The Role of Digital Technologies in Contemporary Craft Practice from UK-China Insights

Authors: Nick Bryan-Kinns, Yuanyuan Liu, Duoduo Zhang, Zhengyu Tan, and Hao Tan

Abstract

Digital technologies such as digital production and online marketplaces have generated revenue growth and sustained work in the music and game creative industries. However, there is little research on how digital technologies impact contemporary craft. Here we present the results of a 20-month AHRC research project which explored the role of digital technologies for craft in China and the UK. The research was undertaken prior to the mass adoption of online tools such as videoconferencing, which became necessary due to enforced social distancing during the recent pandemic. It provides an account of the craft ecosystems in China and the UK as they started to embrace digital technologies – ecosystems which inevitably evolved with craftmakers' enforced migration online. This paper reports on mixed methods research stakeholder surveys, workshops and quick ethnographic studies conducted to capture how digital technologies were used across the craft making journey from Planning and Inspiration through Materials and Preparation to Production and Making. Comparing the differences and similarities between China and the UK enables us to better understand the potential of digital technologies for craft. For example, live streaming, an emerging digital technology at the time of the research, was already a popular way for craftmakers to engage broad audiences in China, whilst UK craftmakers tended to use personal websites, emails, and newsletters. Craftmakers' knowledge has necessarily shifted to encompass the digital, often at the expense of precious making time. On the one hand, digital tools and processes of the Fourth Industrial Revolution have transformed many craft skills from making by hand to making by computer; on the other hand, social media and online marketplaces have changed the relationship between craftmakers and consumers and may shape which crafts flourish in the future.

Keywords: craft making; digital technology; digital production; making journey

1   Introduction

The rise of digital technologies in our contemporary digital era has radically changed the way we live and how people who make craft - craftmakers - work. Digital technologies such as social networks and online marketplaces are key to enabling growth in the creative industries and are used across different creative sectors, including craft. However, there is a notable gap in research regarding the use of digital technologies in the creative industries that produce physical objects – especially the craft sector. Whilst studies such as the Boston Consulting Group's desk research (Bazalgette, 2017) have examined government interventions across the creative industries, they focussed on digital consumption and production, such as audiovisual production, music and video games, often overlooking the craft sector.

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This paper reports on the findings of a 20-month research project conducted between China and the UK in 2019-2020. The research was undertaken by a multi-disciplinary team of researchers from Queen Mary University of London (UK) and Hunan University (China). The project delves into the role of digital technologies in the craft sector, aiming to uncover challenges and opportunities for using digital technologies. The research offers a snapshot of digital technology usage in the craft sector just before the COVID-19 pandemic, a period that forced many craftmakers to use digital technologies for communication and sales given the imposition of social distancing throughout the world.

Craft practice is about how craftmakers undertake making-related activities and is deeply rooted in the relationship between materials, tools and techniques (Lof, et al 2016). In this paper, we characterise a typical journey of craft making in terms of the following stages inspired by different types of making processes (Development Commissioner – Handicrafts, 2020) and the UNESCO culture cycle (UNESCO, 2009). We use this characterisation of a craft journey as a process-based lens through which we view and analyse the research in this paper:

i) *Planning and Inspiration* – seeking inspiration, conceiving ideas, drawing, sketching, and designing based on personal motivation and market demand.

ii) *Materials and Preparation* – sourcing, exploring, understanding, selecting, and preparing materials for the craft making.

iii) *Production and Making* – undertaking a series of making techniques and procedures to make the craftwork by hand and with tools.

iv) *Promotion and Consumption* – advertising and selling craftwork in-person and online for example, in marketplaces, social media, exhibitions and by word of mouth.

Craft has been transformed by the digital era, embracing digital elements across all stages of the making journey. For example, craftmakers use design software such as AutoCAD® and CorelDraw® to facilitate their *Production and Making* and help reduce mistakes whilst contemporary machine embroidery requires using visual design software to design the embroidery and computer-controlled embroidery machines to make it. The emergence of terms such as 'digital craft' and 'hybrid craft' have been coined to describe craft making with digital materials or practices (Golsteijn et al., 2014; Zoran et al., 2015; Loh et al., 2016). In this paper, we consider the wide range of digital technologies that support craft activities, from social media platforms (e.g. Instagram and WeChat) and online marketplaces (e.g. Esty and Taobao) to digital production tools (e.g. 3D printers and digital software), materials, and even makerspaces.

