Royal College of Art

Manchester Metropolitan University

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Aspect

A human-centric research of skills and decision-making capacity among technical workforce in fashion garment manufacturing to support policy development and technology acquisition for sustainable fashion/manufacturing/growth.

Final Report
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Contents

Project Team

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Introduction

The UK's fashion industry has an international reputation for creative design and contributes £32.3billion to the UK economy.[1] But this is a field which is seeing limited impact of digital technology in manufacture and which has seen much of its production being moved offshore. Current levels of automation across UK fashion manufacture is much lower than other sectors. The UK imports vast quantities of low-value, high-volume fashion goods from international suppliers which are produced in largely automated factories. Advances in machinery and new tooling are happening very rapidly but often involve the deskilling of the workforce. Machines are often designed to carry out a single process with a technician feeding textile into a former to be stitched automatically. The challenges of integrating automation into a highly creative UK fashion sector with a need for very high levels of agility in micro-production processes added to the costs of R&D to develop appropriately agile tooling to support small-scale business needs is hampering the reshoring of UK fashion manufacture.

Most Fashion Industry reports (Alliance Project, 2017[2]; Reshoring UK Garment Manufacturing with Automation. Recommendations for Government, 2022[3]; UK Textiles Manufacturing: Opportunities and Challenges for the UK and Midlands, 2022[4]; Let's Talk Real Skills Report Commissioned by Calderdale College, 2022[5]; The Environmental Audit Committee. Fixing Fashion Report: Clothing Consumption and Sustainability, 2019[6]; Business of Fashion. Textiles and Technology: Mapping the UK Fashion Textiles and Technology Ecosystem, 2021[7]) suggests the industry suffers from the lack of a skilled workforce.

Amongst young people who might enter the industry a lack of interest in manufacturing, an anxiety about modern-day slavery, poor working conditions, precarity in the jobs market and low levels of pay and training are exacerbating the situation. An ageing workforce, with some level of skills which might be passed on, is failing to inspire young people. Some reports suggest negative experiences working with the education sector and trying to recruit from there. There are multiple low-level training offers in the UK. Traditionally focused on training students in conceptualising, designing and making of their own collections, most undergraduate and postgraduate fashion courses in the UK have not significantly evolved over the past 25 years. At Manchester Fashion Institute (MFI) design students are being trained to work with digital tools and leading manufacturing systems, engineering technologies and supported in the development of new models of entrepreneurship and circular economic models that now make up the fashion industry landscape. Reports from Fashion Industry Journal Business of Fashion (State of the Industry Report McKinsey & Company/ Business of Fashion 2016)[8] showed that students entering the jobs market were lacking knowledge specific to new technologies resulting in impaired ability to challenge current practice or develop new design-led roles which has led to this change and the adoption of a STEAM-based approach. We have carried out desk-based research to establish the state-of-the-art/ skills levels held by machinists in the UK garment industry.

[1] www.standard.co.uk/insider/fashion/uk-fashion-industry-ps32-billion-uk-economy-british-fashion-council-caroline-rush-a3934781.html
[2] https://s3-eu-west-1.amazonaws.com/ukft/wp-content/uploads/2018/05/13115441/Repatriation-of-UK-textile-manufacture-The- Alliance-Project-Report.pdf
[3] Postlethwaite, S., Thiel, K., Atkinson, D. (2022). Reshoring UK Garment Manufacturing with Automation. Recommendations for Government. Research Report. KTN Made Smarter.
[4]
5 https://www.calderdale.ac.uk/wp-content/uploads/2022/02/LTRS-Engineering-and-advanced-manufacturing-full-report-FINAL.pdf
6 https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/1952/full-report.html
7 https://bftt.org.uk/wp-content/uploads/2021/08/BFTT_Mapping-the-UK-Fashion-Textiles-and-Technology-Ecosystem_2021.pdf
[8]mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/the%20state%20of%20fashion%202017/the-state-of-fashion-mck-bof-2017-report.pdf

The broad aim of the MMU/RCA/Cranfield collaboration is to create a vision of a micro-scale digitised fashion industry in which garment manufacturers collaborate with robotic technologies and digital-controlled fabrication. Developing digital twin technologies to consider scale and agility of production and prototyping and scaled manufacturing models whilst also considering the future of work, meaningful employment and upskilling of workforces and place-based manufacture. RSA's report from 2018 'From Design Thinking to Systems Change: How to Invest in Innovation for Social Impact'[9] suggests a need for a human-centred industrial strategy. To transform markets and orientate investment toward empowering innovation, innovators will need to build on human-centred design methods and augment them with systems thinking. They propose a 'think like a system, act like an entrepreneur' approach which follows a Design Thinking logic akin to the Design Council's double diamond model.

Working with colleagues from the Psychology and Human Factors Group in the Centre for Structures, Assembly and Intelligent Automation at Cranfield University and their expertise in Hierarchical Task Analysis and eye-tracking tools for retrospective analysis and motion capture enabled an understanding of the decision-making stages, the physical requirements, cognitive skills, and evaluative steps that are taken by expert makers. Developing a new methodology, the project is based in Human Factors and design practice research to explore skills levels in garment manufacturing, considering the steps that can be designed out, and performed by robots, or those needing to remain performed by skilled human makers, importantly identifying requirements for promoting worker satisfaction via new technology and automation particularly involving co-botics.

This tightly limited scope study has been an ideal way of demonstrating the value in this area of research as a platform for a larger collaborative piece of work in the future. Professor Postlethwaite will lead a Horizon Europe funding application with Cranfield and European partners with a focus on co-investigating, with micro and SME fashion design and robotics businesses, what kind of small-scale tools might need to be designed to enable new forms of on-shored production, leading naturally to a new design aesthetic. If robots can perform sampling and prototyping tasks following a suggested tool path, they could then store information on a blockchain for production and protect the designer's IP. These cobot systems could support decision making for fabrication sequencing. There is already potential for interactive robots to be mobile on desktops as well as self-assembling swarms - concepts that can help to address further development aims for garment manufacturing.

Background

STEAM as a new industry-facing pedagogic model originated from Rhode Island School of Design (RISD). Driven by an understanding that design education fosters critical thinking and comfort with risk-taking, RISD's ambition was "to reach consensus among disciplines on the requirements of the 21st Century workforce" (Allina, 2019. pp 32).[10] In the United States, the understanding of the value of design to advanced manufacture is well established, where RSDI considers design to be a literacy, a capability and a specialism. The Design Council Report Designing a Future Economy - Developing Skills for Productivity and Innovation 2018[11] suggests that design skills are the fusion of creativity with technical ability and interpersonal competencies. They highlight moving from STEM to STEAM+D - that is, Science, Technology, Engineering, Art and Maths, to include D, the Design element, to ensure a resilient economy in the longer term. In their 'Leading Business by Design: High Value Manufacturing' (2015)[12] report the Design Council's policy recommendation was that

9 https://www.thersa.org/reports/from-design-thinking-to-system-change

10 Allina, B. (2019). STEM to STEAM: A North American Perspective of the Emerging Arts School. Design School: After Boundaries and Disciplines, pp.32. Wilmington, Delaware: Vernon Press.

11 https://www.designcouncil.org.uk/fileadmin/uploads/dc/Documents/Designing_a_future_economy18.pdf

12 www.designcouncil.org.uk/fileadmin/uploads/dc/Documents/Leading%2520Business%2520By%2520Design_High%2520value%2520manufacturing.pdf

young people at all stages of education require exposure to the multidisciplinary mix of science, technology, arts, humanities and enterprise that should underpin both creative and manufacturing success in the UK. They go on to say that government should provide incentives to universities to deliver an increased range of multidisciplinary design courses in partnership with expert bodies to enable engagement with the fourth industrial revolution. The LEO data (2019)[13] supports the proposition that it is through a mixed and interdisciplinary training, particularly an undergraduate degree in science and engineering, married to a post-graduate design degree that enables graduate earnings to substantially increase.

The basic principle of Industry 4.0 is that by connecting machines, work practices and systems, businesses are creating intelligent networks along the entire value chain that can control each other autonomously. Economic models that are informing new thinking about manufacturing Industry 4.0. Hannover Fair 2011. Digital, automation and robotics.
Industry 4.0+ rejects the Hannover definition as too rigid as proposed by Professor of Economics Dr Lisa De Propris.[14] Industry 5.0 brings the human back to the centre of the value chain. Well-being, meaningful work and a living wage are central. Upskilling, retraining, lifelong learning.

UK fashion students have often been trained to become micro businesses and then Small to Medium size Enterprises (SME's) and UK Government research funding has targeted small-scale enterprises through research with UK universities like the Creative Clusters Programme. This strategy looks as if it may pay significant dividends in the new post-pandemic business environment. McKinsey & Company/ Business of Fashion (2019)[15] recognised a new role for small players where they might support R&D for larger brands in in-house labs or attached to universities as Learning Factories designed as a simulation to enable experiential learning as happens in European technical universities. Fashion thinking for advanced manufacturing[16] encourages work that radically reimagines making processes, machines and systems from a designer-led perspective within the context of Industry 4.0. Degrowth and just-in-time economic models, agility in manufacturing, scalability and adaptability, R technologies (Stahel 2017)[17] and reverse logistics can be developed here.

In order to equip master's students with research skills for them to explore and critically examine Industry 4.0, we have proposed they will need both hard and soft skills. Skills that include an understanding of technologies, digital tools and engineering, married to critical thinking, collaboration and interdisciplinary working. To fully exploit Industry 4.0+ there is a need to take a Socio-Technical perspective, in which the social impacts and benefits are given equal weight to the technical. We are therefore proposing a people-centred approach to robotics and automation through a joint project based in Human Factors research.

Vaughan (2017)[18] claims that underpinning practitioner research is the understanding that the practitioner–researcher has the skills and expertise in the actions of the field to be able to undertake research within it. Citing Schon, Vaughan points to the transition from designer- practitioner to designer-practitioner-researcher in the course of academic study, as a shift from being able to understand and articulate the value or challenges of technical acts, to being able to place these in broader socio-cultural, technical and economic contexts. The situation for Art and Design training at undergraduate and postgraduate level in the UK remains complex and uncertain, particularly in light of the UK's withdrawal from the European Union. If the UK government continues to support the development of an advanced manufacturing sector and the reshoring of the UK manufacturing industry then UK fashion education can rise to meet this challenge by developing the way fashion is taught to engage more fully with Industry 4.0.

13 https://explore-education-statistics.service.gov.uk/find-statistics/graduate-outcomes-leo/2018-19

14 De Propris,L.David Bailey (2020) Industry 4.0 and Regional Transformations. London, Taylor and Francis.

15 www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/the%20state%20of%20fashion%202019%20a%20year%20of%20awakening/the-state-of-fashion-2019-final.ashx

16 Postlethwaite,S. 2021. Design Culture (of) Making: Investigating Creative Processes and Pedagogy as Fashion Thinking. Conference paper. Cumulus. 9 June 2021. Rome, Italy.

17 Stahel, W. L. (2017). *Circular Industrial Economy* in *Designing for the Circular Economy* edited by Martin Charter 12- 20. Oxford: Routledge.

18 Vaughn, L. (2017). *Designer/Practitioner/Researcher.* In. *Practice –Based Design Research*. Edited by Lauren Vaughn, 9-17. London: Bloomsbury Visual Arts.

1. Part 1
DESK-BASED SKILLS RESEARCH

Manufacturing is one of 5 priority sectors to which the government appointed a 'sector delivery lead' in autumn 2021. The future of manufacturing can be more flexible and need not necessarily be tied to major cities, which will help to shorten supply chains and lead to more localised production for local markets. Many recent fashion industry reports have focused on the circular economy and sustainability concerning textiles or retail, but the modernisation of garment manufacturing is largely considered to be beyond the remit of the reporting.[19]

The following extracts are lifted verbatim from reports.

Report 1
Let's Talk Real Skills Report. Commissioned by Calderdale College, 2022[20]
Key Findings re skills levels

Many businesses reported negative or significant (with negative connotations) impact due to Brexit, regardless of whether they were an exporting business. This reflects the fact that many of them are reliant on raw materials from outside the UK. Delivery delays, increases in costs, taxes (VAT) and paperwork all impact on the ability to respond to market needs and customer requirements, whether they are importing raw materials/ products or exporting to customers outside the UK.

Some businesses saw opportunities in the need for their customers to onshore production, rather than rely on supplies from abroad and the related delivery delays, increased paperwork and costs. This resulted in some significant (and positive) impacts in terms of increased market or potential markets, through reduced numbers of competitors.

The specific roles that the textile businesses need are - technicians, pattern cutters, seamstresses/ machinists.

Some businesses have identified recruitment difficulties for highly skilled industrial machinists – they are always on the lookout for appropriate candidates.

Report 2
Alliance Report, 2015[21]
One of the most significant reports in recent years
Key Findings

An ageing workforce, endemic skill shortages (especially Cut Make Trim/machinists) and lack of investment are the critical barriers that are threatening the UK's existing supply base. Most notably the growth in export markets for luxury and high-end fashion

Addresses the image of the textiles industry which is often thought of by potential entrants – particularly teenagers – in terms of 'sweat-shops' and not the more typical opportunities in high-tech and fashion-related premises

A lack of 'Prime' manufacturers to invest in research, innovation and upskilling – the decline of UK textiles manufacturing in the early twentieth century was hastened more by underinvestment in implementing technology rather than developing it

Recommendations address immediate skill shortages alongside image and branding of the sector. There is a need to urgently address two key issues: the immediate skills shortage; and the image of the industry. Skills shortages, especially in Cut-Make-Trim (CMT), are acutely evidenced in the research, alongside growing skill needs emerging from rising demand in the luxury and fast-fashion sectors and in bespoke homeware. Overall, the number of skilled entrants into textiles needs to be

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20 https://www.calderdale.ac.uk/wp-content/uploads/2022/02/LTRS-Engineering-and-advanced-manufacturing-full-report-FINAL.pdf

21 https://s3-eu-west-1.amazonaws.com/ukft/wp-content/uploads/2018/05/13115441/Repatriation-of-UK-textile-manufacture-The- Alliance-Project-Report.pdf

increased if the current workforce size is to be retained.

Additional support will be needed to change young people's perceptions of the sector with appropriate labour market information, advice and guidance. Working with schools and colleges to promote good career pathways in the industry will be key.

Further work is required to identify latent skills in the labour market that can be more readily deployed, meeting immediate employer needs and giving time to develop a longer-term skills pipeline. This will include assistance to support moving people from the informal to formal labour market, most notably in the Black and Minority Ethnic community.

Interviews with manufacturers highlighted that a third of firms were looking to potentially employ additional staff, typically five employees, in the next 12 months. Applying the potential number of 'growth firms' and 'new jobs' to the national level suggests that there could be an opportunity to create 5,000 to 15,000 new jobs in the course of the next decade, depending on how quickly investment and the opportunities can be realised. Taking a scenario for import growth also suggests that a 0.5% to 1.0% shift in the current level of UK imports would equate to an additional 2,000 to 4,000 jobs in the UK economy. Given these growth opportunities (jobs and economic output), it is worthwhile noting that many UK textiles firms are located in some of the areas experiencing high levels of long-term unemployment, including high levels of unemployed residents from minority ethnic backgrounds and young people. The recent growth in employment in the textiles sector suggests an immediate opportunity to deliver economic and social prosperity, alongside re-balancing of the economy.

The demand for CMT has led to three urgent and interrelated barriers to further growth in the sector. Initially, research highlighted that retailers and fashion designers reported a lack of supply of skilled machinist and artisan apparel workers linked to London's fashion sector. London firms are already actively looking to grow their sourcing outside the region because existing capacity has been stretched to meet demand.

One of the critical success factors identified throughout the interviews, with both retailers and manufacturers, was the need to ensure that the UK textile and clothing industry has strong and relevant skills to compete successfully in world markets. The supply side research highlights that UK manufacturing lies in specialist, highly skilled production with an emphasis on smaller production cells, delivering shorter – quicker runs.

