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Transitioning between Industry and Education:
The Centre for Advanced Textiles (CAT) Case Studies in Digital Textile Printing

Helena Britt, Department of Fashion & Textiles, The Glasgow School of Art
Alan Shaw, Centre for Advanced Textiles, The Glasgow School of Art

Abstract

The Centre for Advanced Textiles (CAT) was founded at The Glasgow School of Art (GSA) in 2000 with a Research Development Grant from the Scottish Higher Education Funding Council. Throughout CAT's existence the facility has been at the forefront of digital textile printing in the United Kingdom, providing a unique interface between industry and education. Equipment has included Stork Amethyst and Trucolor TCP digital printers, Stork Sapphire machines and recent instalment of a Le Meccanica R500 printer with large-scale industrial finishing equipment. Today, CAT exists as a commercial digital textile printing bureau facility, engages in research and knowledge exchange projects and supports learning, teaching and entrepreneurship. This paper presents a collection of case studies whereby CAT is utilised as a platform to transition between industry and education. The case studies will evidence and discuss examples where CAT has provided support for business start ups, engaged in prototyping and production of textile products, worked collaboratively with industry and cultural organisations, connected industry and education to support learning and teaching and facilitated research project engagement, all of which have ultimately led to advances and innovation within the digital textile printing domain. Case studies encompass both local and global examples. The paper will conclude by describing areas for future investigation and activity surrounding CAT, GSA and further potential transitions between the digital textile printing industry and higher education.

Keywords: digital textile printing, Centre for Advanced Textiles, industry, education, enterprise, work placements, knowledge exchange, research, teaching

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Helena Britt, Department of Fashion & Textiles, The Glasgow School of Art
Alan Shaw, Centre for Advanced Textiles, The Glasgow School of Art

Introduction

Existing for the past fourteen years, the Centre for Advanced Textiles (CAT) at the Glasgow School of Art (GSA) was established with a Scottish Higher Education Funding Council (SHEFC) Research Development Grant of £661,000. From the outset the Centre's aims were to provide cutting edge digital textile printing (DTP) facilities for textile design education; investigate the aesthetic, technical and commercial opportunities presented by DTP; operate a commercial bureau service for industry and individuals. This paper focuses on CAT as a mechanism to facilitate transition between industry and education. The wider situation surrounding the formation and evolution of CAT is reviewed, outlining utilisation of DTP in industry and higher education (HE) and agendas emphasising connections between industry and education in the United Kingdom (UK). The specific textile context at GSA is explicated, as is the development of the Centre relating to staffing and equipment. Following this contextualisation, a selection of case studies are described which disseminate various CAT projects and activities, evidencing support for business start-up, undertaking prototyping and textile product production, collaborating with industry and cultural organisations, connecting industry and education to support learning and teaching and facilitating of research project engagement. The concluding section of the paper outlines future areas of CAT and GSA investigation and activity to further advance and innovate within the DTP domain.

Digital Textile Printing Industry Utilisation

During the late 1990s the textile design industry and therefore textile design HE witnessed the proliferation of computers and digital technologies. Although DTP came into existence for the carpet industry during the 1970s, at the time of CAT's inception in 2000, the technology was used by industry primarily for sampling to replicate traditional processes. Potential for product customisation was being touch upon by a handful of designers, for example with Anya Hindmarch's 'Be a Bag' and Pia Mryvold's 'Cybercouture'. In the UK, only a few companies offered DTP services. At the time of setting up CAT, DTP was recognised as having the potential to revolutionise printed textiles, however, high costs, production speeds, inconsistences with print-head technology and pre-treatment methods restricted the process from threatening production of using traditional processes. Vicky Begg has worked for CAT since 2004. Begg came to the Centre after setting up and running one of the first DTP bureaus in the UK. Over the past 10 years there has been a transition from the utilisation of DTP as a sampling process to mimic other methods of

production, to use as a production process primarily for the creation of high-end products. DTP has removed restrictions previously imposed, freeing designers from constraints regarding pattern repeat, maximum number of colours within a design and minimum order requirements. Short print runs and the engineering of prints to product shapes have increased opportunities for experimentation and textile product development. Advances in DTP technology, accessibility to facilities and availability of a larger range of pre-treated fabrics has led to reductions in printing costs and greater choice for those using the process. Digitally printed textiles now feature throughout the collections of high-end designers and are becoming increasingly more common on the high street. Bureau services facilitate DTP by non-textile print specialists and the technology is widely used by those working in other creative industries.