Craft practice is inevitably shaped by culture and context (Howe and Dillon, 2001; Zhan et al., 2017). Our motivation for the work in this paper is that learning best practices in craft from different countries could help catalyse new opportunities and ideas in other countries. In this paper, we examine Creative Arts, specifically craft in China and the UK, which provide comparable and contrasting international settings. On one hand, China and the UK both have extensive histories and traditions of craft, for example, philosophical understandings of craft in the UK can be traced back to Plato and Aristotle's definitions of techne, or practised

knowledge (4th – 5th century BC), whilst in China the Artificer's Records (考工记, Kaogongji) written in the late years of Spring and Autumn periods (5th – 6th century BC) summarised more than 30 types of crafts work. On the other hand, there are deep-rooted differences in culture and heritage between China and the UK, which affect conventions and methods of creative production and consumption. This results in different uses of digital technologies to support craft and offers insight into Creative Arts in China and beyond. Moreover, there are significant differences between countries' internet infrastructure and policies of use, which would impact how digital technologies can be used for craft in China and the UK.

To sum up, this paper explores how digital technologies are used for craft practice in two countries with rich traditions of craft making. It focuses on the ways in which digital technologies are being used to support craft practice, identifies challenges that craftmakers may face during their making process when using digital technologies, and explores the implications for future craft practice and research. The research questions (RQs) addressed in this paper are:

RQ1: What digital technologies facilitate craft practice in China and the UK?

RQ2: What impact do digital technologies have on contemporary craft practice?

2 Methods

Mixed methods including desk research, surveys, and quick ethnographies (Handwerker, 2001; Pink and Morgan, 2013) were used to collect a broad set of data to map out and understand how digital technologies are used in and for craft. Desk research using the 'snowball' method was conducted to grasp the broad craft sector and digital technologies. Surveys were used to gather stakeholders' experiences (Spilsbury, 2018) and views regarding the features and uses of digital technologies for craft. For ease of completion the survey consisted of 20 closed questions with 13 of these questions offering an open-ended response option, ensuring the survey could be completed in less than 10 minutes and allowing respondents the flexibility to provide more detailed feedback where necessary. The survey was disseminated through WeChat in China and through craft organisations such as the Crafts Council and social media such as Twitter in the UK. For the administration and management of the collected data, the platform 'Wenjuanxing' was utilized for responses gathered in China, and 'Qualtrics' was used to manage the data in the UK. In China, 34 craft stakeholders participated in the survey. Some of them held multiple roles in the craft sector, mainly including designers (71%), consumers (44 %), producers (38%) and researchers (38%). In the UK, 54 craft stakeholders responded to the survey including craftmakers (85%), managers/ curators (11%), retailers (5%), researchers/ educators (7%) and restorers (2%) in the UK. Among the respondents, about 75% of the respondents had over five years' work experiences in the craft sector.

Quick ethnographies (n=6 from China, n=6 from the UK) were undertaken to gain in-depth, hands-on knowledge of how digital technologies typically used for design practice are appropriated for craft (Figure 1a and 1b). They provide illustrative vignettes of the kinds of use of digital technologies used in craft identified in the surveys and desk research. Participants were selected from the most representative craft types and those who were readily available to participate in the research, including embroidery and jewellery from both countries, ceramics

and textiles from the UK, and wood, leather, and pyrography from China. Chinese craftmakers covered locations including a major city, Changsha, and rural areas of the Hunan Province. Most of the UK participants came from London with one craftmaker from a suburban area. Some craftmakers were recruited from surveys, and others were contacted through online searches and email invitations. Formal invitations and participant information sheets were sent by email before visits. Researchers from both countries visited each participant 1-3 times with each visit lasting more than 2 hours to follow participants' craft practice over 12 weeks. The data collection was structured using a template to record and categorise observed data including identifying the ways and challenges for craftmakers to use digital technologies along their making journeys, pictures and descriptions of their work, and descriptions of typical craft activities.

Figure 1 a) Quick ethnographies in the UK (Tatty Devine, left) and b) China (Yan embroidery, middle); c) Topic clustering in the data synthesis workshop.

To conclude the data analysis, a three-day synthesis workshop was held in person in China with the UK and Chinese research teams. In the workshop, the researchers undertook intensive analysis and synthesis of all the data to generate insights and shared understandings between China and the UK on the uses, challenges, and potential of digital technologies for crafts sectors through topic identification, card sorting, and topic clustering to produce affinity diagrams as illustrated in Figure 1c.

Ethical approval for this study was granted by the ethics committees of two universities, ensuring compliance with standard research ethics protocols. Prior to their participation, all participants were required to sign a consent form. This process was diligently followed to respect and protect the rights and privacy of the individuals involved in the study.

3   Results

In this section, we address the RQ1 by reporting on the kinds and uses of digital technologies we identified and provide illustrative vignettes of how digital technologies are used in contemporary embroidery in China and the UK. We then present our findings about the pragmatic challenges of applying digital technologies in craft practice, which stimulates further discussion that explores RQ2 in the next section.