The Alliance Project has undertaken several strands of skills research with companies, mainly within Greater Manchester (and some further afield), looking at demand, provision and funding. This research has identified skills shortages as the main barrier to growth facing the sector. The survey of textiles employers shows that just under two-fifths (37%) of firms interviewed stated that skills are a barrier to growth; half (49%) reported hard-to-fill vacancies; and half (50%) said that their recruitment problems over the last two years related to low levels of applicants with the right experience and qualifications required.

Throughout the research undertaken, employers expressed serious concerns, including

- The industry's ageing workforce, associated loss of skills and training capacity, and recruitment difficulties reported across a range of occupations by employers;
- Poor image of the sector, and a potential workforce, especially young people and parents, that lack information about career opportunities and progression in the industry;
- A lack of understanding by employers of the funding and support available for skills, a lack of time and resource to address workforce development in a mostly micro-size sector;
- A lack of support for appropriate work-based training.

The research identified several factors which affect the ability of companies to compete successfully in world markets. The findings rehearse well-known challenges to the repatriation of manufacturing and cover a wide range of practices which affect international trade in textiles and clothing.
The sector suffers from an ageing workforce. National research suggests that half of the fashion and textiles workforce is aged 45 years and over, which is higher than the average across all sectors in England (40%).

Employers interviewed in Greater Manchester said they face an urgent challenge to replace an estimated 150 machinists each year over the next decade, due to retirements. Adding in other non-skilled machinist occupations to these figures increases the total to a replacement demand of 400 employees per year.
Bi-monthly Employers Skills Groups were held in Greater Manchester to identify and address skills issues in the textiles sector and, in particular, to complete workforce planning research identifying the number of:

- Staff expected to retire over the next five to ten years and their job roles
- New employees and their job roles expected to join over the next five to ten years.

Employers at the Skills Group were also asked to discuss specific training requirements and complete training plans identifying specific job roles, skill requirements and training methods. Over two-thirds of vacancies (66% or 80 jobs) relate to machinist roles, and just over a quarter (28% or 34 jobs) are managerial/professional/ technician roles. Just under one-in-ten (7%) are semi – and unskilled staff. Over half (52%) of employers in the Alliance Project's research state that recruitment difficulties are related to the 'image' of the sector, in particular the views of parents and young people.

As within other areas of core manufacturing, there is a widely held perception that the textiles and clothing industry has been in decline for many years; and where it does exist, jobs are perceived to not offer good wages, skills and careers. Equally, there is evidence that young people do not fully understand the breadth and scope of careers within the UK textiles and clothing manufacturing industry. More extensive and co-ordinated campaigns in partnership with careers advisors and national agencies would help to demonstrate the breadth of careers and career paths, and help to signpost young people towards relevant training.

Focus groups with students from Universities and interviews with staff suggest that more could be done to provide the work experience and employer links they need. They suggested a need for coordinated labour-market information for students and parents that promotes links to local manufacturers as well as the fashion/retail brands which they supply. The employer discussion groups identified the need to re-brand the sector and establish closer links with schools and colleges, and give greater opportunities for pupils and students to gain first-hand experience about the industry. These factors were seen as central to supporting more young people to enter the sector.

The rapid growth in demand for skilled machinists points to the potential to identify and hire latent skills in the local labour market. Manufacturers have highlighted the potential to work in areas with the densest concentrations of textiles skills and to engage with people that want to progress further in the industry, as well as those that have the requisite 'latent' skills, but might be currently working in other sectors/used to work in the industry.

It is worthwhile noting that many firms across the UK operate with banks of machinists who they call on for piece-work as and when needed. From a social perspective, 'formalising' the industry will open opportunities for residents to enter jobs with training.

There is a need to urgently address two key issues: the immediate skills shortage and the image of the industry. Skills shortages, especially in Cut-Make-Trim (CMT), are acutely evidenced in the research, alongside growing skill needs emerging from rising demand in the luxury and fast-fashion sectors and in bespoke homeware. Overall, the number of skilled entrants into the textiles sector needs to be increased if the current scale of the textiles workforce is to be retained.
Additional support will be needed to change young people's perceptions of the sector with appropriate events and labour market information, advice and guidance. Working with schools and colleges to promote good career pathways and opportunities for progression in the industry will be key.

Further work is required to identify latent skills in the labour market that can be more readily deployed, meeting immediate employer needs and giving time to develop a longer-term skills pipeline. This will also include assistance to support moving people from the informal to the formal labour market, most notably in the BME community.

1 Research with retailers and manufacturers emphasises the growing importance of design and innovation in driving the success of the sector. The lack of large supply-chain 'Primes' reinforces the need

to develop stronger linkages between firms and local universities and colleges – including access to state-of-the-art facilities that will help to recruit, promote and develop future innovation. With encouragement from Government, retailers have potential to also grow their role as 'Primes' in this supply chain, as indeed many of them already do with their offshore suppliers.

2 Industry, working with government, universities, and other public/private support agencies should deliver a physical space for industry that will drive innovation and excellence. This will enable and foster networking and collaboration between industry and globally recruited 'world-class' talent from the disciplines of Design, Fashion, Manufacturing and Engineering.

Report 3

BFTT - Business of Fashion, Textiles and Technology, 2021[22]

Key Findings

- Skills Shortages. Throughout the BFTT's consultation period, the shortage of skills within the sector was a hot topic. As part of the inaugural British Textile Biennial in Oct 2019, the BFTT and Creative Lancashire led the Fabric of Our Times roundtable discussion on the future of the UK fashion industry, at the Blackburn Museum and Art Gallery. The roundtable hosted 14 FTT industry stakeholders, including designers, business owners and educators (see participant list, page 91 of the report), with an audience of over 30 delegates. Roundtable stakeholders identified that an essential requirement for the growth of the UK FTT sector is addressing skills shortages in areas such as technology training and crafts/technical skills The UK lags behind other European countries in skills such as AI and shows slow adoption of digital and Information Communication Technology (ICT) skills. Roundtable participants emphasised that ICT skills shortages are being met by technical skills shortages, for example in making and crafts skills, such as pattern cutting by hand, as well as technical garment and digital technology skills. Deficits were attributed to the slow adoption of industry skills training by higher education providers. There was a perception that university education in the UK is seen as the most credible way to gain skills and employment in the sector, compared to alternative training schemes such as apprenticeships. The slow adoption of skills was also attributed to a lack of perceived interest from a younger generation in technical textiles and manufacturing careers – due partly to a decline in the UK's manufacturing industry over the past 20 years.

Stakeholders pointed out that the skills gaps should be addressed before university education level, at primary, secondary, post-18 and further education levels. Since 2018, UKFT and other skills sector trade bodies have actively sought to enhance the UK's provision for highly skilled apprenticeship programmes as a way to close the skills gap in the sector. Despite successful lobbying by sector trade bodies for a T level in crafts and design, A levels and university degrees are still perceived as more desirable by employers and university recruitment teams. Universities cannot overlook the rising costs of studying for a degree in the UK. The rise in recent vocational qualifications, such as T levels, and the UK government's announcement in September 2020 of plans to expand post-18 education and training with the Lifetime Skills Guarantee programme, emphasise the need for FTT universities to provide more technical and industry-specific skills training. As well as technical skills, SMEs and stakeholders place high importance on soft skills essential for the ethical and sustainable development of the sector. These include business development, collaborative working and developing leadership skills.

Central to developing these soft skills is the urgent need to improve access to a diverse talent force. SMEs emphasise the need for a more racially and

[22] https://bftt.org.uk/wp-content/uploads/2021/08/BFTT_Mapping-the-UK-Fashion-Textiles-and-Technology-Ecosystem_2021.pdf

ethnically representative workforce. The business case for diversity is heightened by the need for more decisive leadership across the sector as it transitions to a more technological ecosystem. SMEs focus more on day-to-day operations and are therefore unable to access time and resources to develop their leadership skills alongside developing their business. This identifies that executive coaching and leadership skills development is necessary for business development programmes.

Report 4

Arup. Rethinking the factory. Report, 2015[23] – Beyond sector report from architecture, relevant section 'The Human Factor(y)'

Key Findings

One significant development in workplace automation is that the factory robot of the future will be able to safely interact and cooperate with its human co-workers. The aim of industrial designers is to combine the ingenuity and versatility of people with the precision and repeatability of robots, enabling human-machine collaboration in dynamic and reconfigurable manufacturing environments. A world optimised for both humans and robots.

Arup claim robotics and automation along with the application of cyber-physical assistance systems will lead to safer and more productive working environments. This integration of technology will also increase the demand for highly skilled workers to operate and maintain machinery and control smart production processes. The lines between blue- and white-collar workers will continue to blur, with a growing focus on factory environments that facilitate collaboration and innovation along the supply chain and across production lines. As workers' roles continue to adapt and merge, the configuration of factories will have to change to reflect these new working patterns.

Smart processes, products and machines will enable the optimisation of production and will require a fine-tuned integration of building and machinery. Sensor-driven production lines and product components will enable factories to react in real-time to changes in the market and supply chains. The increased use of insights arising from data collection and analytics will allow more rapid and responsive manufacturing, where products and production processes can adapt, perhaps even autonomously, to changing customer demands or market trends.

- Resilient and Adaptive Spaces

Climate change and resource constraints will require that the construction and operation of factories be both sustainable and resilient. This includes reduced energy, water and material consumption, a shift towards the circular economy, and design and location choices that limit climate-related weather risks and reduce transportation needs. Faster innovation cycles, together with constantly changing market conditions and demand patterns will require flexible and adaptable spaces. Modular and adaptable factory buildings allow companies to quickly set up or expand production capacity, or shift production from one type of product or location to another.

A focal point of continued factory innovation is reduced energy and material consumption within the manufacturing process. Advances in technology continue to enable lower energy consumption.

Factories will need to be significantly more responsive to rapidly changing market dynamics and operational environments in the future. They will need to adapt physically to supply chain disruptions and variations, new product lines, machinery and equipment.

As such, the factory will need to accommodate a range of floor layouts, production systems, equipment configurations and extensions, an example of which can be seen in Images 2 and 3. Most automotive factories today are typically set up to maximise economy of scale for a limited range of vehicle models. In a smart factory, however, the equipment is flexible and readily adapted to manufacture multiple models within the same factory.

[23] file:///Users/katharinathiel/Downloads/Arup_Rethinking_the_Factory_FINAL.pdf

Images 2 and 3 - HQ of Norton motorcycles in the West Midlands. The Norton factory has a manufacturing area that is analogous to a lab, with freestanding structural elements that could support robotics.

The shift to flexible and adaptable factory designs and layouts is in part enabled by the increased use of building information modelling (BIM) in factory design, planning and management. BIM enables production plants to evolve into intelligent digital factories. Digital models of factories enable factory owners and operators to make changes to the physical plants far more quickly and accurately.

Nestle's modular factory is an excellent example of flexible factory design. When new components are installed in the physical plant in future, they will be able to configure themselves and establish communication with each other, thereby eliminating start-up time and reducing costs. Once in operation, production processes will optimise and even heal themselves.

The ability to pre-visualize the factory design and layout in order to fine-tune the relational integration of all components, including the building's structure, building systems, machinery, logistics processes, resource flows and energy production systems. BIM allows designers to perform performance and process-related analysis before the factory is constructed and any equipment installed, optimising machine utilisation and energy consumption, maximising footprint efficiency, and increasing production throughput.

Design for disassembly incorporates a number of core principles. These include

- Careful initial selection of recycled and recyclable materials. At scale, use of easily recycled materials in new projects can drive industry and governmental development of new recycling technologies.

- Minimise the number of material types used. Fewer material types simplify sorting and reduce complexity of recycling transport.

- Preferentially use mechanical, rather than chemical, connections. Easy separation and disassembly of components reduces damage to materials and simplifies recycling.

- Embrace modularity. A freely interchangeable building system enables rapid and efficient changes to layout and function.

- Improved adaptability and flexibility will also mean that factories can be constructed from modular components that are easily disassembled and relocated. Modular structures can be expanded quickly and easily to meet changing spatial requirements. Tented factories, for example, can be used for extra capacity or as stand-alone moveable facilities.

Modularity and disassembly are alternatives to current construction practice, which sees the assembly of buildings as a uni-directional project to create a final structure. However, in the future, there will be more focus on design for disassembly. This more cyclical view of the built environment will take into consideration the deconstruction process as well as the construction process.

Report 5

National Audit Office. 'Developing workforce skills for a strong economy', 2022[24]
Sector(s): Business and enterprise, Education and skills Department(s): Department for Education
Key Findings

This report examines whether government has an effective approach to enhancing workforce skills.

Background to the report

In early 2022, the UK workforce comprised around 32.6 million people. Workers require a range of skills to be productive and the skills system involves government, employers, training providers, local bodies and individuals. Employers play a crucial role in developing workforce skills and stimulating the skills system. They can encourage and support their staff to take up government-funded training opportunities. They also invest in their own training activities, create high-skilled jobs, and offer career progression and other opportunities for those with the appropriate skills.

Within government, the Department for Education (DfE) leads on skills policy in England and is accountable for securing value for money from much of the funding government provides for skills initiatives. In January 2021, DfE published the Skills for Jobs white paper. This explained how government would carry out reforms so that the further education system would support people to get the skills that the economy needs throughout their lives, wherever they live in the country. The Skills and Post-16 Education Act 2022 made provisions to implement proposals from the white paper.

Scope of the report

Government has had an enduring role in supporting workforce skills development, understanding that the market does not supply all the skills the country needs to provide goods and services and enhance productivity and competitive advantage. The funding and attention government gives to this area is continuing to grow.
The report examined whether government has an effective approach to enhancing workforce skills. Given its responsibilities for leading government's approach to skills, much of the examination focused on DfE's activities, as well as other departments which play a role in supporting skills development.
This report covers:

- the workforce skills system (Part One);
- the scale of the skills challenge that government faces (Part Two);
- government's understanding of workforce skills needs (Part Three); and
- how well government is supporting the development of workforce skills (Part Four).

Report conclusions

Having a sufficiently skilled workforce is critical to the country's economic success and to achieving wider government aims such as greater equality of opportunity. Government, led by DfE, has strengthened its approach in recent years. It has taken sensible steps to deepen its understanding, improve its oversight and work more coherently to address this priority.

At the same time, the skills challenge that government is facing has grown significantly, with key indicators going in the wrong direction. Employers' investment in workforce training has declined, as have participation in government-

[24] https://www.nao.org.uk/wp-content/uploads/2022/07/Developing-workforce-skills-for-a-strong-economy.pdf

funded skills programmes and the programmes' impact on productivity. In addition, wider changes in the labour market are intensifying the challenge. Government therefore needs to be much more effective than it has been in the past at helping to provide the skills the country needs. DfE is staking its success on a more employer-led system but, from the evidence we have seen, it is unclear whether the conditions are in place for this to be implemented successfully, in particular, whether employers are ready to engage to the extent that will be needed to achieve a step-change in performance. As a result, there is a risk that, despite government's greater activity and good intent, its approach may be no more successful than previous interventions in supporting workforce skills development.

Wider economic and societal changes are creating skills shortages and making the skills challenge more acute. A variety of factors bring about changes in the workforce and the skills needed in the labour market. At present, these factors include the following:

The UK's exit from the European Union has reduced the supply of workers from member states and potentially increased the need for the country to train its own workers, particularly in sectors such as hospitality, transport and storage, manufacturing and construction.

The requirement to achieve 'net zero' greenhouse gas emissions by 2050 will significantly affect the workforce. For example, the increased production and use of electric vehicles and improving the energy efficiency of heating systems will create new skilled jobs. Research in 2019 estimated that around one in five jobs across the UK (approximately 6.3 million jobs) is likely to be affected by the transition to net zero.