Digital Textile Printing Higher Education Utilisation

By the late 1990s, computer-aided design (CAD) software and peripheral devices were taught as part of some textile design HE programmes. This high cost of investment meant that access to DTP was via external bureaus, the Royal College of Art, London was an exception. Research taking place in higher education institutions (HEIs) explored the creation of innovative visual qualities not previously achievable on fabric (Tang 1997, Briggs 1997). Further topics of investigation surrounding DTP and design included the generation of non-repeating designs (Carlisle 2001, 2002) and printed textile garment integration (for examples see Bunce & Briggs 2001, Townsend 2004, Campbell & Parsons 2005). Cathy Treadaway (2004a, 2004b, 2006) examined the impact of digital imaging technology upon the creative practice of artists and designers operating in the field of surface pattern for printed textiles. In the same year that CAT was established the Center for Excellence in Digital Inkjet Printing of Textiles was formed at Philadelphia University. Today, further centres based in HEIs include the Digital Fashion Lab, London College of Fashion and Textile + Design Lab, Auckland University of Technology. The People's Print, led by staff from Chelsea College of Art, utilises DTP technology to consider and create systems which involve co-creation of textile designs and products. Technological and scientific aspects of DTP technology are investigated in industry and by HE researchers, for examples see Digital Print CIC, University of Leeds. Design focused and practice-based research in HEIs surrounding digital textile printing continues, although not at the same pace as when the technology was in its infancy. Writing in 2005, Schoeser commented that within the UK, undergraduate courses have developed and adapted to encompass the challenges presented by CAD and DTP, with postgraduate programmes offering the potential to further explore technological utilisation. Similarly, the QAA (2008: 5) recognised that undergraduate art and design education had '…responded to, assimilated, manipulated and appropriated the creative potential…' offered by digital technology.

Wider Higher Education Context

At the time of CAT's inception, the HE sector was responding to recommendations prompted by the Dearing Report, including the need to familiarise students with the world of work, consider opportunity for entrepreneurship, support business idea development, form incubator units and provide businesses particularly small and medium sized enterprises (SMEs) with access to information about local HE services (Dearing 1997). Subsequent government policy signalled the introduction of references to work-based learning (Blunkett 1998) and enhancement of interaction between business and HE (Davis 2002, Lambert 2003). Published in 2003, *The Future of Higher Education* stated that links between HE and industry '…were neither as extensive nor as consistent as the government had hoped…' (Adams & Smith 2007: 100) Specifically surrounding the creative industries, there was criticism that from an outsider perspective, curriculum delivery and development appeared progressively more detached from issues in the real world (ADM-HEA & NESTA 2007). Since this time there has been continued drive towards enhancing employability, enterprise and work-related learning. Student work placements, even those lasting a short time, are recognised as beneficial learning experiences and alumni networks can provide valuable contacts for work placement opportunities (McConnell 2008, Clews & Mallinder 2010). Although progress has been made with industry and HE collaboration there has been further drive for enterprise education opportunities (QAA 2012, Wilson 2012). Entrepreneurship is cited as important to economic growth (Williamson 2013) and there is ambition in Scotland to create 'Entrepreneurial Campuses' (Mason 2014).

Alongside the evolution of the employability and enterprise agendas, HE has witnessed continued emphasis on research and growth in knowledge exchange activity. At the time of CAT's inception, expansion of postgraduate provision, increased funding for research, continued research assessment submission and the formation of a research council specifically for Arts and Humanities has prompted further research activity. Developing and sustaining a research culture has become an economic necessity for institutions. Research benefits teaching and enhancing links between the two has become an area of focus over recent years (Wareham & Trowler 2007). A model has been proposed which positions undergraduate students as researchers to become fully connected within the research cultures of HEIs and increase student engagement (Taylor & Wilding 2009). This proposition is supported by the '…notion of an inclusive academic community where learners, teachers and researchers are seen as scholars and collaborators in the common pursuit of knowledge.' (Taylor & Wilding 2009: 3) More recently, government has requested that HEIs '…look again at how they work with business across their teaching and research activities, to promote better teaching, employer sponsorship, innovation and enterprise.' (Wilson 2012: 13)