3.1   Uses of Digital Technologies

We found that a wide range of digital technologies including social media, online marketplaces, e-education, design software, digital making tools and devices are used to facilitate different stages of craft practice (see Table 1) even prior to enforced social distancing. Craftmakers from

both countries learn craft skills online in the *Planning and Inspiration* stage, and the *Production and Making* stage. In China, people use digital technologies to learn craft from specialised online craft course sites such as the online Zhongguo shougongyi wangluo daxue and Aikecheng Wang, an education-sharing service supported by the Ministry of Education and Finance, which includes video-based craft courses. In the UK, people find craft courses on YouTube and step-by-step craft tutorials on website pages. Similarly, mobile devices such as iPads and mobile phones may help record inspiration by taking photos in two countries. For example, Bridget Bailey, a textile artist interviewed in this research uses her iPad to take pictures when she gets close to nature. Finally, the Internet including social media offered craftmakers an opportunity to search for pictures, learn from other people's craftwork and undertake craft-related research in the *Planning and Inspiration* stage.

Table 1. A summary of how digital technologies are used for craft practice (RQ1)

Making journey	Digital technologies	Use of digital technologies for design practice in craft
Planning and Inspiration	e-Education	Online craft courses
	Mobile Devices	Pads and mobile phones help record inspiration through taking photos and video
	Internet	Pictures/Craft work on Internet
	Social media	Craft education and research on social media (e.g., Twitter in the UK, Sina Weibo in China)
Materials and Preparation	Online marketplaces	Buy and research raw materials online (e.g., Amazon, Taobao)
Production and Making	e-Education	Online craft courses (e.g., watch YouTube to learn making skills)
	Digital Software	Transfer hand-drawing into digital file (e.g., Adobe® Photoshop, AutoCAD®, and Adobe® Illustrator) Aided digital equipment software (e.g., Weavepoint for textile)
	Digital making tools and technology	3D printer, laser cutter, table saws, CNC machines, Outsourcing part of craftwork to use digital technology
	Social media	Co-design with customers using digital communication (e.g., Facebook in the UK and WeChat in China)
	Live streaming	Sharing the making process (e.g., TikTok China)
	Website	Engage in making process (e.g., order personalised necklace from Tatty Devine's website)
	Others	Emails and Newsletter are used by UK craftmakers to engage customers in sharing and discussing craft.

In the *Materials and Preparation* stage, craftmakers reported that online marketplaces such as *Amazon* in the UK and *Taobao* in China make it possible for craftmakers purchase raw materials online, saving them time and money.

In the *Production and Making* stage, digital design software such as Adobe® Photoshop, AutoCAD®, and Adobe® Illustrator have become popular for some craftmakers to digitise hand-drawn drawings ready for production using digital technology such as laser cutters and 3D printers. In the UK, weavers used the niche digital software, Weavepoint, to connect to computer-aided looms. In jewellery design, digital software such as JewelCAD and RhinoJewel allows designers to express their creative ideas easily and freely, which not only enriches the artistic form of jewellery, but also effectively saves time and cost. In this way, the

application of digital software makes the high-quantity production of jewellery and personalised customer service possible.

Digital production equipment has been embraced to facilitate making in both countries. For example, Blue Wood from China has used table saws, laser cutting machines, and CNC machines in the making process (Figure 2b) - their SawStop PCS52 table saw was imported from America, which is famous for its professionalism and precision. This allows for faster production of craft objects whilst retaining traditional style and aesthetic. Similarly, all the pieces of Tatty Devine's jewellery (UK) are cut by laser cutters (Figure 2a). Laser cutting technology has been used in making acrylic jewellery since the founders Harriet and Rosie discovered laser-cut acrylic when they visited New York in 2001. 'The detail we can achieve with a laser cutter is much higher than what we would achieve by sewing it by hand. I think it's a very good medium to use - it's fast, it's relatively low waste, and you can use lots of different colours and patterns and stuff', said Tatty Devine's design assistant, Hollie Melding, in the interview.

Figure 2. a) Laser cut acrylic of Tatty Devine (UK), b) table saws of the Blue Wood (China), and c) 3D printed handle model and its plane graph (Jeremy Nichols from the UK)

With the development of digital technology, outsourcing has become more popular. In China, there are some parts of craft products of Li Yan's embroidery art studio which have also used outsourced production. In the UK, one of our interviewees, ceramist Jeremy Nichols, reported that he uses outsourcing to 3D design and 3D print the moulds for teapot handles (Figure 2c), which can make more accurate moulds and allow for quicker modification. In the future, increased outsourcing and closer collaboration with other makers may empower craftmakers to save cost and create innovative craft products.

It was reported in the research that it is more convenient for customers to engage in the making process through digital technologies. For example, Tatty Devine offers a personalised jewellery service for customers, for which customers can choose different colours and materials and tailor their personal necklaces online. To encourage people to learn craft skills, Hand & Lock provides an embroidery toolkit online for customers to purchase and make their own embroidery work. In a sense, digital technologies also change the relationship between craftmakers and customers from making for customers to making with and even by them.