People aged over 50 made up around one-third of the UK workforce in 2021, compared with one-fifth in the early 1990s, although there are also indications that many older people left the workforce after the end of the COVID-19 furlough scheme. Research suggests that employers are less likely to train older employees than younger employees.

Adult participation in government-funded further education and skills training has declined significantly, particularly in disadvantaged areas. The number of adult learners fell from 3.2 million in 2010/11 to 1.6 million in 2020/21, a decrease of 48%. Over a shorter timeframe for which consistent data are available, from 2015/16 to 2020/21, the number of participants aged 19 and over in the 20% most disadvantaged areas of England dropped by 39% (280,100 participants). This compared with a 29% decrease in overall adult participation over this shorter period. The largest decline within these disadvantaged areas was for learners aged 50 and over, whose numbers fell by more than half.

Government's understanding of workforce skills needs

DfE has diagnosed that, in order to improve the skills system's contribution to economic performance, more people should undertake higher-quality learning in subjects with the greatest economic value. The workforce is more highly qualified in formal terms than it was in the early 2000s. However, on the basis of analysis, DfE has found that:
DfE has concluded that, for the skills system to be more effective, there should be increases in: the number of learners; the number of learners achieving qualifications at higher levels; the proportion of learners doing more economically valuable subjects; and the rigour and quality of learning.

Only 4% of people had a level 4 or 5 qualification as their highest level of attainment by the age of 25 (the typical level for acquiring higher technical skills), with a much higher proportion opting to study at degree level (level 6); and for all age groups, too much learning is done in subjects that tend to lead to relatively low salary levels.

Government is relying on a number of new arrangements to strengthen its understanding of future skills needs and its plans to address them. In late 2020, government established the Skills and Productivity Board, a committee of academics and business experts, to provide independent evidence-based advice to DfE ministers. In February 2022, DfE announced the creation of a Unit for Future Skills, which supersedes the Skills and Productivity Board. The Unit is a division within DfE but is intended to work across government and meet the information needs of other departments as well as DfE. The Institute for Apprenticeships and Technical Education plans to draw on the Unit's insights to help its employer-led groups devise new apprenticeships and technical qualifications, and

revise existing apprenticeships to reflect future skills needs in their sectors. In 2017, DfE set up skills advisory panels to better understand and address regional and local skills needs, and strengthen the link between employers and skills providers. DfE has decided to replace skills advisory panels with local skills improvement plans (LSIPs), and provision was included in the Skills and Post-16 Education Act 2022. LSIPs are intended to provide a framework to help colleges and other providers reshape what they offer in order to tackle skills mismatches and respond effectively to labour market skills needs.

A designated employer representative body will lead the development of the LSIP in each local area. Training providers will have a duty to cooperate in developing the plans and to have regard to these plans when considering their technical education and training.

Technological changes

Artificial intelligence and other technological advances are expected to change the structure of the labour market significantly, increasing the need for workers to be reskilled or upskilled. Research for the Department for Business, Energy & Industrial Strategy in 2021 suggested that around 7% of existing jobs in the UK were likely to face a high probability of automation over the following five years, with the percentage rising to nearly 30% after 20 years. The research projected that the health and social care sector would see the largest gains in employment and also rising skills shortages; sectors such as wholesale and retail, finance and public administration, and transport were expected to face employment losses.

Analysing current skills needs

Every two years since 2011, DfE has undertaken a survey to collect information on the skills issues that employers face. In 2019, the survey comprised more than 81,000 telephone interviews with employers in the commercial, public and charitable sectors across England, Northern Ireland and Wales. Some of the 2019 survey's main findings were as follows:

Successive employer skills surveys suggest the number of skill-shortage vacancies in England grew from 77,000 in 2011 to 199,000 in 2019, a rise of 158%. By 2019, around one-quarter of all vacancies were skill-shortage vacancies.

5% of employers had 'skill-shortage vacancies' (vacancies that are hard to fill because of a lack of the required skills, qualifications or experience among applicants), and 13% of employers had skills gaps among their workforce.

Skill-shortage vacancies were most prevalent in construction and manufacturing, where 36% of vacancies were proving hard to fill compared with the average of 24%.

84% of skill-shortage vacancies were at least partially caused by a lack of technical or practical skills, often a lack of specialist skills or knowledge needed to perform the role.

The most common actions that establishments took to overcome skill-shortage vacancies were using new recruitment methods or channels and increasing advertising or recruitment spending (37% of establishments in both cases).

Nearly one in five establishments reported that they either had apprentices or offered apprenticeships but did not have any apprentices undertaking one. The likelihood of offering apprenticeships increased with the size of organisation and over time. In 2019, 80% of large establishments (with 250 or more staff) reported that they offered apprenticeships, compared with 59% in 2014. The proportion of the smallest establishments (with two to four employees) offering apprenticeships increased slightly, from 9% in 2014 to 10% in 2019; for employers with five to 24 employees, there was a larger increase, from 18% in 2014 to 25% in 2019.

Skills Bootcamps are being offered in the Fashion and Textiles sector. They are courses lasting up to 16 weeks for people aged 19 and over who are looking to change sectors or progress in their current industry. The courses are designed to help people develop sector-specific skills, and where relevant they provide a fast-track route to an interview with a local employer. By April 2022, 24,500 people had started a Skills Bootcamp, which was 9% above DfE's planned trajectory.

The digital skills sector is thoroughly investigated by the report

- The Department for Digital, Culture, Media & Sport (DCMS) provides the sector delivery lead for digital. As part of this work, DCMS has launched the Digital Skills Council, which will work with industry to support the growth of the

digital workforce and help improve collaboration between industry and government.

- DCMS works directly to address critical technical skills gaps identified in the National Data Strategy, the National Artificial Intelligence Strategy and the National Cyber Strategy. DCMS funds interventions such as artificial intelligence courses, Cyber First training and specialist boot camps for digital skills, and it works with the National Cyber Security Council.

- An assessment to inform the Prime Minister's jobs and skills stock take in December 2021 identified digital skills challenges across all five of the priority sectors, as well as a need for more information on skills gaps and private sector training provision, and evidence on the effectiveness of initiatives.

- DWP is identifying claimants who do not have essential digital skills and referring them to skills provision, such as relevant Skills Bootcamps.

- DCMS is working with DfE on wider digital skills provision, including improving and increasing computing education in schools. However, it will take time for this to feed through into the workforce.

Report 6
East London Fashion Cluster Report. Strategy and Action Plan, 2017 [25]
Key Findings

- Skills - physical displacement also risks dislocation from a local workforce with the specialist skills needed to support high-end fashion manufacturing. High-end fashion production has an outdated and unattractive image of 'sweatshop' labour, particularly for young people, making recruitment difficult. Many fashion manufacturers currently lack 21st-century skills, from basic software to the utilisation of emerging digital fabrication methods. This is compounded by a lack of garment technology skills among young designers.

Report 7
British Fashion Council. Future of Fashion. Strategic Considerations for Growth, 2016[26]
Focus on apprenticeships and training
Key Findings

- More needs to be done to ensure that the skills coming out of colleges, at all levels, match the demands of business, as well as giving other routes into the fashion industry for non-designers. Apprenticeships can help and our focus now must be to ensure they are commonplace, accessible for both individuals and businesses and a viable option.

- While lower-level apprenticeships may help larger firms obtain specialist skills, there remains a gap in the provision of higher-level technical and management skills for specialist fashion businesses.

- The government's Creative Industries Council has established a Skillset Skills Group, to support the industry in identifying the skills gaps that exist and how they might be filled. At present, this group is exploring how to map the national apprenticeship scheme onto the specific needs of the fashion sector. One option might be to create higher-level apprenticeships to design graduates, perhaps at level 6 (postgraduate) or 7 (PhD or equivalent), in addition to lower-level NVQs targeted at school leavers.

- In 2006, Sir Philip Green identified a gap in the market for teaching specialist fashion retail skills and so established the Fashion Retail Academy. It now has 700 students and the

[25] https://www.fashion-district.co.uk/wp-content/uploads/2018/09/170314_ELFC_SummaryReport_PRESSQUALITY_FINAL.pdf

[26] https://www.britishfashioncouncil.co.uk/uploads/files/1/BFC_Future_of_Fashion_v9_lo_res.pdf

support of 85 brands including the Arcadia Group, Marks and Spencer, Next and Tesco. Last year 60% of its students went straight into jobs after graduating.

Considerations

- We must build on our strengths to ensure that we are delivering the specialist skills that the whole industry requires to grow, not just the top-end designer talent. This means offering real, relevant qualifications alongside training — ensuring that the various career paths available are fully promoted and understood. The development of leadership skills to ensure that we have the commercial support to back our creative talent is also essential.

- There is an expectation that British art colleges will deliver exceptional education to maintain Britain's reputation as being at the forefront of the creative industries. However, resources for the colleges and industry professionals aren't sufficient to maintain this reputation in the long term. Increases in tuition fees mean that the spectrum of those considering fashion as a career is narrowing. International cities and governments are looking to how London and the UK has achieved its reputation for innovation and creativity in fashion and are investing in emulating our fashion education. If we don't do the same we are at risk of losing one of our country's key competitive advantages — the creation of talent. Politicians must ensure their actions do not damage the assets we already have. To remain globally competitive, the funding of our fashion colleges and departments needs protecting.

- Immigration restrictions that prevent international students from building sustainable relationships with UK-based businesses, or restrict the availability of staff, are a problem not only for the sector's future growth but also for the global attractiveness of our fashion colleges.

- The industry must continue its efforts to fully map all fashion career routes, ensuring they are professionalised at all stages to make the most of our talent and establishing new qualifications and institutions where required. A fresh approach to vocational training for fashion should be developed with Skillset, including the potential to establish a Group Training Association to co-ordinate key training requirements. This should also include building on the Fashion MBAs and developing links between fashion and business schools to develop leadership and entrepreneurial programmes targeted at small businesses.

- Across the board, the priority is to integrate top-notch business expertise and technical skills with our long-established reputation for creative brilliance.

- Britain's manufacturing base has shrunk in the last few decades, and within that, the demise of fashion manufacturing has been even more acute. But there are still some opportunities for UK fashion manufacturing, such as quality and luxury products. Over half the designers showing at London Fashion Week make some of their collections in the UK.

- Similarly retailers such as John Lewis and Topman have recently begun to understand the positive consumer response that comes from championing those products that are made in Britain. Designers including Aquascutum, Burberry, Mulberry and Victoria Beckham proudly sew 'Made in Britain' into the garments and products they make here.

- In order to build on these encouraging developments, the industry must come together to carry forward the work of the Fashion Manufacturing Alliance (British Fashion Council, Centre for Fashion Enterprise, Skillset and UKFT).

- It needs to identify latent demand for UK manufacturing facilities and work to plug the gaps and build the necessary skills to optimise this opportunity.

The return of manufacturing

- The last fifteen years have seen a dramatic fall in UK manufacturing as emerging markets have become more competitive. Oxford Economics estimate that the value of UK fashion manufacturing has fallen by two-thirds since 1995.

- More recently, however, some companies have started to see the benefits of manufacturing in Britain, both in terms of reducing carbon emissions through less travel, greater production flexibility and positive brand association.

- Topman used Harris Tweed to create a unique collection for the last two seasons which has sold out. They also had a successful 'Made in England' traditional tailoring range. John Lewis is introducing a new 'Made in GB' label and is training its buyers to increase the number of products that qualify for it.

- Many of London's design communities produce some of their collections in London. Whilst there are challenges around price and capacity, the close nature of the manufacturing facilities enables easier management of production.

- To support this trend, a new Designer-Manufacturer Innovation Support Centre (DISC) will shortly launch through the London College of Fashion, to provide advice and support to designers and manufacturers on global and UK fashion sourcing, sustainability, jewellery manufacture and design and technical innovations.

- The UKFT has an online directory of UK suppliers under the slogan 'Let's make it here' and a new UK Fashion Hub in East London states its aim to unite the mainstream 'UK fashion and textile industry'. Through anecdotal evidence there appears to be demand and opportunities in this area, with resources and a focused strategy to address the breadth of challenges from skills training to investment, more can certainly be achieved.

Barriers to re-industrialisation

- In this highly competitive market, Britain's advantage is its reputation for quality and innovation over price. This suggests that the future of British fashion manufacturing lies in specialist, highly skilled production with an emphasis on the concept of small/atelier type units serving the designer sector. Britain's existing reputation makes us well placed, for example, to capitalise and develop existing centres of excellence such as knitwear, leather, tailoring, woven material, finishings and trimming.

- But work is required if this potential is to be realised. There is a problem, for example, on the capacity side. Designers and retailers do not always have the confidence that orders can be fulfilled to the required standard in the UK, or that the capacity exists to undertake large-scale production. This is a vicious circle. If the orders go abroad then the British skills become obsolete, making it even less likely that future orders will be placed here.

- A significant number of manufacturers report issues around investment and cash flow that restrict their growth despite the demand for their product.

- The skills required to manufacture at the highest level necessitates training at a level not provided for in the existing apprenticeship and qualification framework. As a result, many small manufacturers are looking at Eastern Europe to source labour to meet growth.

- This needs to be addressed with Skillset.

- Another issue is around the image of jobs of this type. The current labour force in the textile manufacturing sector is ageing — 60 per cent are over 40 years old — with little enthusiasm from younger people to learn their skills.

- Manufacturers themselves are fragmented and would benefit from greater co-ordination, something that the Fashion Manufacturing Alliance has started to address through seminars where manufacturers can get together to discuss key issues.

- Finally, there are problems of information. Designers developing ideas may not know what can be done within the UK, and production units may not know where their market lies.

- Oxford Economics have taken a look at UK manufacturing trends in this sector over the past three years and using ONS data, anecdotal evidence from retailers and designer businesses, have applied a macro model to create a conservative scenario of what continued increases in UK sourcing may contribute to GDP.

Let's make it in Britain

- These problems are not insurmountable; they just need to be prioritised. First of all, a mapping exercise is needed of the existing manufacturing capability in the UK fashion sector and the current bottlenecks experienced by designers and retailers. A quick win could be a rated directory of UK manufacturing options for use by designers. In the longer term, the exercise could bring designers and manufacturers together so that they can forge new relationships. It may be, for example, that there is unmet demand to make small sample batches of new designs in locations that are physically near the creative centres; this in turn could be a useful way to ensure that British manufacturing skills are kept up-to-date.

- In sectors where we already have a comparative advantage, there needs to be as much focus on the next generation of production talent as there has recently been on new design talent. Fashion production needs an image make-over, with more emphasis on careers in craft and artisanship, and less on traditional manufacturing. As a first step, the industry should work to provide clear routes into craft apprenticeships — accessible in many different ways — that offer technical, designer, marketing, retail and production experience and so help professionalise the 'making' side of the fashion industry whilst strengthening the whole supply chain within Britain.

Report 8

Design Council. Design Economy. People, Places and Economic Value, 2021[27]

Key Findings

- Design skills include abilities such as creative problem-solving, visualisation and the use of design methods. They are important skills in jobs ranging from civil engineering to electronics manufacturing, many of which are vital as we transition to a more equitable and sustainable economy.

- In 2019, design skills contributed an additional £179bn in GVA to the UK economy and were important to a further 2.5 million jobs beyond the design economy. When the contribution of design skills is added to the value of the design economy, design is worth £276bn (14% UK GVA) and supports 4.47 million jobs (one in every seven UK jobs).

- However, the design skills pipeline is at risk. Across the UK, entries to Design and

[27] https://www.designcouncil.org.uk/fileadmin/uploads/dc/Documents/DC_DE_Eco_Value_Exec_Sum_digital_Final.pdf

Technology GCSE have fallen by 68%, a decline which has not been offset by increases in take-up of Art and Design GCSE. This is a crucial career pipeline for designers: seven in ten designers surveyed for this research had a design GCSE.

- At the same time, the design economy is becoming increasingly professionalised: 62% of designers now hold a degree, compared to 58% in 2016. Whilst this demonstrates that the design economy is a high-skilled workforce, there is an urgent need to diversify pathways into the design workforce so it can benefit all.