Local Higher Education Context

GSA is a small specialist institution and one of the few remaining art schools in the UK, with approximately 1,900 students (GSA 2014). As a subject of study, textile design has existed at GSA since 1845. The four year BA (Hons) Design – Textiles programme ran until 2013, when the BDes (Hons) Fashion & Textile Design programme was phased in, offering a new fashion pathway alongside the textile pathway with the specialisms of weave, knit, print and embroidery. The MDes Textiles as Fashion programme commenced in 2006 and has recently revalidated to become the MDes Fashion & Textiles programme. Within the Department of Fashion & Textiles the undergraduate programme has approximately forty students per year, whereas the masters programme has approximately twelve students per year. Doctoral research projects in fashion and textiles have existed at GSA since 2001. The initial CAT grant funded a PhD student (Britt 2008) and two further projects surrounding DTP have been completed (Carden 2009, Madonald 2013). For a period of time CAT employed a Centre Director and then a Research Fellow. There is currently a Centre Manager, Bureau Coordinator, Finishing Assistant and Administrative staff. Initially, the equipment installed at CAT included Stork Amethyst and Trucolor TCP digital printers, a Stork pressure steamer, domestic washing machine, tumble dryer and small rotary iron. Due to customer demand and the need to increase production capacity these machines where upgraded in 2004 with two Stork Sapphire digital printers, a star bullet steamer and industrial finishing equipment. Although acid inks have been used in the Sapphire machines, reactive inks are the primary dyestuff used. Campus redevelopment has meant that the Centre has been located on three sites since its formation. Today it is situated on the ground floor of GSA's Reid Building, which opened to the public in April 2014. This final move coincided with the purchase of new equipment a La Meccanica R500 printer and SETeMa E-Wash machine/Portafix (production steamer) to increase production capacity.

Centre for Advanced Textiles (CAT) Case Studies in Digital Textile Printing

CAT was formed within the evolving wider and local contexts described. This paper provides an opportunity to disseminate and reflect upon examples of CAT projects and activity, focusing specifically on connections between industry and education. The examples are by no means inclusive of everything that CAT has initiated and worked on, however they are intended to provide comprehensive insight into a range of endeavours. Case study methodology has been adopted as this provides a means to compare examples of projects using multiple sources of evidence, such as textile samples, lengths and products, digital design files, photographs, exhibits, interviews with collaborators, trade articles, press features, promotional and teaching material. The background, aims, intentions, processes, outcomes and advantages of each case study are described. Case studies are analysed and key findings discussed.

Case Studies: Support for business start-ups

Fiona Douglas, Bluebellgray

Fiona Douglas graduated from GSA's undergraduate textile design programme in 2005. Prior to setting up Glasgow-based Bluebellgray in 2009, Douglas worked as head designer for a large interior textiles company. Bluebellgray specialises in the production of hand-painted floral designs for interiors and accessories. Douglas (2012) elected to opt for DTP due to the ability to reproduce accurately hand painted qualities on fabric without compromising on scale or colour. DTP permitted the production of a collection of designs, whereas if this company, when starting up had used traditional printing processes the production of only one design would have been affordable (Douglas 2012). Initially, Douglas came to CAT to test samples of designs, progressing to short runs of textile lengths and fabric for make-up into products. CAT staff worked with the client to transfer watercolour paintings onto fabric. As a graduate of GSA Douglas received a reduced printing fee. This client wanted to print onto a linen base fabric, different from those currently available from pre-treated fabric suppliers. Working with Douglas the required fabric was purchased, CAT outsourced pre-treatment and undertook colour testing to ensure accurate reproduction. In 2011, Blubellgray launched digitally printed textiles and products at trade shows including Maison Object, Paris and Tent, London. Douglas explains reasons for electing CAT when starting up:

> *CAT offers great service and great quality. We work to very tight deadlines and being able to print a quality product…within a couple of weeks is vital...[CAT's location] is an added bonus…they are always on hand to discuss our needs and ideas. They are at the forefront of digital printing and true experts in their field.*
> (Douglas 2012).

Since working with CAT Bluebellgray has continued to grow, exporting worldwide and supplying to retailers such as John Lewis and Liberty in the UK, Bon Marche in Paris and Mitsukoshi, Japan.

