particularly in the initial stages of customer design development.

Investment in Computer-Aided Design (CAD) Technology

CAD sampling can be used as a sustainable alternative to physical sampling, reducing waste and speeding up design options in response to customer requests. The company had previously not invested in a CAD design system largely due to a lack of digital in-house expertise. Instead, all design work had to be carried out manually, hand weaving each new sample and approved as part of a "blanket" or "range" of patterns. Embedding a recent textile graduate in the mill with CAD experience enabled research to be carried out so that a suitable CAD system could be installed. This investment reduces sampling, saves time, manpower, resources, and waste allowing the company to respond to customer requests more efficiently.

The investment in a CAD system within the mill has significantly accelerated the first stages of the design development process. Initial in-house setting up of the CAD system required inputting all the colors, yarn blends, and technical information currently in use at the mill which was time-consuming but is now fully installed. The programme was ready to be rolled out for customer developments at the beginning of the second year of the project where in the first year it was used for inhouse projects including collection development up to this stage. Providing a visual representation of fabric helps give customers an idea of how their chosen colors and patterns will look as an end product. Some customers are happy to sign off on a design using physical yarn colors and CAD designs and others use CADs as a tool to refine down their selection before proceeding to sample lengths. This in turn reduces sampling waste where previously all design developments were undertaken manually, weaving meters of cloth for a customer to choose a single design. CAD has also significantly reduced sampling lead times as previously, customers would be quoted six to eight weeks for woven design development. Now, CAD designs can be posted and even emailed out in the same week. In the future the aim is to manage the pattern loom time most effectively, freeing up time by carrying out initial design development work using CAD.

Industry Certification

Certification in the textile industry provides customers with assurance of a company's management systems, ensuring all appropriate standards are maintained. Increasingly customers are selecting products that align with sustainability criteria, namely economic, social, and environmental. Certification supports companies who want to communicate their environmental measures externally in a credible and transparent way. Before the project, the company only had the Harris Tweed authority authentication stamp for its fabric. One of the project's objectives was to research and apply for world-wide industry recognized certification. An application to the OEKO-TEX®

Association was identified as the most appropriate as criteria for certification confirms "… the human-ecological safety of textile products from all stages of production (raw materials and fibers, yarns, fabrics, ready-to-use end products) along the textile value chain." (OEKO-TEX 2022). The application for the Oeko Tex Standard 100 certification was successful, and the company now has an additional international certification that provides assurances to customers that textile production is safe, environmentally friendly, and socially responsible.

University Benefits

The KTP structure provides academic staff with the opportunity to apply and test their theoretical research within a commercial setting (Innovate UK 2015). This supports the increasing demand to provide evidence of the economic impact of research investment, whilst informing the direction of ongoing and future research. Importantly, the papers and publications developed through a KTP, together with the research income, can contribute to the Research Excellence Framework (REF), the UK's research assessment process for benchmarking and accounting of Higher Education institutions' research submissions. In addition to this, KTPs provide opportunities to develop teaching materials, opportunities for student projects, work-based activities, and for introducing commercial contexts.

One of the key objectives of universities is to develop strong courses producing graduates that have excellent employability skills where they are adaptable and flexible and can use their transferable skills in different contexts. This requires universities to provide students with the knowledge skills central to building life-long learning capacities and employability skills as required within today's society and workplace where the Higher Education Academy (HEA), the UK's professional membership scheme for HE, identifies twenty-first century work skills as encompassing three distinct themes: literacies, competencies, and character qualities (HEA 2022). Education for Sustainable Development (ESD) is increasingly becoming a priority for universities to embed within their curriculum. ESD develops competencies - skills, attributes, and values that link to both subject knowledge and knowledge of sustainable development (QAA and Advance HE 2021). It is around these competencies that students need to develop graduate attributes for sustainable employability throughout their working lives. Understanding this multi-faceted datum, which defines contemporary graduate employability within the HE sector, will increasingly demand HE to support graduates to develop interdisciplinary skills to become resilient and adaptable within this evolving landscape. These demands and challenges are particularly evident, although not limited to the creative sector with a statistically high level of self-employment, which is only set to increase in the future (Creative Industries Council 2022). One of the recommendations in the COP26 Universities Network paper (2021) is to include partnering

with industry to facilitate curriculum reform towards ESD. It is within this context that the project supported teaching and learning across two schools: the University's Art School and the School for Creative and Cultural Business with a range of student undergraduate projects, talks, and curriculum events supported by the associate.