Design *diversity*

- The lack of diversity in the design economy workforce is holding it back. We need urgent action to change this.

- The design workforce needs to reflect the diversity of the world it designs for. If it does not, the design of products, places, and services can overlook the aspirations, assets and needs of many people, excluding them and reinforcing existing inequalities and forms of marginalisation.

- The design economy is still disproportionately male: 77% of designers identified as male in 2020, with hardly any change since 2015. Designers who are female, from an ethnic minority (excluding white minorities) or have a disability are also under-represented at senior and managerial levels.

- This is skewed by the three largest sectors in the design economy. Only 19% of workers in architecture and the built environment, 12% of product and industrial design and 15% of digital design workers identify as female.

- There is significant variation in the representation of identities and communities across design sectors. For example, 24% of workers in craft and clothing are disabled or have a long-term work-limiting illness, compared to only 10% in advertising. We need more design-wide and sector-specific interventions to learn from each other and tackle the diversity crisis within the design economy.

- Both multidisciplinary design (which includes roles such as fashion designers, product designers and interaction designers) and product and industrial design were the second fastest growing design groups, experiencing 69% growth and 54% growth between 2010 and 2019 respectively.

- Growth was not experienced by all sub-sectors in the design economy. Both clothing (-59%) and craft (-18%) reduced GVA contributions over 2010 to 2019, although craft has seen a slight recovery since 2017. This long-term decline is reflective of longer-term trends of large-scale production and manufacturing being outsourced to other parts of the world, although some sub-sectors such as garment manufacturing have seen increases over that time of in-country production. As we start to understand the longer-term impacts of the COVID-19 pandemic on businesses, it remains to be seen if we might see a reversal of this trend as businesses look within the country for manufacturing opportunities.

- It is important to note that clothing does not include the work of fashion designers, which are included in multidisciplinary design.

- Clothing design does not include all fashion designers, who are also captured in multidisciplinary design. For a broader view on the employment and GVA contribution of the UK fashion industry as a whole, see the British Fashion Council's Value of Fashion report (2015). Their next instalment of this research is due to be published in Autumn 2022. Britishfashioncouncil.co.uk

- UK Fashion & Textile Association, UK Fashion & Textile Association's Compendium of industry

statistics and analysis, 2020 ukft.org

- Design can help to drive regional prosperity and create flourishing places. Investment in regional and place-based design initiatives and training can help to build on existing design capabilities across the country.

- In addition, qualification levels vary significantly across different design sectors. The sectors with the highest proportion of graduates in 2020 were advertising (84%), graphic design (80%) and digital (72%). The previous report noted that this suggests that sectors that trade in intangible assets are driving greater demand for designers with higher levels of formal qualifications. However, it is interesting to note that these sectors also have lower levels of professional regulation and certification when compared to others such as architecture and the built environment. In contrast, craft and clothing were the lowest (22%).

Image 3 - Participant 1 during task performance

2. Part 2
HUMAN FACTORS RESEARCH

Background

Industrial garment manufacturing has at its core remained the same since its inception. The standard factory setup is made up of a combination of lockstitch machines, overlockers and industrial steam irons. Depending on the sewing operation and needs of the product, a range of special purpose machines like buttonholers, embroidery machines, blind hem machines, chain stitch machines, to name but a few, might be added. In industrial manufacturing, sewing machines are laid out on the factory floor to minimise manufacturing cost by speeding up the material flow. Efficient layouts group machines according to process sequence and workflow with an incentive to keep work transfers to a minimum. They can follow the line layout (both with and without a central table), a U-shape or be arranged side-by-side or at an angle. In a traditional manufacturing plant as well as smaller ateliers, all sewing is controlled by sewing machinists. The smaller the business, the more likely it is for one person to be in charge of many tasks, from completion of whole garments to fabric cutting and quality checks whereas assembly lines with specialised tasks distribution are favoured in larger settings.

The advent of automated and semi-automated sewing machinery has enabled plants to streamline production for even larger profit margins. Specialist automated machinery now operates near autonomously. All stitching is done by the machine without the machinist's handling of the fabric during sewing activity. In factories working with this level of automation, sewing machinists have largely been replaced by machine operators, whose work it is to ensure the fabric is placed correctly at the start of the process and removed after task completion. Many companies now use sewing frames, perspex contraptions that clamp fabric layers with recesses along the preconfigured seam paths. A semi-automatic configuration, this process requires the operator to align and feed the pieces into the system.

Quality is commonly measured by a combination of endlessly repeatable and identical output which is made possible by removing the one unpredictable variable in the system - the skilled machinist whose performance levels might be affected by various influences. On the back of labour shortages and legislation demanding increased wages for skilled work across the globe, deskilled labour has been a consistent trend in fashion manufacturing and makes up a large proportion of modern factories now.

Asian and American producers in particular are pioneering investment in machine optimisation to archive larger throughput and increase worker satisfaction by simplifying operations for their workforce. Japanese machine manufacturer YUHO for instance develops hybrid machine setups consisting of industrial sewing machines mounted onto fabric processing machinery such as winding or calendaring units to feed, hold and stabilise the sewing piece. The development of sophisticated machinery capable of automating whole fabrication processes like plackets, cuffs, pocket applications, zip insertions, fly fronts and collars amongst many other processes, is however very cost intensive and only possible in a mass manufacturing context. The need to stabilise the process as much as possible is made difficult by the mere fact that fabric is floppy and comes in all sorts of weights and levels of stretch. Therefore, the engineering of specialist machinery is directly affecting the product development stage, forcing designers and pattern makers to create with limited fabrics and sewing processes in mind.

Naturally, this standardisation of processes and material is impacting the level of creativity and skill applied to achieve intrinsic detailing. Complicated patterns are unlikely to be automated unless the number of items produced justifies the development of a specialised process. This is unlikely to be the case in a production environment like the UK where the majority of the fashion sector is made up of mico and SME businesses. This is aggravated by continuous skills shortages and problems to recruit new sewing machinists. Reasons for slow recruiting are manifold including a lack of incentive for young people to work in the industry as anything other than creative director, manager or designer. This has been draining the sector of talent who are willing to manufacture in the UK.

Low pay is another contributing factor. Input Youth estimates that experienced sewing machinists are expected to make between £8.50 and £14.00 an hour, depending on area of specialism. 38-40 hours make up the length of a typical work week. This is spent either in a factory, a workshop or at home. Conditions are noisy and work is generally repetitive and driven by deadlines. Piecework is still common as a machinist especially in the luxury sector, contributing to irregular income that cannot be easily planned for. The National Career Service estimates annual salaries for sewing machinists of £15,500 - £21,000 from starter to experienced. Likely the highest possible promotion would be moving into production management which would involve further training (for a comprehensive list of training provider's job descriptions for sewing machinists see Appendix 1).

To counter the skills shortage and make manufacturing interesting for young people, smart solutions for advanced manufacturing processes are needed. The following section discusses the skills levels of machinists as well as cognitive decision-making during sewing activities.

Method

The research uses a joint methodology of Human Factors and Design Practice research to explore skills levels in garment manufacturing, considering the steps that can be designed out, and performed by robots, or those needing to remain performed by skilled human makers, importantly identifying requirements for promoting worker satisfaction via new technology and automation particularly involving co-botics.

A limited trial to understand what tools exist to enable an analysis of the skills levels held by garment technicians/machinists was undertaken. Eye-tracking and biomarker data were collected by the team of researchers to explore cognitive / decision-making activity during task performance.

Procedure
The overall goal for the trial was the fabrication of a standard sleeve placket without the use of a pressing iron in between sub-tasks. Reflective, unstructured interviews were held after task completion to enable a more granular analysis of the decisions taken. Participants were presented with playbacks of their performance as captured by the eye-tracking device to collect rationales for decisions made during task performance. The interviews shed further light on participants' overall perception of eye-tracking accuracy and whether the focal point of their activity was captured correctly and consistently.

Participants

All three participants were female, spectacle wearers, between 30 and 45 years old and equipped with an eye-tracking device by SensoMotoric Instruments and the Empatica E4 wristband to capture heart rate and electrodermal activity during task performance. Participants one and two each produced one placket in pale blue shirting on different sewing machines captured at the Royal College of Art on 31 January 2022. Participant one wore prescription glasses underneath the eye-tracking device, participant two did not. Participant three, captured at MMU on 4 April 2022, produced 3 plackets under varying conditions to further understand the optimal calibration of the SMI device to capture this task. The first placket was performed with prescription glasses underneath the eye-tracking device on calico, placket 2 without prescription glasses on calico and placket 3 again with prescription glasses on dark blue shirting.

Analysis

Areas of interest identified by an analysis of the eye-tracking data indicate two strong focal points, as seen in Figure 1. Participant three's main focal point during all three trials is the fabric on the sewing machine table, handled either directly in front of the foot of the sewing machine or just to the left of it. The second focal point is the needle at the base of the presser foot close to the moving part of the needle.

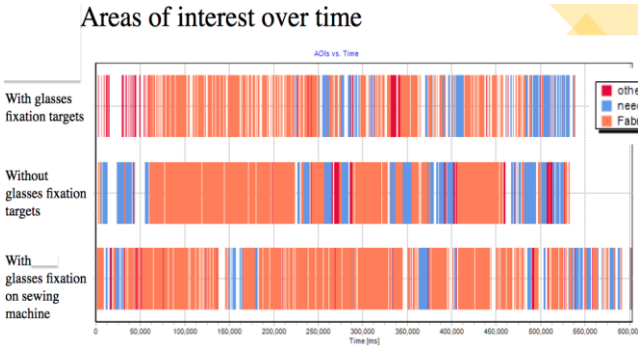

Figure 1 - Areas of interest over time, three plackets sewn by participant 3 with and without glasses and varying fabrics

Orange areas indicate activities related to visual inspection and manual manipulations of the fabric to prepare the fabric for the next seam and are the most time consuming in comparison. Blue areas indicate shorter bursts of sewing activity. Orange handling tasks can be a combination of any of the following: unpicking a seam, pinning and unpinning, trimming, cutting, folding, turning, aligning, marking and measuring the fabric. All of these sub-tasks are carried out directly on the sewing machine table to save time and ensure efficiency.

Image 4 presents a visual comparison of all three participant's main focal/handling areas. Shown is the preparation of the fabric to the left side of the machine head and visual fixation on the needle, presser foot and fabric as it is being held in place before being sewn.

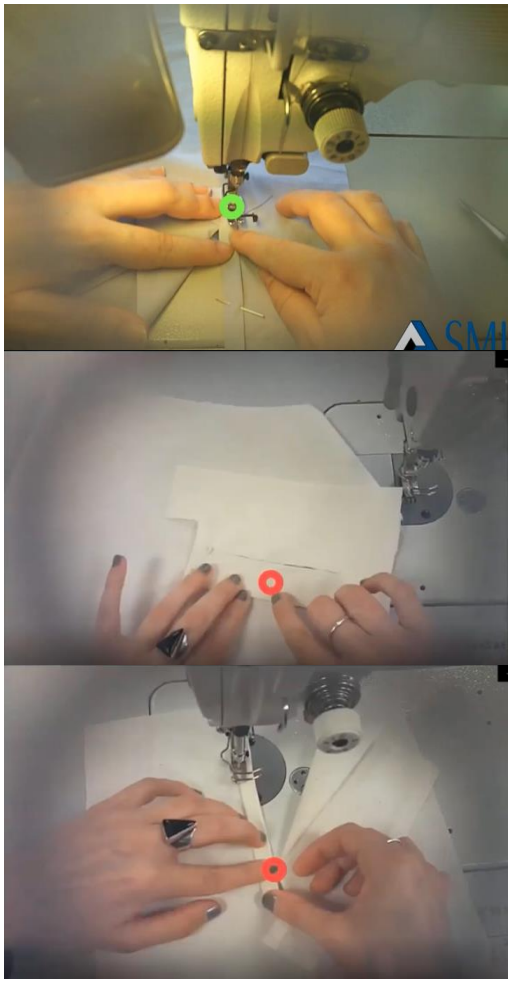

Image 4 - top to bottom: Participants 1, 2 and 3 main focal areas

The formal analysis of the eye-tracking data, interviews and heatmap visuals evidences the tacit knowledge an experienced sewing machinist will have acquired over time. The analysis was done by first applying a Hierarchical Task Analysis followed by reflective interviews to uncover why and where participants applied individual techniques to reach the overall goal. The overall goal to fabricate a standard sleeve placket follows five basic tasks:

- placing the placket
- securing the placket
- opening and turning the placket
- inner placket construction
- outer placket construction

Cognitive decision-making

Interviews with participants revealed how they applied different approaches and techniques to the placket construction, added sub-tasks and handled the fabric slightly differently in order to arrive at the same result. The high level of skill demonstrated and decisions made prior to and during the task performance were heavily influenced by previous experience with the material properties informing the machinist's tactile knowledge (Tallis, 2003)[28] and haptic perceptions about the speed and functions of the machines they used (Magnenat-Thalmann & Bonanni, 2008).[29] These factors as well as personal preferences for particular techniques then informed the individual steps added by each machinist that provided them with the confidence to fulfil the task successfully and to a high standard.

Task variations

The task diagram in Figure 3 shows a comparison of participant one (purple) and participant two's (pink) approaches. The green central line describes the hierarchical tasks of a standard placket contrasted with the individual sub-tasks taken to complete the task in pink and purple. In Figure 4 cognate steps are rendered light green, illustrating that not only did the sub-tasks differ in order and action, participant one used one step more than participant two. Both participants described their actions and intentions in the grey boxes above and below their sub-tasks. The information shared highlighted the machinist's tacit and tactile knowledge and evidenced the haptic skills applied during task completion (Smith, 2012).[30] In this example, all three participants fabricated the placket without pressing the fabric during construction. This factor led participant two to pre-press the edges of the inner and outer placket before sewing began, participant three folded by creasing the fabric with her fingernails, whereas participant one decided to add a stay stitch to ease the folding of the fabric.

[28] Tallis, R. (2003). The hand: A philosophical inquiry into human being. Edinburgh, Scotland: Edinburgh University.
[29] Magnenat-Thalmann, N., & Bonanni, U. (2008). Haptic sensing of virtual textiles. *Human Haptic Perception: Basics and Applications*, 513-523.
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It is worth noting that decisions were made predominantly with one of two goals in mind. Either to make the task at hand easier or to increase the overall quality of the outcome. Often the machinist assesses the steps needed depending on familiarity with the machine and according to the properties of the fabric in relation to task complexity.

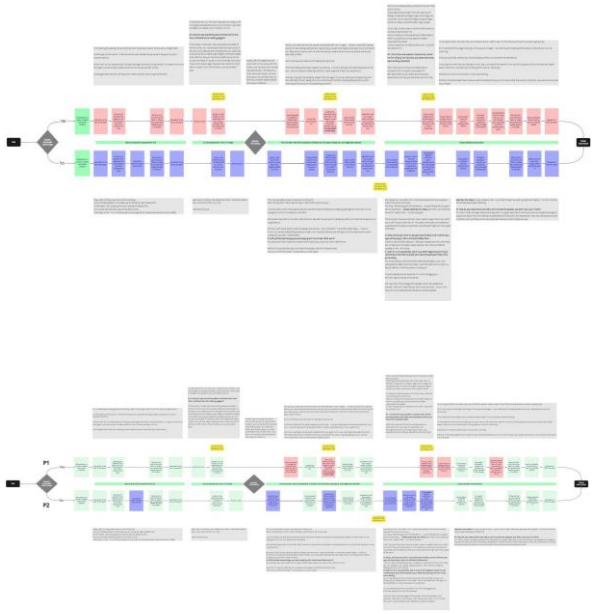


Fig. 2 and 3 - https://miro.com/app/board/uXjVOHG-jeQ=/

Muscle memory and dexterity

Despite all central tasks happening in the direct line of sight as described above, sewing as an activity involves most limbs and a variety of skills. The full-body engagement indicates a high level of muscle memory and dexterity to reach and activate parts of the machine without having to look at them directly. Broadly, tacit knowledge informs the skilful execution of the task to each sewing machinist's best ability. However, the analysis of our three participants showed evidence of nuanced skills as well as other types of knowledge. While knowledge of tactile properties informs the handling of the fabric pieces, the dexterous handling of the machine is informed by haptic skill.