Shilo Engelbrecht, Älv Textiles

As a fine art graduate focusing on fashion and textiles, Shilo Engelbrecht came from Australia to undertake a work placement at CAT in 2012. The CAT work placement scheme has existed since 2005. Placements vary in duration from a few weeks up to a couple of months depending on the applicant, their suitability and availability. Placements are unpaid but participants receive a substantial amount of printing credit related to placement duration to be used at CAT when required. Engelbrecht (2013) undertook a 3-month CAT placement as part of a journey around

Europe, during which time she created a collection of new work featuring 'spontaneous' paintings which formed the basis of her new textile collection and launched Älv Textiles (figure 1).

Figure 1: Älv Textiles products by Shilo Engelbrecht, digital prints on linen, 2014.

Working with scans of paintings, CAT have undertaken small-scale sampling on cotton, linen and silk base fabrics. Through the Älv Textiles website Engelbrecht offers textiles by the metre and digitally printed products including bags, scarves, napkins, table cloths and cushions. Working from her studio in Cambridge, Englebrecht uses CAT to fulfil her DTP production requirements. Finished prints are dispatched from CAT to Cambridge, London, Sweden and Australia for product make-up, exhibitions and distribution. Due to the understanding gained through the work placement experience, relationships formed with CAT staff and continued support through DTP services, Älv Textiles continues to grow. The Centre benefited from Engelbrecht's contribution during her work placement and increased turnover due to her use of the CAT Digital service (www.catdigital.co.uk).

Case Studies: Prototyping and textile product production

Classic Textiles and Living Union

Established in 2003 by CAT, Classic Textiles (www.classictextiles.com) accurately recreates twentieth century textile designs using DTP technology. With the consent of the designers' estates, printed textile designs are faithfully reproduced and printed to order. There are four collections within the Classic Textiles range – Lucienne Day, Robert Stewart, Sylvia Chalmers and Lana McKinnon. The creation of each collection is similar in approach involving archival and historical investigation, photographing, scanning, digital redrawing of designs and colour testing, with some variation depending on availability and access to original artworks and fabrics. Classic Textiles fabrics are distributed worldwide and are used for a variety of applications. Over the past year Alan Shaw has been working with The Lollipop Shoppe to develop unique Robert Stewart products for

the Living Union brand. During the 1940s Stewart became Head of Printed Textiles at GSA, he then went onto to become Head of the School of Design and Deputy Director. Throughout his thirty-five years at GSA Stewart was a prolific designer well known for his textiles of the 1950s for Liberty, Pringle and Donald Brothers. Living Union is a premium British lifestyle brand, working collaboratively to develop products. Shaw has gained consent from the Stewart family to create a further colourway of Stewart's 'Raimoult' design (figure 2), print other designs for use as cushions and produce a limited addition run of two of Stewart's wall hangings which have never before been reproduced. Shaw has undertaken sampling and worked with manufacturers to prototype products and undertake production using Stewart's fabric for the Living Union brand. The newly created products will retail through The Lollipop Shoppe in the UK and through the Living Union website.

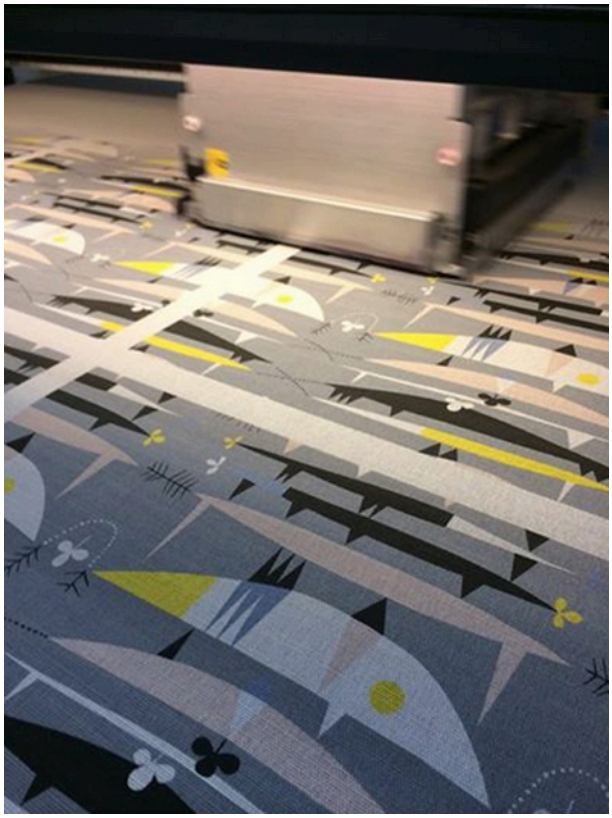

Figure 2: 'Raimoult' Design by Robert Stewart, Classic Textiles for Living Union, digital print on linen union, 2014.