Finally, live streaming such as Kuaishou and TikTok, have become popular ways for craftmakers to engage wide audiences and share their making process in China during the *Production and Making*, and the *Promotion and Consumption* stage. Whilst in the UK, craftmakers tended to use personal websites, emails and newsletters to share their making

processes though some craftmakers in the UK have recently started to use live broadcast websites such as Crafter's Companion.

3.2 Illustrative Vignettes

To further exemplify the use of digital technologies by contemporary craftmakers we present two illustrative vignettes from quick ethnographies of embroidery in China (Li Yan Embroidery Art Studio) and the UK (Hand & Lock).

3.2.1 Li Yan Embroidery Art Studio

Li Yan Embroidery Art Studio was founded by Ms Li Yan, who is a master of Chinese arts and crafts and a representative inheritor of the intangible cultural heritage of Hunan Embroidery. The studio presents a good example of the combination of traditional embroidery skills and modern innovative design, for which the studio follows two paths: one is the collection of artworks, and the other is integrating traditional embroidery into industrialised products as illustrated in Figure 3. It is a family-based studio. Li Yan is responsible for the production of collectables, which may take several years to embroider into a single piece. Li Yan's daughter Chang Ni is mainly responsible for industrialised embroidery products.
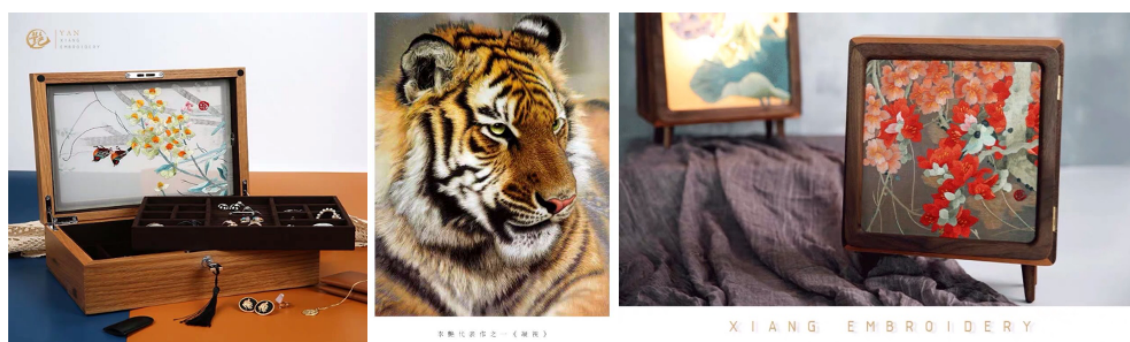

Figure 3. Embroidery work by Li Yan Embroidery Art Studio

Figure 4 summarises the digital technologies used by Li Yan Embroidery Art Studio during their craft making process. Although all the embroidery part in Li Yan Embroidery Art Studio is purely manual, digital equipment and related technologies are involved in their craft making journey. Before embroidery, some digital equipment such as iPads are used for hand-drawn patterns and illustrations, and mobile phones are used for taking pictures and videos. Chang Ni said, 'When I make a product, I usually consciously take pictures of some processes'. A non-contact scanner is used to scan the hand-drawn patterns to get a high-resolution digital version of the picture, which is then printed as a pattern on fabric with digital equipment. Both graphic design software and 3D modelling software are also used in Li Yan's embroidery art studio. Graphic design software such as Adobe® Illustrator and Adobe® Photoshop, have been widely used in their product design, package and promotion as they found that the computer-aided design picture could present their work clearly. 3D modelling software has been applied to the design of products' appearance such as jewellery boxes and refrigerator stickers. Products' dimensions and angles are marked in 3D modelling files, making it convenient for the studio to communicate with manufacturers, reduce time and save communication costs.
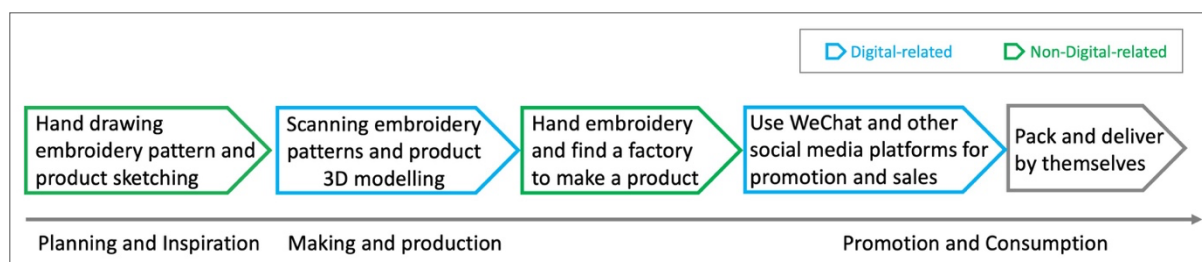
Figure 4. Summary of digital touchpoints by Li Yan Embroidery Art Studio

The studio also uses laser lettering for the customisation of frames as there are some graduation seasons and group gifts that require custom logos. Their previous method was to embroider logos by hand, which both increased the cost and was difficult to complete especially for complicated logos and double-sided embroidery which is reversed when viewed from the back. Therefore, the method of laser engraving on the frame is a very convenient and fast choice for the customisation of products by the studio.