Under the sewing table, the machinist's feet are placed ergonomically at the base of the machine, ideally in a way that ensures a levelling of the hips with at least the right foot on the pedal; some machinists prefer to have both feet on the pedal. The needle is activated by pressing down on the pedal, increased downward pressure will accelerate the speed of the needle. On industrial machines, the right knee commonly controls the lever to lift and lower the presser foot. On top of the sewing machine table, the handwheel is located at the right end of the machine's upright arm and operated by the right hand, as is the lever to activate the reverse stitch.

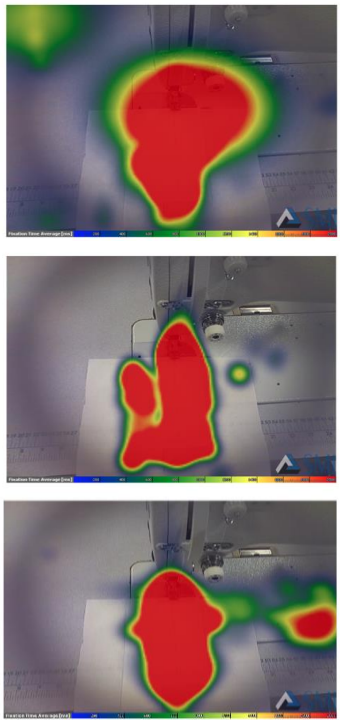
Eye-tracking

The video analysis of the recordings taken by the eye-tracking device shows that both the handwheel and reverse lever are activated by the right hand without looking at them. More advanced domestic and industrial sewing machines will have computer-controlled options for automated backstitch to secure seam beginnings and endings, stitch-length, automated thread cutting on finished seams and many other functions intended to reduce manual actions to execute repetitive functions. The footage also confirms that tools like scissors and pins are picked up and put back by the hands using peripheral vision mostly without breaking eye contact with the focal point (fabric, base of the presser bar). Pins are commonly kept as close as possible to the sewing area, often on small wrist cushions or on fabric pads that are secured around the horizontal arm of the machine.

Prescription glasses

The dependence on prescription glasses by all participants led to interesting insights. Most importantly, it demonstrated the limits of the eye-tracking device to capture pupil movement consistently. It also evidenced sight as one of the most crucial elements of any sewing activity. As can be seen from Images 5, 6 and 7, by analysing the overall conditions and changes in the heatmaps several observations can be made with regards to sight. The intensity with which participant three focussed on the machine parts is much more directed in trials 2 (without glasses) and 3 (with glasses on very dark fabric), hence a more strenuous and less relaxed activity for the eyes can be assumed, especially over longer periods. The occurrence of heatmap activity to the right of the presser foot/needle in trials 2 and 3 further suggests that the participant needed to locate needles and scissors by eye instead of intuitively reaching for them by way of peripheral

vision as seen in the heatmap of trial 1, which indicates a much larger peripheral area.



Images 5, 6 and 7 - Focal points when sewing, Participant 3 - left with glasses on calico, middle without glasses on calico, right with glasses on dark fabric (Trials 1, 2 and 3)

Overall, the eye-tracking device performed better and more consistently when not obstructed by a pair of prescription lenses. Table 1 shows a breakdown of the conditions for all participants. In the case of participant one's footage, the tracked focal point can be seen to be off the actual focus point for almost the entirety of the video, a notion confirmed during the playback with the tracker visible on the recording. During participant three's first and last trial the eye tracker can be observed to shift erratically to the top left corner, presumably, this glitch is due to lens flare hindering an unobstructed view of the pupil. However, removing the correctives decreased stitch accuracy and the overall quality of the placket as minor inconsistencies can have a significant impact on the visual quality.

	Machine	Fabric	Location	Wore prescription lenses during task	Eye tracking fixation shifts	Cross markers used for calibration
Participant 1	1	Pale blue shirting	RCA	yes	Consistently off focus	yes
Participant 2	2	Pale blue shirting	RCA	no	Occasionally off focus	yes
Participant 3	3	Calico	MMU/MFI	yes	Frequent erratic flares	yes
Participant 3	3	Calico	MMU/MFI	no	Occasionally off focus	yes
Participant 3	3	Dark shirting	MMU/MFI	yes	Frequent erratic flares	no

Table 1 - All participant's conditions compared

Recommendations

Varying light conditions with a combination of both natural and artificial light on and around the sewing machines were observed during the trials which might have negatively affected the capture of eye-tracking data. These conditions will need to be taken into account should this trial commence for more robust testing. It would be advisable to create a controlled environment for all future participants to work under the same conditions and from the same machine.

As for the calibration of the eye-tracking, cross markers were used in four out of 5 trials. There is an indication that further calibration test will be needed to capture a task where the participant looks down towards their nose frequently, as these devices traditionally capture data of people looking straight ahead rather than down. Some of the inaccuracies could therefore be attributed to calibration issues.

Questionnaire

The research included a small survey study to establish the state of the art of the skills levels held by sewing machinists in the UK garment industry and establish what tools exist to enable analysis of these skills levels and their decision-making activity. It was circulated with universities, fashion manufacturers, SMEs and design businesses as well as training providers. Participants were asked to complete several open-ended and skill/training related questions and watch a video on how technology could assist with garment manufacture and consider what aspects of the process they would like some technological assistance with.

Overall, most participants in the study were university educated. The majority had received sewing inductions at University (80%) and 40% identified as self-taught or having received short health and safety introductions. 60% formally learned how to sew during an apprenticeship. Notably, these were passed in various EU countries. None of the people taking the survey stated having learned how to sew during BTECs.

When asked which sewing task they find most challenging, a large number found material to be the defining factor in the sewing operation. Slip, stretch and fraying were amongst the most mentioned fabric concerns. Wrongly calibrated machines as well as the general state of them were mentioned to also have an impact on how challenging a sewing task was perceived (Fig 4).

When asked what sewing task they least liked to perform, participants disliked projects that involved frills, gathers or anything too fiddly. Messy work environments were pointed out as factors that negatively affected task performance. Examples of this are too little light around the sewing machine and an untidy work environment. Hand stitching was perceived as either too time consuming or rewarding and meditative.

- **Tailoring**
- **Working with fine, slippery non-natural fibre fabrics**
- **depends on the state of the machine, it is annoying to have to unpick a seam or buttonhole if the machine is wrongly calibrated. The type of material matters too, silks are challenging as well as fabrics that fray easily**
- **working with stiff material in stretched fabrics, when constructing sculptural shapes for example, holding the pieces in place so they can move through the sewing machine without stretching the fabric unintentionally. Inserting hardware such as zips is not too hard but could be met with more refined tools.**
- **Sewing for special material**

Figure 4 - What sewing task do you find most challenging? Please describe.

Contrary, when asked which sewing task people enjoyed most, time and complexity were the key defining factors for the perception of a successful project. There was a clear preference for "tasks [which] are quick and easy rather than the lengthy nitty gritty ones". Projects which ***"are done quickly, where you experience quick progression and success"*** were preferable over difficult ones. How much time was available dictated the selection of a new project with participants valuing techniques that are ***"fun and quick to do and efficient"***.

Generally, they showed appreciation for straightforward shapes and materials and favoured straight line sewing over curved ones. Only one participant mentioned they particularly enjoyed unusual construction techniques and sewing details like collars, cuffs and plackets. Rather, there was a notion of delegating complex tasks and projects to more seasoned machinists, with one participant stating that they ***"value and appreciate detailed work, but [are] inclined to leave these tasks to someone more specialist as [they felt] they are best done [by somebody who sews on a] more regular basis"***. A calm state of mind with plenty of time to work on projects was pointed out as the ideal state for sewing activities. On the whole, there was a sense that the participating sewing community preferred simple garment construction that led to successful completion of the project on first try, any sense of frustration would make the progress stall. Simply, they favoured ***"sewing garments that don't take too long but have maximum effect"*** like ***"Basic casual clothes, the kind I teach workshops in: hoody, T-shirt, denim jacket, tailored trousers, jeans etc".***

Participants assessed their understanding of what made a skilled sewing machinist. Resonating with earlier answers when describing challenging tasks, the feedback indicated adaptability and versatility across different fabric types as a key skill. Another skill that got highlighted was the ability to calibrate or fix the machine when problems start to arise. Delicacy of touch, the capacity for creating intricate detailing and achieving high quality finishes were considered core abilities. One participant pointed out it takes years of experience to master different materials and machines, indicating proficiency levels taking a considerable amount of time to accomplish.

As part of the survey, participants suggested new types of automation they could envision being useful to lessen fears around the machines in a sewing context. A few people noted that they would like a system to automatically spool the bobbin thread to prevent it from ever running out.

Similarly, automated threading or systems that would indicate if and where exactly there was a threading/tension issue were considered ways to reduce barriers and boost confidence in the machine to work perfectly when you get to the sewing task. Another recommendation was a vision system to help with material recognition and automated matching of stitch length and form. Automated sewing was mentioned as well as easy to read manuals and visual guides of the machine. More generally, participants were asked what sewing task they would like some automated assistance with. The fabrication of buttonholes got a high number of mentions, followed by automated cutting of the fabric. Finishing techniques like piping and hemming, as well as gathering of ease were pointed out as great uses for automation.

Reflecting on a video of a fully automated placket construction in a mass production setting, participant's overwhelming response centred around the value of manual labour and the human touch visible in the product. ***"The basic relationship of garment/ person in the making process seems fully abandoned in this process as no bodily input through control of speed through foot, or touch of the fabric is needed"*** was remarked along with similar sentiments ***"from a sort of valuing the work of a small studio perspective, the customers value also the manual work"*** and ***"because there is value in manual work and labour that goes into making and it's highly dependant on the context".***

Respondents were divided over whether this kind of production had a place in smaller operations. Some were of the opinion that particularly smaller businesses should automate in order to make their businesses viable. They found that businesses should automate ***"especially this part of the sewing [because it] is often a pain point for people who are not trained or even the ones that are trained"*** while others argued that ***"this kind of machine takes the humanity, value and creativity out of sewing. It makes sense in a world that only cares about making money"***. Aforementioned limiting factors of automation directly affecting the product development stage were picked up during this segment as well. ***"Automation brings a different type of limitation that is linked to making the machine viable. Designers will think we bought this machine, so we have to use it, but it can only do this width for a placket"***, highlighting the increasing standardisation of garment manufacturing and opening debate as to how creativity can be reinjected into the production of clothing.

3. Part 3
DISCUSSION

This study has delivered perspectives on ways to increase collaboration capability between science and engineering and creatives/designers to innovate within manufacturing processes amidst a growing skills shortage in the UK. Contrasted with the increasingly integrated manufacturing business models as described above, our research has uncovered the huge potential and interest from businesses to innovate in the co-botics field driven by design and human factors researchers. Researchers have had initial conversations with robotics systems integrators about the commercial potential of ideas around future fashion manufacturing which were met with huge enthusiasm but warrant further research.

Part of this study was an interview with Adam Mansell of UKFT on their survey study 'Skills and labour challenges for UK fashion and textile manufacturers' launched at the end of 2021 (full transcript in Appendix 3). The UKFTs forthcoming report will give an overview on the labour markets and skills in the UK fashion sector. Responding with anecdotal insight at this point, Mansell reflects on the difficulties to recruit for manufacturing jobs saying many roles are not reflected accurately by industry. He argues that the problem is twofold, by pointing out a mismatch between educational standards and the expectation of the industry. Hoping that vocational training options will attract more pre-16s in the future, he sees massive scope for better promotion of jobs in the industry: ***"I think the industry is not very good at telling young people about their process, and where their position would be. You could be working in textile manufacturing, making stuff for Balenciaga"***.

In a similar vein, addressing the topic of sustainability, he suggested the industry should more accurately reflect what the UK is already pioneering in. Listing UK commitments like ***"energy management, [...] water management [and] chemical management, because it has to be because it's legislated. The manufacturing industry could quite easily talk to young people about its role in sustainability and how actually, UK manufacturing can be a bit of a panacea to fashion's sustainability woes"*** and continues ***"we ought to concentrate our activities in making sure that the end-of-lifecycle piece is much better managed. Therefore, we're not just using the resources once and then going into landfill, etcetera, we try and capture the value of end of life."*** He is clear about the difficulties to change people's behaviours and sees the need for legislation in the sector to integrate changes permanently and effectively.

While young people are finding it less and less intriguing and rewarding to enter into manufacturing and prefer academic training over T level vocational training, Mansell suggests looking into the future of work as a meaningful pointer towards a more labour positive approach: ***"I'm being told all the time that the future of work in an office-based environment has changed and young people are less interested in the financial package. They're more interested in the support that comes with it, the ethos of the company"***. He continues: ***"how do you replicate that sort of new approach to a manufacturing environment where you do have to punch in and punch out timewise? They do have to manage shifts? There is some experimental stuff going on at the moment with a couple of manufacturers in London around, actually, can we job-share across three women so that they can do childcare properly? There's all those sorts of stuff that need to be explored that make manufacturing a more attractive place to work."***

Acknowledging the current reality of low progression routes and very low pay for long work weeks as two of the factors negatively affecting the image of fashion manufacturing, he sees potential in harnessing technology and looking at transferable skills from other sectors and to address those issues head-on. ***"We need to think quite clearly about what the roles in our industry actually are. And therefore, should we actually be talking about engineering skills or digital skills, so if one of the roles of the future is about using avatars, and using haptics and all that sort of stuff, to better communicate, and less travel a product and all that sort of stuff, we need to think about how we position those jobs, in terms of talking about the opportunities. And that sort of plays to your point about bringing in experience from other industries. Now, we can learn a lot from people like automotive and Aerospace, all***

those sorts of things. We can probably learn an awful lot from other countries".

Predictions of sewing machinist recruitment are looking precarious in the next coming years, following a steady downward trend, with sewing machinists and weavers the most sought-after worker's groups in the sector (Fig 5).

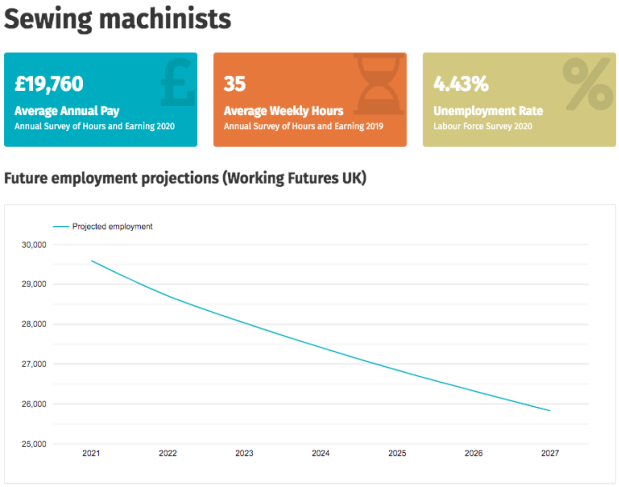


Fig 5 - Union Learn careers directory for sewing machinist (https://www.unionlearn.org.uk/careers/sewing-machinists)

Throughout this study, researchers have found mounting evidence that workers strive for better work fulfilment, personal reward and want to contribute to innovation creatively. What is currently lacking in the UK fashion manufacturing sector are systems to apply transferable skills to rejuvenate the job market with opportunities that can inspire and entice a young workforce to enter into this dynamic field. The Cranfield/RCA/MMU collaboration itself is a demonstrator of this where the design of a joint methodology which encompases fashion practice research and human factors research has been developed.