London Fashion Week Collections

Since 2001, CAT Digital has worked with the fashion industry to produced textiles for London Fashion Week (LFW). This type of work began in 2001 with clients such as Fake London and Frost French. CAT produced initial samples and then sample lengths that were made up into garments which were presented to buyers. Full production of the printed fabrics was outsourced to rotary printers due to the necessity to produce larger volumes at lower cost. CAT produced all of the engineered prints shown at LFW, for the first and subsequent collections (2003-2004) of GSA graduate Jonathan Saunders. Likewise, CAT worked with Edinburgh College of Art graduate Holly Fulton to redraw digitally hand rendered artwork for engineered designs which were then printed

onto silk and jersey (2003-2005). CAT produced engineered prints for Giles Deacon (2004-2005), the Jeff Koons prints for Stella McCartney in 2005 and for the student collections of Mary Katrantzou (2006-2008). When Mulberry collaborated with illustrator Julie Verhoven in 2007, CAT staff developed hand drawn artwork and garment shapes to produce engineered prints for garments and bags. Topshop, and in particular the Unique and Kate Moss ranges, have been regular clients of CAT since 2009, production tends to be for sampling garments although in certain instances larger runs have been produced. A similar relationship has developed with ASOS over recent years. Clients benefit from CAT's short turnaround times, expertise in artwork preparation, colour matching, engineering prints to product shapes, no minimum quantity order requirement and extensive base fabric selection. GSA alumni and graduates from other HEIs use the services of CAT and often these connections can lead to work placement opportunities.

Case Studies: Collaboration with industry and cultural organisations

Iona Crawford

A Scottish Funding Council (SFC) Innovation Voucher (£5,000) was awarded in 2010 to CAT to work collaboratively with the Scottish fashion designer Iona Crawford. The aim of the project was to develop a new collection of digital prints on linen/cashmere fabric. As a fashion designer, Crawford required CAT's assistance in developing selected imagery into repeating designs. CAT was responsible for testing chlorination, pre-treatment, digital printing and post-treatment processes. The methods used for the most successful technical samples were utilised to print Crawford's textile designs, which she manufactured into garments (figure 3).

Figure 3: Dress by Iona Crawford, digital print on linen/cashmere, 2010.

The collection was showcased at national and international events, promoting Crawford as a designer using Scottish weavers, printers and finishers for collection production (Shaw 2010). CAT has also worked on SFC Innovation Voucher projects with GSA graduates, Timorous Beasties and Morton Young and Borland. Involvement in these projects enhanced CAT's reputation for knowledge exchange; the exploratory nature made possible due to CAT's unique position as research facility and business located within an educational institution.

Glasgow 2014 – XX Commonwealth Games

For the recent Commonwealth Games, CAT worked with organisers and designers of various events and products to meet their DTP needs. The 310 Team Scotland athletes wore outfits designed by GSA graduate Jilly Blackwood, comprising a tartan fabric and textural printed design (Blackwood 2014). The printed component was sampled and CAT produced 1,500 metres of the final design. The outfits of the 39 female medal bearers were designed by Kerry Nixon and printed at CAT (Glasgow 2014). Using the design of the official games tartan, CAT worked with Nixon and a pattern cutter to carry out custom pre-treatment, colour matching, engineering of the design to the garment shapes and final print production. In total 2,000 metres of the printed tartan was produced and used with other fabrics printed by CAT for the opening and closing ceremonies, other exhibitions and cultural events. Although lower production costs could be sought,

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Commonwealth Games organisers and the designers with who CAT collaborated wanted to work with a local company and for the production to remain in Glasgow.