During the making process, the studio regularly posts information and images on WeChat about their new products including materials, models, the manufacturing process, and real shot details regularly to engage with potential customers as illustrated in Figure 5. Through WeChat's video chat function, customers could view the making process and discuss the details of customised work with the studio. Finally, a WeChat Mini Program is used by Yan Studio to sell products online.
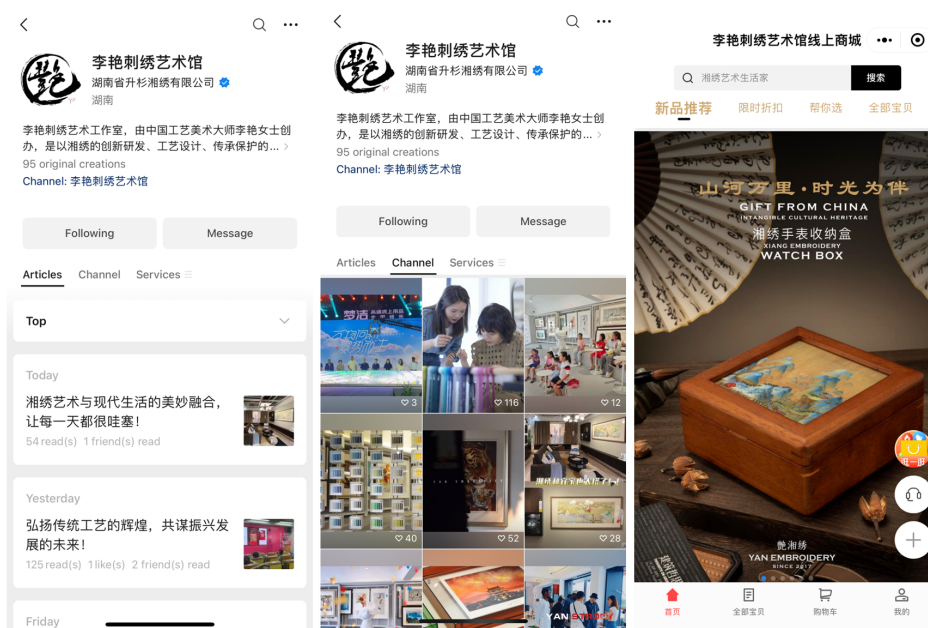

Figure 5. WeChat public account and WeChat mini program for online market

3.2.2   Hand & Lock

Hand & Lock have 250 years' experience embellishing, embroidering and monogramming garments for the UK Royal family, the military and fashion houses including Dior, Hermes and Louis Vuitton. They offer a wide range of services, for which they both embrace computer-controlled machine embroidery and sustain traditional embroidery techniques.

Figure 6 summarises the making journey of a commissioned work or a large order in Hand & Lock, which combines digital-related and non-digital activities. Although the design methods and embroidery techniques that Hand & Lock use are traditional, digital techniques are also involved in facilitating the making in order to minimise mistakes and better present their work to customers before final making. As the studio manager Lucy Howe said, 'If we have a customer and they want a certain design done, it will always mock that up in Adobe® Illustrator first and then it will become digitised and the way it's transferred is by hand, but the original design process is using digital technology, digital software'.
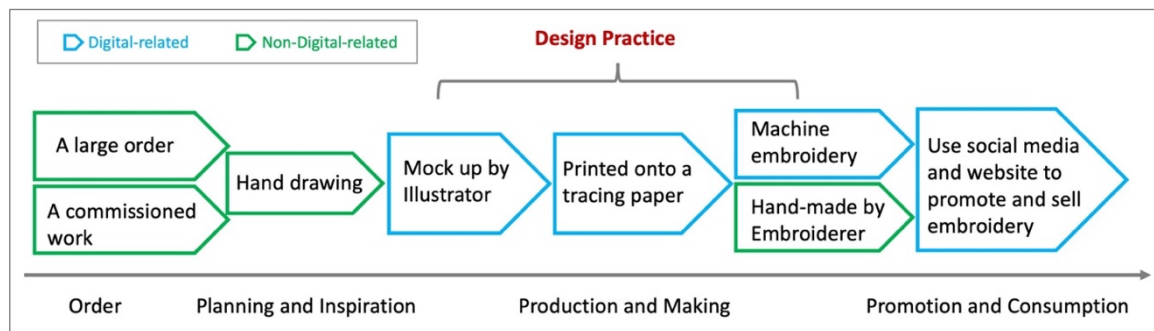

Figure 6. Digital touchpoints used in Hand & Lock

At Hand & Lock's studio there are four digital embroidery machines, an office printer and nine computers in the studio (Figure 7). Machine embroidery offers quality embroidery with added versatility, speed and affordability compared to hand embroidery. For most artworks, Hand & Lock will send a mock-up to customers for approval beforehand. With the best embroidery software and technology, designers can skilfully digitise an image, a logo or a design and programme the machine to render it in embroidery so that customers can visually see what it is going to look like when it is stitched (Figure 8).