Student Projects

Deadstock Fashion Design Project

As part of the KTP partnership, a live undergraduate student project was undertaken with second year Fashion and Textile Design students to work collaboratively on a garment design project using deadstock Harris Tweed® fabric (Figure 4). Deadstock fabric is a fabric that the company can no longer sell due to several factors. For example, the fabric has been woven incorrectly and does not meet quality standards set by the mill or the Harris Tweed Authority, it could also be surplus from a customer order, incorrect dye shade, or a discontinued range. Deadstock fabric from Harris Tweed® mills cannot be resold and therefore has limited options for reuse. The ten-week project included a briefing to students, a mid-point review, and final student feedback by the KTP Associate. The opportunity to work with the company enabled students to gain first-hand experience of working on a live project brief and gain feedback on their work both in development and at the final presentation of the work. A selection of student's work was selected and shown at the company's Chinese fabric agent's stand as part of Shanghai Fashion Week.

The project demonstrated the importance of building meaningful partnerships with external organisations to enrich the curriculum with real-world commercially driven student projects that have a focus on sustainability and the circular economy. All the students who took part in the project gained from the experience. In addition, the project outcome was significant in building their portfolios with examples of

Figure 4
Examples of second-year fashion and textile Student's work using deadstock Harris Tweed® fabric. Image credit: Fergus Connor.

work that relates to design for sustainability as a key graduate attribute.

Fashion Management Projects

Two further projects took place with students from the Fashion Management course: Fashion Retail and Store Design project with first-year students and a Fashion Branding project with third-year students. As for the fashion design projects the associate worked closely with the academics delivering the project and provided first-hand experiential insights on the students' work, together with providing information on the company's branding, customer retail, and marketing strategy.

In addition to the student projects the associate was involved in a range of University initiatives specifically in line with their ambitions towards ESD. The associate contributed to the University's first creative industries sustainability symposium providing insights from an industry perspective on their sustainability development goals and on their work as part of the KTP project in developing sustainable design practices. Involvement also included taking part in a student focus group discussion focusing on the University's awareness and ESD ambitions.

The Design Graduate—Associate

The role of the designer in this project highlights the agency of design where the associate has acquired a complex range of skills. They are the creator of new knowledge for the company and must navigate between two different organisations with diverse priorities and objectives - the company and the University. For the company, the associate needs to innovate and present design-led initiatives that transform their current operations to ensure a successful outcome that fully meets the expectations of the project. Within the academic context, the associate supports and informs research and teaching, where the tangible impact of new knowledge generation and application within a scholarly and research context brings value to the sector and the curriculum. They must also exploit softer skills through project management, meeting performance objectives, and undertaking a formalized personal and professional development program. For the designer as an associate, their specialist design knowledge together with training supports their understanding of management concepts and how to apply design thinking to strategic design decisions in a dynamic process with the aim of moving the business from "potential absorptive capacity" to "realised absorptive capacity" (Zahra and George 2002, 190–192).