Case Studies: Connecting industry and education to support learning and teaching

Andy McDonald, Digital Customization

As part of his PhD research, Andy McDonald, working with supervisor JR Campbell, received a £20,000 Technology Strategy Board (TSB) Feasibility grant in 2008 to work with Timorous Beasties. 'BeastiesLAB: The digital design ecosystem' explored the potential benefits of a digital workflow based on co-creation (McDonald 2010). This involved the development of a retail installation that invited customers to create their own cushion by interacting with Timorous Beasties print design components. Once the design was completed the product could be ordered, printed on demand by CAT, manufactured and dispatched (http://vimeo.com/9577131). The prototype system offers greater flexibility, facilitates co-creation and results in a unique product (McDonald 2010). Following on from this, McDonald received an SFC Innovation Voucher (£5,000) to work with Natasha Marshall Ltd (a GSA graduate company), to design and test a multi-touch interface for customised textile design (http://vimeo.com/28024125). The project provided valuable insights into on-demand production, improved the software framework on which the interface was developed and explored the balance of control between designer and customer (McDonald 2010). McDonald benefited from CAT's previous connections to the companies involved in the projects and support with securing external funding. The projects permitted McDonald to undertake industry engaged practice-based learning relevant to his PhD study. The analysis of this work, contributed to the creation of new knowledge within the DTP domain (Macdonald 2013).

Helena Britt, GSA Undergraduate Printed Textiles Curriculum

A further PhD, funded by the initial CAT SHEFC grant, investigated the role of the designer educator in the development of digitally designed and digitally printed textiles (Britt 2008). The study utilised, reflected upon and analysed design and teaching practices, alongside other methods of data collection from research participants. The design and print of interior textile collections using CAT was central (figure 4).

Figure 4: Ribbon by Helena Britt, digital print on leather, 2006.

As the printed textiles Lecturer at GSA, Britt's PhD study, interaction with CAT staff, projects and business activities informed and continued to enhance the content of GSA undergraduate printed textiles curriculum. In Year 2, students are introduced to CAT, an overview of the DTP is provided, printed samples shown and examples discussed. Over time CAD skills develop through workshops and utilisation. Good workshop practice in terms of recording and analysing technical, material and colour exploration is promoted throughout the programme. Technical workshops cover pre and post-treatment processes and encourage combinations of digital and hand processes. Through group and individual feedback, emphasis is placed on individual image creation, innovative base substrate utilisation and exploration of potential DTP product application. Classic Textiles fabrics are used as a teaching aid to demonstrate drawn qualities, repeat and scale. These fabrics also form the basis of technical workshops during which students' reconstruction designs using dyeing and screen-printing processes. MDes students utilise the services of CAT due to the viability of DTP for fashion collection production and ability to engineer prints to garment shapes. CAT staff provide guidance to students on an individual basis. GSA graduates, Laura Boomer and Stuart McKirdy are employed to work as part of the CAT team.

Case Studies: Facilitated research project engagement

Mackintosh Reinterpreted

This project involved CAT staff, working with the Hunterian Art Gallery and University of Glasgow,

to reinterpret and create a collection of digitally printed textiles from the textile sketches of Charles Rennie Mackintosh. While the architecture and furniture designs of Mackintosh are well known, the textiles he designed are largely unknown. Using high quality scans of Mackintosh textile designs held by the Hunterian Art Gallery, the CAT team explored the colour matching process. The team worked individually to create new designs from original textile design sketches. The project resulted in an exhibition in 2008 of newly created printed textiles and archive sketches (figure 5), an exhibition catalogue (Campbell 2008), series of talks and schools workshops.

Figure 5: Mackintosh Reinterpreted Exhibition, Hunterian Art Gallery, University of Glasgow, 2008.

The project was funded by The Monument Trust. The resulting collection of fabrics was also exhibited at Hill House, Helensburgh in 2009. Today these fabrics are on permit display at the Mackintosh Interpretation Centres, France. The project publicised the lesser-known textile designs of Mackintosh and contributed to understanding surrounding utilisation of archive resources for textile design practice.

Digital Art Capture

The Digital Art Capture (DAC) project was a multidisciplinary pilot study (2008-2010) funded by the TSB under the Creative Industries Fast-Track Scheme. It received £50,000 funding distributed between project partners AutoEye Ltd, University College London, University of Northumbria, The Glasgow School of Art, The Henry Moore Foundation, TATE, Natasha Marshall Ltd and Angela

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Flowers PLC. The DAC project was driven by creative sector requirements for detailed digitisation of two-dimensional artwork, particularly large scale, that could not readily be captured using standard scanning and digital photography. The purpose of the project was to develop a prototype system to advance affordable high-resolution digital image capture capabilities for fine art, design and heritage artefacts. CAT contributed to the project by providing expertise in terms of design and craft sector requirements. Testing the developed software and equipment was undertaken, textile samples were scanned, processed, digitally printed and analysed to provide feedback surrounding usability, scan quality, impact of textural qualities, software performance, light conditions and potential utilisation. This project facilitated working within a multidisciplinary team comprising industry, HE and cultural sector partners, promoting CAT, its services and expertise to new markets.