Having used eye-tracking and heart-rate monitoring during the trials in this study to successfully evidence cognitive decision-making and tacit/tactile knowledge of sewing machinists, we suggest exploring cognitive-decision making with brainwave monitors/EEGs in trials with cobotic sewing systems as the next step to detect innovation potential in new tool behaviour.

Participants of the questionnaire and eye-tracking trials have stressed a sense of reward being one of the main reasons for a feeling of success and accomplishment. Aligning the development of new tooling to rewarding activity is therefore a critical next step in design research with human factors.

Research with functional magnetic resonance imaging or functional MRI (fMRI) into creative problem-solving activities revealed critical reward network engagement in the brain during eureka/AHA! moments.[31] A sense of reward felt during task completion accounts for reinforced learning, resulting in memory consolidation. Other studies in the same field using EEGs[32][33] suggest problem solving and AHA! moments were achieved only when study participants were able to overcome their Psychological Inertia[34], mental impasse or functional fixedness. Critically, research found that inertia will be higher with growing expertise and skill, opening up interesting strands for research into meaningful, rewarding work and tools behaviour.

Currently robots and cobots are deployed for pick and place activities along the assembly lines of huge manufacturing settings. Largely lacking that scale of manufacturing in the UK, the sector is made up of micro and SME businesses who struggle to automate parts of their operations. Gaining more creative autonomy for on-demand and co-located manufacture is a huge interest of businesses in this country.[35]

However, figures of the International Federation of Robotics report 2020 show that robot density is still very low in the UK with recent numbers for new installations having dwindled by 16% in 2020. The same year 2,000 units were installed, mainly in the automotive and food industries. This compares only a tenth of Germany's investment of 20,500 new units, and Italy 11,100 and France 6,700 units each.[36] Developing the systems needed to modernise the UK's fashion manufacturing sector and populating it with smart, agile cobotic systems that can ease pressure on recruitment and facilitate more dynamic and creatively rewarding work during production processes suggests huge potential for commercialisation.

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[36]https://www.ppma.co.uk/resource/record-robots-work-in-factories-worldwide.html

Appendix Part 1

- Desk-based skills research

Data gathering from various training providers for sewing machinist roles

- **Skills training for garment workers**
- **https://www.linkedin.com/posts/uk-fashion-and-textile-association-a2530527_ukfts-made-it-scheme-is-under-way-for-2021-activity-6924353940285210625-uGeJ?utm_source=linkedin_share&utm_medium=android_app**

UKFT
https://www.ukft.org/skills-and-training/job-profiles/fashion/sewing-machinist/
Sewing Machinist

A Sewing Machinist uses stitching skills to create stitched items, from fashion accessories to medical textiles. Sewing machinist skills are fundamental to production across the industry. They need to work quickly, using specialist industrial machinery, have an eye for detail and be able to follow instruction.What would you do? Sewing Machinists can produce a wide range and variety of products from clothing and fashion items to leather goods, soft furnishing, knitwear, marine and medical textiles. They can work alone or as part of team, on one aspect of sewing the product or on various operations. Whatever the product, Sewing Machinist skills are highly valued and fundamental to the sewn product manufacturing process.Day to day tasks include:Organise and maintain of an efficient workstation/Operate specialist industrial sewing machines/Work with a variety of materials, threads and trimmings/Use given sewing production techniques and methodsWhere would you work?Sewing Machinists can be employed by large, medium, small or micro size textiles business. They can be based in a design studio, workshop or on a factory production line, depending on the size of the business.

Conditions can be noisy, work can be repetitive and deadlines have to be met.What would you be paid?For a typical working week of approx. 39 hours.

A sewing machinist starting salary on average is £12,000-£14,000 per year
An experienced sewing machinist salary on average is £16,000-£18,700 per year.

Pay rates vary depending on age, experience, location and the size of the company. Additional benefits may include pension and health care. Many companies offer overtime, bonuses or piece rate in order to meet deadlines.Sewing Machinist Apprenticeships: Employers, by law must pay the government's apprenticeship minimum wage rate. Research show that many fashion and textiles employers supplement this rate of pay. https://www.gov.uk/national-minimum-wage-rates

Will you need qualifications or training? Experienced is preferred, however employers are keen train new sewing machinist and qualifications are not required. Training is delivered on-the-job; either on the production floor or in a training section. Employers may also register new trainees onto the Level 2 Sewing Machinist Apprenticeship
www.instituteforapprenticeships.org

Qualifications relating to the Sewing machinist are available via ABC Awards, City & Guilds, Pearson, SQA and UAL

What are the career prospects?Experience could lead to a sample machinist, team leader, supervisory or quality control role, or a career in staff training, product technology. Self-employment and freelance work from home is also an option for sewing machinists with significant experience.
How secure is the future of this career?The UK's world-class textile manufacture base is growing, thriving and continually investing. Sector employment continues to grow steadily from 97,000 in 2011 to 108,000 in 2016, with an added 19,500 self-employed and research estimates the creation of 20,000 new jobs by 2020.
The number of UK textile & apparel manufacturing businesses has increased annually from 7190 in 2013 to 8075 in 2017 with forecast of further growth.
Textile goods exported across the globe continues to grow with export increases recorded at £250M in March 2016 to £273M in March 2017.UK Fashion & textile manufacture covers traditional craft to technical textiles and has a production value of £9.1BN, add the wide fashion sector this increases to £28.1BN sector – 4.7% of the total UK economy.
For further information go to: www.ukft.org

Where can you find job vacancies?Vacancies are advertised across the UK with concentration in London, the Northwest, West Yorkshire and the Midlands. Check out the latest vacancies on the site below:
UKFT is working with the Department for Business, Energy and Industrial Strategy (BEIS) to outline the skills and labour challenges the UK fashion and textile manufacturing sector is facing. There is a cross government approach, being driven by Number 10, to look at labour markets and skills and so this is an important opportunity to feed in information on key policy making discussion.
https://www.ukft.org/survey-skills-labour-challenges/

SURVEY: Skills and labour challenges for UK fashion and textile manufacturers
https://www.surveymonkey.co.uk/r/56ZK565

- **MAKE UK**
- **https://www.makeuk.org/insights/reports/make-uk-pwc-executive-survey-2022-harnessing-agility-and-resilience**

Accessed 14/1/22
key words - access to talent/ access to domestic labour and skills, upskilling or retaining existing staff, plan to invest in apprenticeships, labour shortages

VACANCY RATE IN THE MANUFACTURING SECTOR IS AT THE HIGHEST IT'S BEEN SINCE ONS RECORDS BEGAN, STANDING AT 3.7% IN OCTOBER 2021 (VS. AVERAGE 1.8%)

UK manufacturing is a high-skill sector. Manufacturing companies in this country pay significantly higher wages than the national average and Make UK members are often at the cutting edge of innovation. Our survey results confirm that investing in talent and technology are key priorities for firms in 2022. Apprenticeships: A total of 44.7% of firms say they are planning to recruit apprentices within the next 12 months, while a further 19.7% say they plan to within the next 24 months. An additional 17.5% do not yet have plans to but say they are considering doing so. Just 18% of UK manufacturers definitely do not plan to hire any apprentices in the next two years.
Wider training programmes: In addition to apprenticeships, other training programmes are proving popular too, with 51.3% of manufacturers saying they will recruit people for non-apprenticeship training programmes within the next 12 months and a further 15.8% saying they will do so within the next two

years. And only 16.2% of manufacturers say they have no firm plans yet but are considering recruiting extra people for all their training programmes. Just 16.7% say they do not have plans to hire people on training programmes within the next two years. Retraining existing staff: Upskilling and retraining existing staff is also something many businesses are planning on investing in this year. In fact, 67.1% of manufacturers have made plans to do so in 2022, while a further 14.9% plan to do so in the next 24 months. A smaller percentage, 10.5% of businesses surveyed, say they do not yet have plans but are considering investing in upskilling and retraining of existing staff, while a tiny minority, only 7.5%, definitely will not do so within the next two years.
Chart 4: Investment in people, products and tech are planned for 2022 Source: Make UK / PwC Executive Survey, 2022 With so many companies planning on new investments in their staff, it is pertinent to ask how many businesses are planning to reshore or onshore some or all of their overseas operations and activities to the UK. Interestingly, 18.9% of respondents say they definitely plan to do so over the coming year, while a further 16.7% will do so within the next two years. In addition, 12.7% are considering reshoring or onshoring overseas activities but have yet to decide. An overall majority, 51.8%, definitely do not plan to reshore or onshore any of their overseas activities to the UK in the immediate future. As well as investments in labour, many manufacturers are planning investments in technology to improve or grow their business. Digital technologies and techniques: Just short of half of all businesses surveyed (44.7%) have made concrete plans to invest in automation, artificial intelligence (AI), additive manufacturing or other forms of digital technologies over the next year. Another 19.7% of firms plan to do so if not next year, then the following year. On top of this, 20.6% of manufacturers say they are considering doing so but have not yet made a final decision. Only 14.9% of manufacturers surveyed do not plan to invest in new digital technologies within the next 24 months. Capital equipment: Investment in other capital equipment is also on the agenda. More than half (54.4%) of all firms will invest in capital equipment next year and another 20.6% will do so the following year. An additional 15.4% of manufacturers are considering investments in capital equipment. Just 9.6% have made up their mind not to do so next year or the year after. Green technologies: Regarding the transition to net zero, this appears to be a top priority for many manufacturers, with 49.1% of firms saying they plan investments in green technologies or energy-efficiency measures over the next 12 months and a further 21.5% saying they will make these investments within the next 24 months. On top of this, 18.4% of manufacturers are considering investments in green technologies or energy-efficiency measures, while just 11% do not plan to make any investments in these areas. These investments may be the result of the huge number of firms who plan to develop new products next year. A significant 60.1% of manufacturers surveyed said they will be developing new products in 2022, in addition to 10.5% who want to do so over the next two years. Furthermore, 14% of firms are considering developing new products, while just 15.4% are content with their current range and will not aim to develop new products in the immediate future. Upskilling or retaining existing staff New product development Capital equipment Training programmes for new recruits (excluding apprenticeships) Green technologies/energy efficiency measures Digital technologies (e.g. automation, AI, additive manufacturing) Apprenticeships Expanding 'service' based activities Reshoring/on-shoring overseas activities % 0 20

- **UCL Creative and Collaborative Enterprise MA**
- https://www.ucl.ac.uk/prospective-students/graduate/taught-degrees/creative-and-collaborative-enterprise-ma

Students learn innovative tools and practises derived from the creative performing arts and from effectual entrepreneurship, and combine them with insights from anthropological in order to explore and implement their own enterprise ideas and embark on their entrepreneurial journey in today's complex socio-cultural frameworks.

Students will learn to initiate a creative enterprise project; to apply creative arts and ethnographic practices to business activities; to think critically about the relationship between ethos and delivery when starting a business; to utilise the skills of effectual entrepreneurship needed to initiate, grow and establish a new enterprise; and to critically assess and reform enterprise activities and their context. Students learn creative and collaborative practices, and follow customer-funded business models, to provide them with the understanding, critical abilities and skill sets that will enable them to develop innovative, desirable and distinctive new products or services, and to start-up the value-rich, ethos-driven enterprises that will take those products to market and thrive in the contemporary world.

- **Greater Manchester & Lancashire employers: Occupational Traineeship**
  https://www.linkedin.com/posts/uk-fashion-and-textile-association-a2530527_greater-manchester-and-lancashire-employers-activity-6886954944172232704-MnFo

  Are you an employer in Greater Manchester or Lancashire? Get involved in this exciting opportunity: We have developed a new six-week occupational traineeship programme to encourage people aged 16-24 into the fashion and textiles manufacturing sector and to make them 'job ready'. There are 20 fully funded places available across Greater Manchester and Lancashire only from February 1st 2022. Free to the employer and employers can claim an incentive of £1,000 when a work experience placement has been completed. If you are interested, find out more: https://lnkd.in/e3ka_23C

- **Best jobs online. Sewing machinists.**

  https://uk.best-jobs-online.com/search.php?keyword=Sewing%20Machinist%20From%20Home&cq_src=google_ads&cq_cmp=984610760&cq_term=sewing%20machinist%20from%20home%20jobs&cq_plac=&cq_net=g&cq_plt=gp&locphysical=1006886&gclid=Cj0KCQiA8vSOBhCkARIsAGdp6RSQ5D3E3ZB1vyfFYBtThZJDAaQIMUp78ajQR3mcXQ2zUnh_CUtH6rsaAkUCEALw_wcB&bjokid=b0cb46d6-2fa4-440c-a5f2-ea3da8c706a454b569e2-2fb8-41df-8cc6-bb501b685db31642177413

- **Sewing Machinist – Scotland**

  https://www.planitplus.net/JobProfiles/View/343/91

  The Work

  You could be:

  - making all or part of a garment or other fabric items such as curtains
  - following instructions for each sewing job
  - using a range of machine programs and machines, such as overlockers, hemmers and bar tackers, to carry out a range of tasks and produce different finishes
  - guiding the material through the machine, correcting any mistakes as you go
  - altering machine settings to suit the type of material and finish required

- checking that a finished article matches the pattern instructions
- oiling and cleaning your machine
- working with designers and pattern cutters to make up samples of new styles for buyers.

Pay

The figures below are only a guide. Actual pay rates may vary depending on:

- where you work
- the size of the company or organisation you work for
- the demand for the job.

Starting pay is often based on the National Minimum Wage (NMW) or the National Living Wage (NLW).

As of 1 April 2022 the National Minimum Wage is £4.81 an hour for workers aged 16 to 17, £6.83 an hour for workers aged 18 to 20 and £9.18 an hour for workers aged 21 to 22. The National Living Wage is £9.50 for workers aged 23 and over.

With experience hourly rates can rise to between £8.50 and £14.00 an hour, depending on area of specialism.

Some employers pay piece rates. This means that the more items you make, the more you earn. You may sometimes be able to earn bonuses. You may be able to work overtime at a higher rate.

Conditions

- You would work around 38-40 hours a week.
- You usually work in a factory or workshop. You might also work from your own home.
- You will spend most of the day sitting down.
- The work can be repetitive.
- Conditions can be noisy.
- You will have to meet deadlines for orders.
- You may have to work shifts and sometimes do overtime.

- **UK Gov website**
  https://findapprenticeshiptraining.apprenticeships.education.gov.uk/courses/334
  Apprenticeship training course

Sewing machinist (level 2) - funding available for training £4000 12 months duration. Falls under Engineering and manufacturing - Apprenticeship category. Taught skills - this is very low level.

- blind hemming
- cover stitch

- cup seaming
- linking
- lockstitching
- overlocking
- ruffling

- **Textile House stitching skills course**

http://textilehouse.co.uk/stitching-skills-course/
Textile Centre for Excellence. Huddersfield.
See also apprenticeships.
Fashion and Textiles skills academy The Textile Centre of Excellence has developed a new Fashion Industry Training Programme in Huddersfield to help people into work.

The Centre is delivering a new 'Stitching Skills' course which aims to support unemployed individuals with up to 6 weeks' training on the fundamental principles and practices of using industrial sewing machines. This course is based around the needs and expectations of the textile and apparel employers, which includes a 2 week work placement at a local manufacturing business. This approach gives learners a chance to try sewing machinist roles before being considered for employment at a local manufacturing company. There is no cost to your business for a placement. In many cases, the chance to put work experience on a delegate's CV can really increase future opportunities. All learners receive a (non-accredited) level 1 certificate on completion.

- **TUC**

https://www.unionlearn.org.uk/careers/sewing-machinists
lots of good stats about earnings
Qualifications NVQs/SVQs levels 1 and 2.