The industry needs creative individuals that can collaborate, communicate, and integrate activities and projects. Designers who can be agile and responsive to new emergent lifestyle trends are attractive to industries that struggle to achieve this internally but know it is

essential to their future growth. Design's intangible qualities and less quantifiable assets need to be appropriately communicated and adapted within company structures. For the associate, taking on the role of stewardship, planning, and managing a project, involved developing nuanced oral communication skills to work effectively and sensitively with all staff with different roles and responsibilities. As new processes and systems were developed and design innovation practices began, they needed to become embedded within the company through effective communication with departments to ensure full implementation across all stages of production. Furthermore, designing a new product range needed to be clearly articulated across the company to ensure full buy-in, achieved by communicating and working with staff to guarantee a complete understanding of the importance of new quality control assurance. In addition, the designer's taught visualisation methods through storyboards and visual references within presentations and facilitated conversations and input from staff in new and accessible ways.

Conclusion

What are the implications of this work for textile design practice, education, and research within the framework of design for sustainability? Fashion and textile education tends to focus on the traditional application of design thinking towards product development, however, a key objective of the KTP was to explore how interdisciplinary design skills within a heritage textile brand could develop new products, evolve a product design management framework, develop tools and approaches that can bring systemic cultural transformation towards ambitions for embedding sustainability and circular practices. Through collaboration, formalised through the KTP program, the knowledge exchanged between all parties has deeply impacted the University and has been fundamental for the company's future economic growth.

The project also identified several ongoing challenges for the mills working in the Harris Tweed® industry. The company's business practices must align with the Harris Tweed Act 1993 that protects and maintains the fabric's reputation, so design innovation and design for sustainability must conform to this legal framework. Design innovation is therefore more complex and slower for companies working in the Harris Tweed® industry due to this legal framework where all new products must be undertaken with this heritage in mind. Furthermore, the initial ambitions for the project to explore opportunities for the company to use natural dyes rather than synthetic dyes has been limited as the use of natural dyes at the industry production scale required is not yet achievable.

Throughout the project, there have been several challenges across management, production, communication, and in particular embedding design innovation. Instigating cultural change within a traditional heritage business with a hierarchical and fixed approach to operating

has been complex. Embedding design throughout a company requires a complete rethink in organizational culture where Von Stamms (2008) explains, innovation per se is not enough where the behaviours of staff need to also transform. A people-based approach needs to be implemented through the formation of working groups to ensure successful outcomes where a different culture and mindset to business as usual is necessary. Businesses must commit long-term to ensure the investments made during the project continue once the funding period has been completed. Further developing design expertise is critical for competitiveness and growth within global markets but also acknowledges that it is only part of the picture and design needs to be carefully managed in line with the company's overall strategy. Cooper and Press (2000) also recognise this and recommend the importance of integrating design with effective management to ensure the successful implementation of innovative new products as a clear management objective.

Reflecting on the experiences of the associate, a woven design graduate working as the project manager on the project provided a framework within which to assess the impact and benefits of the KTP project in relation to developing the skills needed for graduates within the twenty-first century.

The associate project managed all the activities both within the company and the University which included developing a first-of-its-kind range of natural, undyed yarns within the Harris Tweed® industry. Furthermore, the associate identified a vital knowledge gap in current wool industry practices regarding the compostability of dyed wool which has led to a further funded research project. The research and results of this additional work are anticipated to generate future sustainable solutions across a variety of areas in fashion and textile manufacturing. Not only did the associate's design skills significantly reduce design lead times and environmental impacts, but input as a sustainability champion also enabled the business to focus on improving their marketing communications surrounding sustainability by leading a cross-department working group within the company to implement changes at every stage of production. The extensive research into product development demonstrated the long-term benefits of reducing issues around seasonality, as well as benefits to rural communities' economy through the numerous improvements instigated across the mill site. In addition, exploring issues, such as waste management, opportunities, such as an undyed tweed collection, natural dyes, lightweight fabrics, marketing, and promotional business strategies all provided the company with the means to diversify, expand globally and generate sustained future economic growth.