Figure 7. Digital equipment (digital embroidery machines and printer) in Hand & Lock's studio

Figure 8. Wilcom embroidery software and machine embroidery work

Hand & Lock believe both digital embroidery and hand embroidery have its advantages and disadvantages. It is difficult to achieve certain techniques for goldwork by digital embroidery. There will always be an industry for hand embroidery in tradition and quality and heritage and the value of it because it is much more delicate. However, the speed of hand embroidery is limited. In fashion they find that digital machine embroidery is more time and cost-effective. More importantly, digital embroidery makes it possible for people with a limited budget to buy embroidery and thus expand the studio's business and customer base. For example, the machine embroidered varsity letters are just 5GBP whilst most of the commissioned hand embroidery costs a thousand GBP (Figure 9). Therefore, it is essential to find a balance between digital and hand embroidery to help them both flourish and be valued. As noted by Studio Manager Lucy Howe, 'The way we get the design even though this is all done by hand it's a very hand-based process there's still a lot of digital components… it's just quite interesting that people might think that it's all hand-done, but you are combining the two (digital and hand), and that's a very traditional way of doing it…'

Figure 9. Machine embroidered varsity letters vs Hand embroidered Vera Wang wedding gown in Hand & Lock. Copyright permission from Hand & Lock

3.3   Comparisons of the Challenges in UK and China

Through our quick ethnographies we identified a number of pragmatic challenges when using digital technologies in craft practice in both China and the UK. A frequent challenge mentioned in our research is that many craftmakers do not think that they are equipped with digital skills in *Production and Making*. For example, participants from the UK mentioned that software including design software is often complex and not always helpful, and they do not know how to make the best use of digital tools to produce craft. Increased provision of digital skills training and awareness would help craftmakers to make better use of production tools, social media, and online marketplaces for their craft practice. However, this is currently lacking in China and the UK. There is also a need to undertake an in-depth analysis of the digital skills needed for contemporary craft. In addition to making skills, craftmakers nowadays need the ability to use digital technologies including software in making and social media to engage with customers in designing craft.

Through our desk research, we found that both the UK and China lacked government policies with an explicit focus on digital technologies for craft, although the two countries have initiatives to preserve traditional craft. Craft, as part of the creative industries in the UK, is situated within the policy framework of culture. A notable exception is the Scottish Register of Tartans Act (2008) which lists all categories of Tartans to help the preservation of Tartans. In

China, handicrafts have received increasing attention from the government. Handicrafts and related cultural activities are managed by a wide range of departments in ministries in China. The government has made significant efforts to protect its cultural heritage using high technology. An example of this is the Digital Dunhuang project for the Dunhuang Mogao Grottoes, a UNESCO World Heritage site. This project involves the digitisation of the grottoes and other temples, creating digital versions of murals, grottoes, and sculptures. However, the preservation of craft is dependent on government support and lacks specific policies to support the craft industry's transformation, especially for craftmakers.

Chinese and UK craftmakers were found to have different access challenges. For example, in China, some participants stated that it is quite challenging for them to connect with some craft accessories' manufacturers during the process of *Production and Making*. Whereas a challenge for digital connections was that there is often no reliable internet connection in rural areas of the UK. Chinese craftmakers mentioned that it is difficult to obtain raw materials online for some handicrafts such as bamboo weaving and ceramics that involve large-sized objects, or require sophisticated making techniques, and these handicrafts are not easily taught online. There is also a lack of digital technologies for craftmakers to connect with manufacturers in order to meet their needs for small batch production. Domestic factories prefer to make large-scale (over 500) orders, and it is also difficult for some craftmakers to find suitable packaging resources in the *Materials and Preparation* stage.

The amount of time and effort it takes to engage with consumers and collaborators, especially online, was found to be problematic for many craftmakers. In the *Planning and Inspiration* stage, Chinese craftmakers highlighted that it is a challenge to collaborate with designers who are provided by third parties, for example, to create large production runs of craft items, because they may have different perceptions about craft and the value of traditional materials and techniques. UK participants noted that it is challenging to engage audiences on multiple social media platforms at the same time and it is difficult to monitor the impact of all this social media effort.

Last but not least, there are also challenges due to people's lifestyles and perceptions of digital technologies across the craft making process. For example, people who are digital natives are more likely to be familiar with digital technologies compared with older generations who were not born in the digital era. Craftmakers have to make a balance between the time and financial cost of digital technologies, making exploration, and generating income. It is a lifestyle choice for some craftmakers to prioritise making and exploration over investment of time and resources in digital technologies. In addition, some craftmakers just do not like digital technologies and prefer to pursue tradition and nature which is often what led them to craft in the first place.