Typical tasks
- operates standard and specialised machines to sew, finish and repair garments and other textile, fabric, fur and skin products;
- examines fabrics of all types to identify imperfections and determine best method of repair;
- performs hand sewing tasks in the making, trimming and finishing of fur, sheepskin, leather, upholstery, mats, carpets, umbrellas and other textile products;
- embroiders decorative designs on textiles with machine stitching;
- cleans and oils machine and reports or remedies any mechanical faults.

unionlearn
from the TUC

LATEST WHAT WE DO OUR PRIORITIES CAREERZONE RESOURCES

SUBSCRIBE

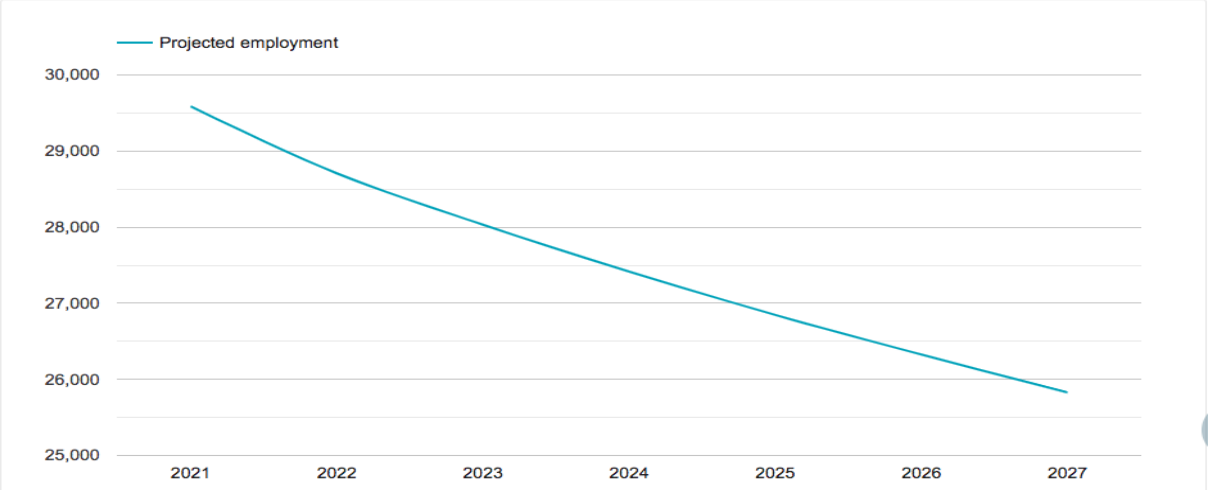
Sewing machinists

£19,760
Average Annual Pay
Annual Survey of Hours and Earning 2020

35
Average Weekly Hours
Annual Survey of Hours and Earning 2019

4.43%
Unemployment Rate
Labour Force Survey 2020

Future employment projections (Working Futures UK)



Common job titles

MACHINIST, SPECIAL (CLOTHING MFR) SEWER, FELT REPAIRER, SHEET MACHINIST, SLEEVING
MACHINIST, STOCKING (HOSIERY, KNITWEAR MFR) MACHINIST, BINDING MACHINIST, FABRIC, CIRCULAR COVERER, UMBRELLA
MAKER, GLOVE FINISHER (CLOTHING MFR) MACHINIST, OVERHEAD MACHINIST (TEXTILE PRODUCTS MFR) RECTIFIER (TEXTILE MFR)
SEWER, FUR FINISHER, KILT MANUFACTURER, GLOVE MACHINIST, BAG (SACK MFR) MAKER, BAG (CANVAS GOODS MFR)
ELASTICATOR MAKER, GOODS, CANVAS TRIMMER (CLOTHING MFR) MACHINIST (HAT MFR) MAKER, PARACHUTE
MACHINIST, CORNELLY FELLER (CLOTHING MFR) SEWER (GLOVE MFR) MACHINIST, WELTING BURLER AND MENDER
MACHINIST, BASTING SEAMER-ROUND MAKER, COVER, TYRE SEWER, SPANGLE KNOTTER (TEXTILE MFR: EXAMINING DEPT)
GLOVER (GLOVE MFR) BINDER, BLANKET ASSISTANT, UPHOLSTERER'S MACHINIST, FOOT SLIPPER, TIE WHIPPER, BLANKET
SEWER, CARPET OVERLOCKER FINISHER (SOFT TOY MFR) MAKER, KNAPSACK MENDER (LAUNDRY, LAUNDERETTE, DRY CLEANING)
MAKER, DRESSING, SURGICAL WORKER, BADGE MENDER, HOSIERY MAKER, TIE FINISHER, CURTAIN THUMBER (GLOVE MFR)
MACHINIST (ELECTRIC BLANKET MFR) BACKER (CLOTHING MFR) FINISHER (EMBROIDERY MFR) MACHINIST, ELASTICATOR
SPILER (TEXTILE MFR) EXAMINER AND MENDER MACHINIST, HEMMING PICKER, CARPET QUILTER (TEXTILE MFR)
MACHINIST, SHIRT MACHINIST (TEXTILE MFR: TEXTILE WEAVING) MACHINIST, TUCKING TACKER (HOSIERY, KNITWEAR MFR)
MACHINIST, SAMPLE MACHINIST, SEWING HOLER, BUTTON MACHINIST, TAPE (HAT MFR) WORKER, BUTTONHOLE MAID, SEWING
MACHINIST, TOWEL HAND, PALM AND NEEDLE MACHINIST (SOFT FURNISHINGS MFR) MACHINIST, FEATHER
SEAMER, CUP (KNITWEAR MFR) FOREMAN, ROOM, MACHINE (CLOTHING MFR) RENOVATOR MENDER, INVISIBLE
SEWER (TEXTILE MFR) LOOPER (HOSIERY, KNITWEAR MFR) MAKER, TRIMMING (CLOTHING MFR) SEWER, GLOVE
MACHINIST, LINING (HAT MFR) SEWER, SEAM MACHINIST (CLOTHING MFR) BINDER (HAT MFR) LOCKER, FLAT MACHINIST, BLOUSE
MACHINIST, WHEEL MISTRESS, SEWING MACHINIST, BELT, CONVEYOR SEMPSTRESS MACHINIST, BARRING (CLOTHING MFR)
MACHINIST, FLAG MACHINIST, KNITTING BINDER (BLANKET MFR) MACHINIST, DARNING (TEXTILE MFR) MACHINIST, MILLINERY
MACHINIST, UPHOLSTERER'S MAKER, BOW (CLOTHING MFR) STITCHER MACHINIST, BUTTONING (CLOTHING MFR)
MACHINIST, FLAT (CLOTHING MFR) MISTRESS, NEEDLE BEADER (EMBROIDERING) HEMMER MACHINIST, CLOTHING
MAKER, SHROUD MACHINIST, JACKET MACHINIST, CANVAS MACHINIST, TEXTILE (CLOTHING MFR) MAKER, ACCOUTREMENTS

MAKER, BAG, SAND MACHINIST, LINING (CLOTHING MFR) MISTRESS, ROOM, WORK MACHINIST, SEAMLESS REPAIRER, CARPET
MACHINIST, AUTOMATIC MACHINIST, FLAT, HAND SEAMER (CARPET, RUG MFR) MACHINIST, DRESSMAKER'S
FINISHER (KNITWEAR MFR) FINISHER, SHIRT MAKER, BAG, GUN SLEEVER (CLOTHING MFR) MACHINIST, EMBROIDERY
SILKER (TEXTILE MFR) MACHINIST, PADDING (CLOTHING MFR) MACHINIST, FUR MENDER, EMBROIDERY MACHINIST, NET
MACHINIST, KNICKER MACHINIST (MATTRESS MFR) MACHINIST, OUTER-WEAR MACHINIST, PLEATING FINISHER, GLOVE
MACHINIST, TROUSER FINISHER AND LINER (FUR GARMENT MFR) MENDER (EMBROIDERY MFR) HAND, NEEDLEWORK
WOMAN, NEEDLE MAKER, SHEET (RAILWAYS) MACHINIST (CANVAS GOODS MFR) MACHINIST (SURGICAL DRESSING MFR)
FANNER (CORSET MFR) REPAIRER, HOSIERY STRAPPER (CORSET MFR) EXAMINER AND FINISHER MACHINIST, TIE
BINDER (FABRIC GLOVE MFR) MAKER, SURPLICE STITCHER, LOCK MACHINIST, STITCH BINDER, CARPET MACHINIST, TENT
SEWER, BUTTON SEAMSTRESS MAKER, TRIMMINGS (CLOTHING MFR) LINER (HAT MFR) SEWER (HAT MFR) PICKER, YARN
MACHINIST, BUTTON (CLOTHING MFR) MACHINIST (TEXTILE MFR: CARPET, RUG MFR) MAKER, HOLE, BUTTON MACHINIST, LASHING
FINISHER (HOSIERY GARMENT MFR) POINTER, MACHINE MAKER, MARQUEE KNITTER, POWER (TEXTILE MFR) MAKER, BELT
HAND, FELLER MACHINIST, NEEDLE MACHINIST, BLANKET MAKER, COVER, LOOSE FINISHER, TROUSER SEWER, BAG
MACHINIST, LACE (LACE MFR) PICKER, CLOTH REPAIRER, NET SUPERVISOR, ROOM, SEWING MAKER, COLLAR (CLOTHING MFR)
HAND, COLLAR (CLOTHING MFR) MACHINIST, HOSIERY, SURGICAL MENDER (HOTELS, CATERING, PUBLIC HOUSES)
SEAMER (HOSIERY, KNITWEAR MFR) BINDER, LEATHER, HAT MACHINIST, LOCK, FLAT SEWER (CANVAS GOODS MFR)
MACHINIST, GLOVE REPAIRER, SACK FINISHER (FUR GOODS MFR) BAGGER-OUT MATRON, SEWING MACHINIST, UPHOLSTERY
MENDER, CARPET TABBER (CORSET MFR) FRILLER MACHINIST, LACE (TEXTILE MFR) MACHINIST, SILK (CLOTHING MFR)
MENDER, NET MAKER, EMBROIDERY FINISHER, COAT MACHINIST, CORSET MACHINIST, COAT MANUFACTURER (GLOVE MFR)
WELTER (HOSIERY, KNITWEAR MFR) MACHINIST, CORNELY MENDER, CLOTH (TEXTILE MFR) SEWER, CLOTH SEWER, TENT
MENDER, BAG WORKER, NEEDLE TIER, KNOT (TEXTILE MFR) LINER (FUR GARMENT MFR) MACHINIST, OVERLOCK
MACHINIST, OVERLOCKING BRAIDER (CLOTHING MFR) MACHINIST, TAILOR'S MACHINIST, TOY, SOFT MACHINIST, JACQUARD
MACHINIST, VEST MAKER, MAT, WOOL TIPPER, UMBRELLA MAKER, CANOPY FINISHER, UMBRELLA
MAKER, SLEEVE (CLOTHING MFR) RAISER AND FINISHER (EMBROIDERY MFR) FINISHER, DRESS FINISHER, TAILOR'S
MACHINIST, BARTACK MACHINIST (TEXTILE MFR: HOSIERY MFR) MACHINIST, QUILTING FINISHER, CAP

- **Clothing Sewing Machinist**

https://www.inputyouth.co.uk/jobguides/job-clothingsewingmachinist.html

More lists of personal qualities/ skills/ what you might do / long term prospects!!
YOUR LONG TERM PROSPECTS
There are opportunities for progression for sewing machinists, especially those with external qualifications and relevant experience.
Promotion is possible to more senior positions such as supervisor or team leader. The role may then include training new staff. This in turn could then lead on to a production management role. Alternatively, they could consider moving into a different area, such as pattern cutting or design.
Good site - v. useful info. Good stats. Skills and personal qualities listed.

OTHER RELATED JOBS - GOOD LIST OF NAMING

- Clothing Alteration Hand
- Clothing Packer
- Clothing Pattern Cutter/Grader
- Clothing Presser
- Clothing Designer
- Fashion Designer
- Tailor/Dressmaker
- Upholsterer

It is estimated that there are around 43,000 people employed in sewn product operations in the UK (source: Skillfast-UK business survey 2008). Many employers are small companies with less then ten employees, but about one in five people in this sector work for large organisations with 200 or more employees.
Clothing factories are found all over the UK. Many companies have scaled down their UK operations and now manufacture their garments overseas. However, there are still good opportunities for skilled machinists in the industry. With this increased competition from overseas, many clothing companies are surviving due to manufacturing for niche markets.

EDUCATION AND TRAINING

There are no formal academic requirements for a career in this area. Employers look for candidates with some sewing experience and a willingness to learn. Some employers offer training in house or in their own training school.
It is also possible to work towards an Apprenticeship in apparel, which provides some of the skills needed for a career in this area. Employers offering Apprenticeships may ask for some GCSE's (A*-E).
Apprenticeships and Advanced Apprenticeships provide structured training with an employer. As an apprentice you must be paid at least £95 per week; you may well be paid more. A recent survey found that the average wage for apprentices was £170 a week. Your pay will depend on the sector in which you work, your age, the area where you live and the stage at which you have arrived in the Apprenticeship.
Entry to Employment (e2e) can help to prepare those who are not yet ready for an Apprenticeship. In addition, Young Apprenticeships may be available for 14- to 16-year-olds. More information is available from a Connexions personal adviser or at www.apprenticeships.org.uk.
The following qualifications are also aimed at people who are interested in a career in this area:

- ABC Level 1 Certificate in sewing and textiles.
- ABC Level 2 Certificate in sewing and textiles.
- ABC Level 3 Award in sample production techniques: clothing.

- **https://www.thetimes.co.uk/article/manufacturers-start-year-upbeat-amid-hopes-worst-of-disruption-is-over-ztzrrnh0g**

Manufacturers start year upbeat amid hopes worst of disruption is over
Tuesday January 11 2022, 9.00am, The Times

Jenny Holloway, chief executive of Fashion-Enter, expects trading this year to be buoyant, helped by the return of more textile production from Asia and the rise of UK "influencer" designers. Yet it will not be plain sailing for the garments maker, which has micro-factories using the latest printing technology in north London and Wales, and a training academy in Leicester.
https://www.fashion-enter.com/
Fashion Enter is a not for profit, social enterprise, which strives to be a centre of excellence for sampling, grading, production and for learning and development of skills within the fashion and textiles industry.

- **https://www.shemakes.eu/blog/new-transfer-labs?mc_cid=3a6d159dd9**
- **12 Transfer Labs join shemakes network**

Results of open call for labs.

Labs are at the core of the shemakes project. They're physical spaces for textile experimentation that may be one of many different types - they can be fablabs, incubators, research institutes, cultural associations or co-working spaces. Labs are where we develop and test new ideas, like learning modules, workshops addressing gender issues or female entrepreneurship, and where we learn how to produce textile differently, with new machinery or methods (in our case, we're experimenting with rethinking the way we work with wool).
From the start of the project, the idea was to expand from our initial core of six labs to include twelve new "transfer" labs at the halfway point. These labs have the role of working together with us to develop tech-based-innovation activities and/or community engagement for change, essentially testing, perfecting, and expanding upon the work done by the initial labs.
The open call was a huge success, involving eighty-five applicants from thirty-one countries. Shemakes partners had the arduous task of evaluating and choosing from many interesting applications. Evaluations were done individually and scores were discussed in a series of meetings. The winning labs have the highest scores while also responding to the need to represent the range of activity types that our labs carry out as well as a variety of countries. The network now covers 16 countries in the EU and associated countries. Furthermore, since we work with a range of publics - from young girls to female entrepreneurs - we looked for proposals that would take on tasks relevant to six specific areas.

- Centre for Circular Design, London UK
- Decode Fabrication Laboratory, Athens GR
- Farmlab.at, Capfenstein AT
- Green Fabric, Belgium BE
- Le Textile Lab, Lyon FR
- Lottozero textile laboratories, Prato IT
- RogLab, Ljubljana SL
- Textile Prototyping Lab, Berlin DE
- The Icelandic Textile Center, Blönduós, Iceland
- VIVA Lab, Porto PT
- VIVISTOP Užupis, Lithuania
- ZIPHOUSE Design Hub, Chișinău, Moldova

- **National careers service**

  https://nationalcareers.service.gov.uk/job-profiles/sewing-machinist
  Sewing machinists make clothes, accessories and soft furniture.
  There are no set entry requirements for this route.