Graduates' experience of the KTP programme has been transformational for fast-tracking career progression, as seventy percent of KTP Associates are employed immediately upon completion by the host company (Innovate UK 2022). This is particularly significant within the fashion and textile job market where only one in seven

graduates in the UK will find employment as designers (Business of Fashion 2017). In the instance of the KTP outlined in this article, recognition for the associate's work includes nomination and shortlisting for the KTP Future Leaders Award and the offer of a full-time post with the host company. This new role would be to further enhance the sustainability and ethical credentials of the brand that are increasingly demanded by consumers, creating long-term value for the business. The associate has also become an associate lecturer at the University ensuring the development of the partnership with the company.

Finally, as this project has been prominently mill based the views of the home weavers have not been sought however for future projects that change or affect the way weavers work, feedback and collective working would be applied.

Acknowledgements

The authors would like to thank Margaret Ann MacLeod, Ruth Masson, and Calum Iain MacLeod at Harris Tweed Hebrides Ltd; Dr Ian Heywood—Knowledge Transfer Adviser, North of Scotland, Knowledge Transfer Network, and the staff team at the North of Scotland KTP Centre.

Funding

This work was funded by the Arts and Humanities Research Council (AHRC) and supported by Innovate UK.

ORCID

Josie Steed http://orcid.org/0000-0002-3075-9072
Karen Cross http://orcid.org/0000-0001-7591-2889
Beth Wilson http://orcid.org/0000-0003-4074-5405

References

Business of Fashion. 2017. *Is Fashion Education Selling a False Dream?* Available online at https://www.businessoffashion.com/articles/education/global-fashion-school-rankings-2017 (accessed 23 December 2022).

Cooper, R. and Press, M. 2000. *The Design Agenda; A guide to Successful Design Management*. Hoboken, NJ: Wiley.

COP26 Universities Working Paper. 2021. "Mainstreaming Climate Change Education in UK Higher Education Institutions." Available online at https://www.gla.ac.uk/media/Media_814664_smxx.pdf (accessed 23 December 2022).

Coscieme, L., Manshoven, S., Gillabel, J., Grossi, F. and Mortensen, L.F. 2022. "A Framework of Circular Business Models for Fashion and Textiles: The Role of Business-Model, Technical, and Social

Innovation," *Sustainability: Science, Practice and Policy*, 18(1): 451–462.

Coulter, J. 2013. "Interdisciplinarity: Creativity in Collaborative Research Approaches to Enhance Knowledge Transfer." Available online at https://pure.ulster.ac.uk/ws/portalfiles/portal/11303508/COULTER_Interdisciplinarity_in_knowledge_Transfer.pdf/ (accessed 23 December 2022).

Creative Industries Council. 2022. Available online at https://www.thecreativeindustries.co.uk/facts-figures/uk-has-almost-2-3m-creative-industries-jobs-official-data (accessed 23 December 2022).

Cross, K., Steed, J. and Jiang, Y. 2021. "Harris Tweed: A Glocal Case Study," *Fashion, Style & Popular Culture*, 8(4): 475–494.

Dormer, P. 1994. *The Art of the Maker*. London: Thames and Hudson.

Fosfuri, A. and Tribó, J. 2008. "Exploring the Determinants of Potential Absorptive Capacity and Its Impact on Innovation Performance," *Omega*, 36(2): 173–187.

Harris Tweed Hebrides/Heriot Watt University (HTH/HWU). 2015. *Context Workshops People Process Impact*. Edinburgh: Heriot Watt University.

Haski-Leventhal, D. 2018. *Strategic Corporate Social Responsibility*. London: Sage.

Helena, S., de Santis, S.H., Giuseppe, F., Marcicano, J.P., Sanches, R., Held, M., Fornazzari, L. and Santis, V. 2017. "Strategy of Textile Design: Use of Design Methodology Tools in the Creative Process," *Strategic Design Research Journal*, 10(1): 57.

Higher Education Academy. 2022. Available online at https://www.advance-he.ac.uk (accessed 23 December 2022).