4   Discussion

In response to RQ2 - what impact do digital technologies have on contemporary craft practice - we found digital technologies have gradually changed and enriched the ways of craftmaking, provoking reflection on the nature of craft practice and the connection between craft and design, and drawing attention to how the heritage and culture of craft evolve within the opportunities

and limitations of the digital era. Firstly, digital equipment and software may facilitate or replace labour work within craft practice. For example, in the *Planning and Inspiration* stage, instead of drawing the patterns on fabric by hand, Li Yan Embroidery Art Studio use a non-contact scanner and print the pattern so that their embroiderers no longer need to spend a long time drawing it and can stitch directly on the fabric. Although the studio produces purely hand-made embroidery, digital scanning technology can greatly facilitate the making process as it can quickly print various patterns and free the craftmaker's hand from drawing complex patterns repeatedly. More importantly, the scanning technology allows craftmakers to pay more attention to the design of patterns and their final work. Similarly, in the *Materials and Preparation* stage, laser cutting and design software helps Tatty Devine, a handmade digital jewellery company, to cut acrylic (plastic) jewellery pieces before assembling them by hand. The iconic laser cut acrylic has become the essential making material and the key characteristic of the company's jewellery. Without laser cutting and design software, all the jewellery pieces would have to be cut manually, and it would not be possible to make a wide range of colourful jewellery quickly (Figure 10). In the *Production and Making* stage, digital production tools such as machine embroidery and computer-assisted looms can help craftmakers to achieve quicker and mass production than by hand. As discussed above, part of or all the craft making processes may be replaced or augmented by digital technologies, which not only enrich the ways of craft making, but also may have the potential to challenge and disrupt what is meant by craft.

Figure 10. Tatty Devine's iconic laser cut acrylic (plastic) jewellery

Craft stakeholders who participated in our investigation were concerned that introducing digital technologies into the *Making and Production* stage may conflict with consumers' perceptions of craft's hand-made nature. And yet, as noted by craftmakers, digital tools and technology are critical to many crafts nowadays, such as computer-assisted loom, machine embroidery, and electronic kilns. It is worth returning to the definition of craft - a skilled activity including planning, exploring materials, producing functional objects and embracing cultural heritage – and reflecting on how the ways of craft making may change in the digital era. The key here is whether and how craft practice can reflect and inherit the characteristics of craftsmanship. For instance, instead of making a mould of the teapot's handle by hand, which is difficult to change and time-consuming to make, digital software can easily modify a teapot's model and print it using a 3D printer, which means that the mould of the teapot's handle can be made much more quickly. Although digital making and production have replaced the hand-made mould process in *Production and Making*, the process of exploring the shapes of the teapot's handle by

sketching epitomises the exploratory spirit of craft in the *Planning and Inspiration* and *Materials and Preparation stages*.

Indeed, the distinction between design and craft remains contentious and opaque in the digital age. Contemporary craft increasingly considers and responds to the needs and requirements of customers, for example, more personalised and unique products (Bunnell, 2004), bringing it closer to design. Meanwhile, whilst the Arts and Crafts Movement emphasised the rebirth of craft as a distinct art form after the European Industrial Revolution (Adamson, 2010), contemporary craft increasingly produces objects for daily use in response to market preferences. In craft production, digital production machinery can meet the demand for mass production and save time as well as cost, for example, becoming an indispensable part of Hand & Lock's embroidery work business which complements their traditional embroidery sales. The digitalisation and mass production of craft also means that some craftwork such as ceramics and textiles become industrialised (Chittenden, 2018). In this way, the very nature of craft may be seen by some as coming full circle to contradict its roots as a reaction against the mechanisation of the European Industrial Revolution. However, craft skills including exploration with materials and embracing culture are still unique characteristics which we find craftmakers cherish. What contemporary craftmakers often need to do is find a way to balance the hand-made with the digitally produced so that their humanity is present in the final piece. For example, Li Yan's embroidered lamps (see Figure 11) combine hand embroidery with laser cut materials to create pieces which are unique, charismatic, and at the same time affordable and (relatively) easy to produce.

Figure 11. Representative craftwork that integrating embroidery into functional products

The affordances of digital technologies may constrain the range of crafts which flourish in the digital era. For example, we found that some handicrafts such as bamboo weaving are not feasibly designed, taught, or produced using digital technologies – there is no specialist software for bamboo designing, there are no machines that can easily produce one-off bamboo weaving, and teaching the three-dimensional skill of weaving is problematic online. Over time the inherent limitations of digital technologies may shift the emphasis of craft to those sectors which can be readily facilitated by digital technologies. Potentially some crafts that are not amenable to digital technologies may disappear as the experts dwindle in numbers or become niche craft or even art forms practiced by a few skilled craftmakers who pass on their knowledge by hand in the centuries old ways. In contrast, those crafts that suit the contrainsts of digital technologies may flourish as barriers to access and training are reduced, for example,

the increasing use of digital design software and laser cutters to produce affordable and unique jewellery.