  Suggests comparable careers as Dressmaker / Seamstress, seamster Dressmakers create and alter clothing like dresses, trousers and shirts for their customers.

  Salary proposed £15,500 - £21,000 from starter to experienced
  Week 38 to 40 hours

  How to become:-

  Explore the different ways to get into this role.
  You can get into this job through:
  - a college course
  - an apprenticeship
  - applying directly

  College

  A college course could teach you the skills needed for this career.
  Relevant courses include:
  - Level 1 Award in Fashion - Sewing Machine Skills
  - Level 1 Certificate in Fashion and Textiles

  Apprenticeship

  You can get into this job through a sewing machinist intermediate apprenticeship.
  You could also do a garment maker advanced apprenticeship. This may be helpful if you want to get into more skilled work like sample machining.

  Entry requirements

  You'll usually need:
  - some GCSEs, usually including English and maths, or equivalent, for an intermediate apprenticeship
  - 5 GCSEs at grades 9 to 4 (A* to C), or equivalent, including English and maths, for an advanced apprenticeship

  Direct Application

  You could apply directly to work as a sewing machinist. Employers would normally expect you to have basic sewing skills and the ability to read and understand written pattern instructions. Most companies would ask you to take a practical test at the interview.
  Sewing skills developed at home or on a college course could help you to get a job.
  Experience of using different types of industrial sewing machines will give you an advantage.

More Information

Career tips

You could get experience of using different types of fabrics and sewing techniques at home. Look out for short courses in adult education centres and online to help you develop your skills.

Further information

You can find out more about using your sewing skills in creative careers from:

- UKFT
- Discover Creative Careers

- **SEWING MACHINIST**

https://www.instituteforapprenticeships.org/apprenticeship-standards/sewing-machinist/accessed 6/6/22

Occupational profile

A Sewing Machinist can be employed by a large, small or micro size sewn product manufacturing business. These businesses produce a wide range and variety of products from clothing and fashion items to leather goods, soft furnishing, knitwear, marine and medical textiles. The Sewing Machinists role is fundamental to the production process right across this diverse, multi sector industry. Depending on the product and company size, a Sewing Machinist may work alone or as part of team on one aspect within the sewing process or on various operations. The role may involve occupations such as lockstitching, blind hemming, overlocking, cover stitch, cup seaming or ruffling or linking. The key responsibility of a Sewing Machinist is to make sewn products that meet specifications and quality criteria, with particular emphasis on maintaining quality standards whilst working at the required efficiency rate and meeting targets and deadlines. Typically, the role of a Sewing Machinist includes:

· Organisation and maintenance of an efficient workstation
· Operating specialist industrial sewing machines
· Adhering to health and safety rules and regulations
· Working with a variety of materials, threads and trimmings
· Using a variety of sewing production techniques and methods
· Producing sewn items that meet quality standards, targets and deadlines
· Interpreting and following instruction and technical specifications
· Monitoring and maintaining the work flow
· Routine machine maintenance

Knowledge: A Sewing Machinist will have knowledge and understanding of:

The company they work for including:
· The companies' product range and business model
· The companies' overall manufacturing and production methods
· How the job role fits into the manufacturing process and structure of the company
· Workplace procedures and policies i.e. employer and employee legal obligations, employees' rights and responsibilities, ethical trading standards, equality and diversity

Materials used in production including:
· The characteristics and behaviours of materials, threads and trimmings used in production i.e. woven, non-woven stretch, finish
· The significance of the materials to the product style i.e. waterproof, durable, drape
· Faults and flaws common to the materials used within production of sewn products i.e. shading, misprint, pulls, holes
· Awareness of material and resource costs

Specialist sewing machines including:
· Different types of industrial sewing machines used to produce sewn products i.e. Lockstitch, overlockers, overstitch, linkers and blind hemming machines
· Industrial sewing machine settings i.e. stitch length, threading, tension, pedal control
· Different types of industrial sewing machine needles and their uses
· Industrial sewing machine maintenance procedures
· The importance of machine test runs and the consequence of not carrying out test runs
· Health & safety procedures in relation to setting up and using industrial sewing machines

The production process including:
· Each stage of the manufacturing process required to make the finished product i.e. pattern making, sample making, cutting, sewing, final checks
· Work techniques and methods used in sewing production i.e. seam types, stitch type, fabric handling and finish
· Common product faults, their causes and remedy i.e. material defects, stitching defects, cutting errors
· The agreed reporting process and the consequence of unreported faults on production
· Stitching industry terminology i.e. stitch, seam and finish types
· Awareness of lean manufacturing and continuous improvement i.e. efficiency rates, organised workstation layouts, fast techniques

Behaviour: A Sewing Machinist will
· Strive for effective working relationships conducive to meeting sewing production targets with a co-operative attitude and approach
· Be efficient when working individually and as part of a sewing production team, with ambition to achieve in all aspects of work
· Commit to achieving and maintaining sewing production quality standards and efficiently rates
· Demonstrate a responsive, flexible approach to changing working environments and sewing production demands
· Demonstrate a positive work ethic and can-do attitude showing initiative and self motivation
· Be punctual and reliable, with an understanding of the consequences of absence from work and late arrival and the effect this may have on colleagues and sewing production
· Have a safety first attitude in sewing production and the wider work environment

Duration:

Typically this standard will take 12 to 18 months to achieve

Entry Requirements:

Apprentices without English and mathematics at level 1 must achieve this level and apprentices without level 2 English and mathematics must take the tests for level 2 prior to taking their EPA. For those with an education, health and care plan or a legacy statement, the apprenticeships English and maths minimum requirement is Entry Level 3. British Sign Language qualification is an alternative to English qualifications for those whom this is their primary language.

Level:

2

Review:

After three years.

Status: Approved for delivery
Level: 2
Reference: ST0549
Version: 1.0
Date updated: 08/04/2022
Approved for delivery: 8 August 2018
Route: Engineering and manufacturing
Minimum duration to gateway : 12 months (this does not include EPA period)
Maximum funding: £4000
LARS Code: 334
EQA Provider: Ofqual

Sewing machinist assessment plan

File size: 880.5 KB

Find an apprenticeship

Find apprenticeship training providers that deliver this standard

Find an end-point assessment organisation

Are you considering applying to assess against this standard?

Contact us about this apprenticeship

Select the type of contact I am an apprentice
I am an employer
Employers involved in creating the standard: David Nieper Ltd (chair), ASOS, Beanie & Bear Childrenswear, Bebop Dancewear, Herbert Parkinson, Cookson & Clegg/ Community Clothing, Point3 Manufacture (previously The AMA Group), Cheshire Bespoke, Burberry, Ena Shaw ltd, Bolton Textiles Group, DRM Ltd, Lantex Ltd, Ushiwear, Barcode Fashion

Entry Requirements:

Apprentices without English and mathematics at level 1 must achieve this level and apprentices without level 2 English and mathematics must take the tests for level 2 prior to taking their EPA. For those with an education, health and care plan or a legacy statement, the apprenticeships English and maths minimum requirement is Entry Level 3. British Sign Language qualification is an alternative to English qualifications for those whom this is their primary language.

- **https://images.app.goo.gl/xx5MrVvmnw6VCbLK9**
- **Modern day slavery commission**

- **https://ellenmacarthurfoundation.org/topics/fashion/overview**

- **https://bftt.org.uk/wp-content/uploads/2021/08/BFTT_Mapping-the-UK-Fashion-Textiles-and-Technology-Ecosystem_2021.pdf**

Appendix Part 2

- Human Factors Research

ASPECT: Eye Tracking Experiments with SMI Eye Tracking Glasses 1.7 (ETG 1.7)
Meeting notes 04/04/2022

Reflection by Dr Zofija Tupikovskaja-Omovie
Manchester Fashion Institute
Manchester Metropolitan University

The following 3 eye-tracking experiments were conducted at MFI:

- Experiment 1: With corrective glasses on, and 3-point calibration on the 3 cross markers displayed on the surface of the sewing machine;
- Experiment 2: Without corrective glasses, the participant felt the impact on their vision, and 3-point calibration on the 3 cross markers displayed on the surface of the sewing machine;
- Experiment 3: With corrective glasses, and 3-point calibration on the elements of the sewing machine, none of the cross markers were used.

During the observation of these three eye-tracking experiments, experiment 1 recorded obvious and continuous tracking fixations' shifts towards the top left corner of the area of the view. This could be a result of the corrective glasses under the eye tracking glasses.
Therefore, during experiment 2, the participant did not use their corrective glasses in order to check if the loss of tracking was a result of extra screen with its own reflective properties. During this experiment, none of the eye tracking fixations seemed to shift to the previously identified top left corner. Although the setting of this experiment seemed to improve the quality of tracking, it impacted the vision of the participant, making it more difficult to complete the task without their corrective glasses.

Upon identifying obvious issues during both Experiment 1 and Experiment 2, a different calibration method was suggested for experiment 3. In my previous research projects, I used 1-point calibration for the eye tracking experiments, and these produced accurate eye tracking data. However, the ETG 1.7 did not respond to the request for this type (1-point) of calibration. Therefore, I suggested calibrating the pointers on the sewing machine instead of the cross markers provided with the eye-tracking kit. The visual reference of the points used could be provided for future use. This calibration method has improved the quality of the eye tracking data as none of the fixations drifted towards the top left corner. Therefore, it would be recommended to use this calibration method with other participants, including those who use corrective glasses.

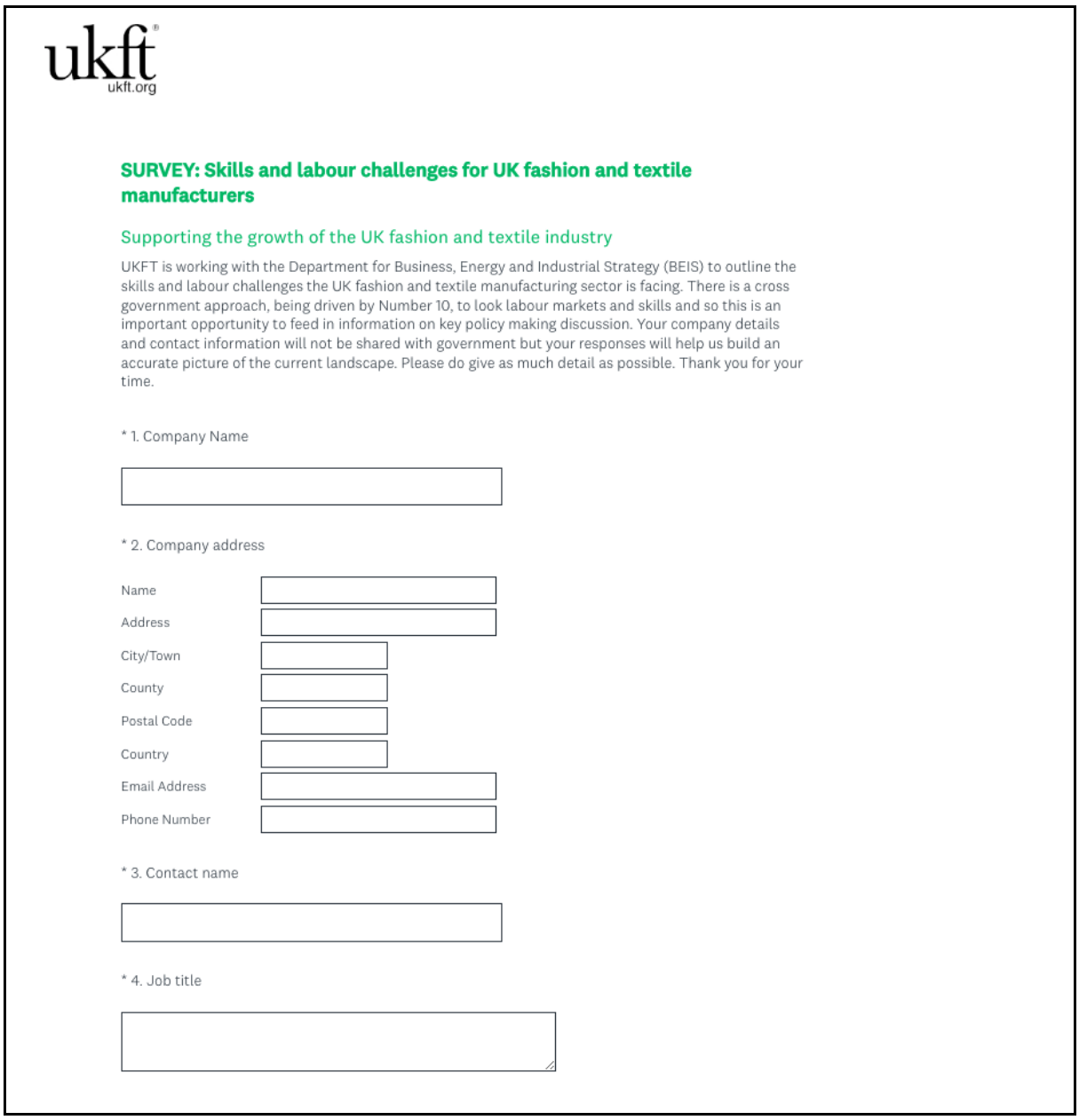
Recommendations and further ideas:
Would recording the whole process aid more insights into the skills levels, including the preparation of fabric parts, ironing, sewing, maybe ironing during the sewing, and finishing? Would it be useful to use a variety of fabrics with the same participant?
Find out about other eye-tracking kits and sensors available at MMU.

Appendix Part 3

UKFT SURVEY: Skills and labour challenges for UK fashion and textile manufacturers

Launched 22/12/2021 - report forthcoming

https://www.ukft.org/survey-skills-labour-challenges/



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SURVEY: Skills and labour challenges for UK fashion and textile manufacturers

Supporting the growth of the UK fashion and textile industry

UKFT is working with the Department for Business, Energy and Industrial Strategy (BEIS) to outline the skills and labour challenges the UK fashion and textile manufacturing sector is facing. There is a cross government approach, being driven by Number 10, to look labour markets and skills and so this is an important opportunity to feed in information on key policy making discussion. Your company details and contact information will not be shared with government but your responses will help us build an accurate picture of the current landscape. Please do give as much detail as possible. Thank you for your time.

* 1. Company Name

* 2. Company address

Name
Address
City/Town
County
Postal Code
Country
Email Address
Phone Number

* 3. Contact name

* 4. Job title

* 5. Email address

6. Have you been trying to recruit in 2021?

- ◯ Yes
- ◯ No

7. What issues have you faced?

8. Have you lost workers due to Brexit/migration?

- ◯ Yes
- ◯ No

If yes, please give details

9. Have you explored apprenticeships or other vocational training?

- ◯ Yes
- ◯ No

If not, why? If yes, please give details

10. Do you need skilled workers from overseas to help address skills gaps?

- ◯ Yes
- ◯ No

Please give details

11. What job roles are you looking to fill in the short-term (i.e. in 2022)? Please tell us details of the number of positions available and expected salaries

12. What job roles do you expect to be looking to recruit in the medium-term (i.e. 2-3 years)? Please tell us details of the number of positions available and expected salaries

13. What challenges do you face when recruiting? (Please give as much detail as possible)

14. What do you think could help the situation?

15. Thank you for your time. If you have any comments to add please use the space below

Done

About Aspect

Aspect (A SHAPE Platform for Entrepreneurship, Commercialisation and Transformation) is a network for organisations looking to make the most of commercial and business opportunities from social sciences, humanities and arts research.

Supported by Research England's Connecting Capability Fund, Aspect members sit at the epicentre of discovery, imagination and progress in the social sciences, humanities and arts. We draw together pioneering academics with innovative industry leaders to tackle the most complex societal challenges of our time.

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Aspect

Aspect is funded by Research England's Connecting Capability Fund

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