Innovate UK. 2015. *Warwick Economics and Development. The Impacts of KTP Associates and Knowledge Base on the UK Economy*. Available online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/467142/KTP_Report_July_2015_Exec_summary__1-SEP-15_.pdf (accessed 23 December 2022).

Innovate UK. 2022. *Knowledge Transfer Partnerships*. Available online at https://www.ktp-uk.org/graduates/ (accessed 23 December 2022).

Lane, P. and Lubatkin, M. 1998. "Relative Absorptive Capacity and Inter-Organizational Learning," *Strategic Management Journal*, 19: 461–477.

Lara, L., Cabral, I. and Cunha, J. 2022. "Ecological Approaches to Textile Dyeing: A Review," *Sustainability*, 14 (14): 8353.

Lellis, B., Fávaro-Polonio, C.Z., Pamphile, J.A. and Polonio, J.C. 2019. "Effects of Textile Dyes on Health and the Environment and Bioremediation Potential of Living Organisms," *Biotechnology Research and Innovation*, 3 (2): 275–290.

Lin, L., Jiang, T., Xiao, L., Nahid Pervez, M., Cai, X., Naddeo, V. and Cai, Y. 2022. "Sustainable Fashion: Eco-Friendly Dyeing of Wool

Fiber with Novel Mixtures of Biodegradable Natural Dyes," *Nature*, 12: 21040.
Mahapatra, N.N. (ed.). 2016. "Textiles and Environment." In *Textile Dye*. New Delhi: Woodhead Publishing India in Textiles.
Moorhouse, D. and Moorhouse, D. 2017. "Sustainable Design: Circular Economy in Fashion and Textiles," *The Design Journal*, 20: sup1.
Niinimäki, K. (ed.). 2018. "Sustainable Fashion in a Circular Economy." Available online at https://core.ac.uk/download/pdf/301138773.pdf (accessed 23 December 2022).
Nonaka, I. 1991. "The Knowledge Creating Company," *Harvard Business Review*, 69: 96–104.
Nonaka, I. and Takeuchi, H. 1995. *The knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford: Oxford University Press.
OEKO-TEX. 2022. Available online at https://www.oeko-tex.com/en/about-us (accessed 23 December 2022).
Polanyi, M. 1966. *The Tacit Dimension*. London: Routledge & Kegan Paul.
QAA and Advance HE. 2021. "Education for Sustainable Development Guidance." Available online at https://www.qaa.ac.uk/quality-code/education-for-sustainable-development (accessed 23 December 2022).
Strauss, C.F. and Fuad-Luke, A. 2008. "The Slow Design Principles: A New Interrogative and Reflexive Tool for Design Research and Practice." slowLab. Available online at https://raaf.org/pdfs/Slow_Design_Principles.pdf (accessed 23 December 2022).
Thorisdottir, T.S. and Johannsdottir, L. 2020. "Corporate Social Responsibility Influencing Sustainability within the Fashion Industry. A Systematic Review," *Sustainability*, 12: 9167. Available online at https://www.mdpi.com/2071-1050/12/21/9167 (accessed 23 December 2022).
UK Government. 2022. "Knowledge Transfer Partnerships: What They Are and How to Apply." Available online at https://www.gov.uk/guidance/knowledge-transfer-partnerships-what-they-are-and-how-to-apply (accessed 23 December 2022).
Ulrich, K.T. and Eppinger, S.D. 2008. *Product Design and Development*. New York: McGraw-Hill.
Van den Bosch, F.A.J., van Wijk, R. and Volberda, H.W. 2003. *Absorptive Capacity: Antecedents, Models and Outcomes. ERIM Report Series Research in Management*. Rotterdam: Erasmus Research Institute of Management.
Von Stamms, B. 2008. *Managing Innovation, Design and Creativity*. 2nd ed. Chichester: Wiley.
Zahra, S.A. and George, G. 2002. "Absorptive Capacity – A Review, Reconceptualization and Extension," *The Academy of Management Review*, 27(2): 185–203.