To us, what is clear from our research is that using digital technologies in new ways in craft is inherently part of the craftmakers' exploration process and can become part of craft production in the same way that mechanical technologies have. Indeed, exploring digital technologies and how they can be combined with craft practice was reported by our participants to be in essence part of what craft is about – exploring materials and tools. However, what has changed in the digital era is that whereas mechanical technologies support the physical manipulation of the craft by the human hand, digital technologies can completely decouple the hand from the craft. This may increase the importance of design in the *Planning and Inspiration* stage increases when making craft in the digital era as the machine may replace physical and laborious work in the later stages.

Also, it should be noted that for some craftmakers such as the Blue dye maker Zou Liulan or the textile artist Bridget Bailey, their design process may be mixed with their *Making and Production* as a form of unselfconscious design (Alexander, 1964). There are two features of unselfconscious design: i) it is influenced by culture, and ii) design goes with making so that it can deal with making results spontaneously. The process of 'design goes with making' by folk craftmakers is essentially based on embodied cognitive processes between bodies and cultural contexts, and may generate some improvisational design innovation. However, in digital production for craft, all the designs are defined before making and cannot be improvised during making, which is a unique characteristic of traditional hand-made craft. There is a risk that digitisation may challenge the inheritance of embodied knowledge and improvisational making skills which are embedded in craftmakers' making and exploration.

Finally, it is worth noting that since this research was undertaken there has been a meteoric rise in the availability and quality of computer based tools for Artificial Intelligence Generated Content (AIGC) which can produce images based on text and image prompts, and offer potentially unlimited customisation through user interfaces. AIGC will no doubt impact crafts across the making processses. For example, in the *Planning and Inspiration* stage craftmakers might use AIGC to help spark creative ideas or to refine their own ideas. These new digital design tools are already having an impact on craft making with the Chinese silk manufacturer Wansli making a pioneering partnership with an AIGC company to offer AI generated silk patterns to customers. In this way, craftmakers can produce hundreds of design patterns in a few minutes and consumers are able to refine and explore their choices in real-time increasing the speed and efficiency of craft work. Such approaches can increase the speed and variety of craft production and may engage a new generation of consumers with craft. However, the use of AIGC in craft raises questions of the ownership of intellectual property when AIGC is used in craft, how human craft skill is attributed and valued in AIGC training data and the generative outputs produced, and whether the embodied and intangible cultural elements of craft can ever be meaningully captured by AI.

5 Conclusions

This paper presents the results of an investigation into what and how digital technologies are used in craft practice in China and the UK along the craftmakers' making journey. Digital technologies act as a catalyst for the transformation of craft practice in the digital age. Craftmakers now acquire craft skills via online platforms such as YouTube or online universities, and digital technologies enable them to capture inspiration much quicker and for longer. Digital equipment and software provide more possibilities for craft making and reduce hand-made mistakes. The dynamic between craftmakers and their prospective clients is also reshaped by digital technologies, enabling craftmakers to instantly share their creative processes. Customers are more engaged in in the craftmaking journey with digital communication tools, potentially transitioning from mere customers to collaborators, co-designers and even co-makers.

Meanwhile, digital technologies may bring many challenges to craft practice. For example, many craftmakers may have to sacrifice their previous making time to learn digital technologies and design design skills, such as using digital software and managing social media accounts. Therefore, we recommend that craft associations or relevant entities provide targeted support to contemporary craftmakers in efficiently learning these essential digital skills. It is important for most contemporary craftmakers to embrace digital skills and identify new ways to combine craftsmanship with digital elements. There is also a need to ensure that the intrinsic value of traditional, purely hand-made craft, retains its value in terms of cultural heritage in the digital era. Some traditional crafts might wane in the digital epoch, but some may evolve and be preserved in innovative digital or hybrid forms.

This research centred on how skilled craftmakers use digital technologies in craft practice. We found that social media greatly impacts the *Promotion and Consumption* stage of craft making journey, an area which is timely for further investigation. The employment of AIGC within the craft industry also merits further examination as it will likely impact all stages of the craft process from inspiration to consumption. Although this study did not focus on the broader impact of digital technologies on the business aspects of crafting, this topic presents an intriguing avenue for future research.

Acknowledgements

Glossary

Names

Chang Ni 昌妮

Li Yan 李艳

Zou Liulan 邹柳兰

Terms

Aikecheng Wang 爱课程网 - a Chinese online course website

Kuaishou 快手 - a Chinese live streaming platform

Sina Weibo 新浪微博 - a Chinese microblogging website

Taobao 淘宝 - a Chinese online shopping platform

WeChat 微信 - a Chinese instant messaging, social media, and mobile payment app

Zhongguo shougongyi wangluo daxue 中国手工艺网络大学 - an online University of Chinese Craft

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