Conclusions and Future Directions

The review featured at the beginning of this paper highlights that there is still more to be done to further connect industry and education. However, through the CAT case study examples it is evident to see engagement in activity and projects, which respond to the wider contextual policies and agendas described. CAT exists as a mechanism which transitions between industry and education to advance DTP utilisation. The Centre's position is unique as it operates as a business within an HE, as a facility for research and knowledge exchange and as a site for digital textile printing skill development, learning and teaching. Today, DTP utilisation continues to grow. With recent investment in equipment to increase production capacity, CAT is positioned to exceed current turnover. The headings below denote key areas for future activity and investigation, an explanation is provided under each heading.

Enhancing Employability and Enterprise

Building on the examples provided in this paper and the CAT digital blog, work could be undertaken to produce a collection of case studies, which describe how businesses using CAT began and continue to expand. Case studies could cover initial ideas, market identification, prototyping, funding, pricing and promotion. Seminars could take place using the case students and, if possible with input from CAT clients. Targeted at GSA students, graduates and individuals interested in starting a business, workshops could focus on entrepreneurial idea development and the next steps forward. Extending and formalising the insights gained from working with CAT clients means that local enterprises and international customers could further connect with HE and the wider creative community.

Work Placements and Residences

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The CAT work placement scheme benefits participants by providing opportunities to enhance DTP and work-related skills. CAT, to carry out necessary tasks, uses the participant. For GSA students work placements are optional, taking place during holiday periods. The placement scheme could be integrated further into the curriculum with each printed textiles student spending a minimum of 1 week working at CAT. Time is required to introduce and train participants to ensure that they can undertake the required tasks. To alleviate CAT staff time the work placement scheme could operate on a rolling basis whereby the outgoing student communicates the necessary insights onto the incoming student, facilitating work-related peer learning. A designer in residence scheme could run alongside the placement scheme for graduates and those wishing to gain experience while working on a project of their own.

From Prototyping to Production

There is opportunity for Classic Textiles to grow with collections developed from the unique resources held by GSA's Archives and Special Collections. There is also scope to create a 'Future Classic Textiles' brand with designs selected from the graduating cohort and made available to order online. Currently, a new CAT Digital website is being trialled. Building on the existing online order function, Shaw has been working with web developers and software programmes to create a new online fulfilment system. Responding to customer demand and monitoring existing use has led to the design and construction of a site through which numerous designs can be uploaded and sent to print onto any number of the forty base fabrics that CAT offer. Once uploaded, submitted and paid for online, the customer's order links directly to the digital textile printer and the design files are added to the appropriate fabric queue. The system generates the customer's receipt and packaging labels, streamlining the administration process. There is potential to extend this system to integrate full product production, working with a network of local manufacturers.

Collaboration with Industry

There are further knowledge exchange projects in the initial stages, for example a project will extend the work undertaken to investigate DTP of Scottish cashmere. Other possibilities exist to work with Scottish textile manufacturers to innovate with DTP. However, the balance between dividing staff time to fulfil the needs of CAT Digital and work on more exploratory projects is complex. Funding to buyout existing staff time or the employment of a research assistant to focus solely on exploratory projects would facilitate this aspect of the Centre's activity.

Digital Textile Printing Learning and Teaching

There are plans in place to use a Stork Sapphire printer solely for experimentation, meaning that individuals, particularly GSA students, could learn to operate the machine. Dyestuffs, substrates and pre-treatment processes can be tested. If access is extended, GSA students could assist with running the printer and providing insights to others, perhaps a step towards Taylor & Wilding's

(2009) notion of the undergraduate student as researcher. There is scope to extend the input of CAT staff within the GSA printed textiles curriculum, which is currently restricted due to complexities removing staff from their day-to-day roles.

Research Project Facilitation

The case study examples indicate the positive contribution of staff and doctoral researchers to the Centre. This is also evident with the forthcoming publication of a book by a former PHD student (Carden 2015). There is potential for research projects to venture further into international and multidisciplinary territory. Topics for investigation could include process combinations (interactive, sensory and 3D technologies), innovation with design and production workflows and historical resource utilisation for DTP product creation. However, potential projects cannot be formed without the necessary staffing. The outcomes of REF2014 and the trajectory towards REF2020 may assist in furthering this area of CAT activity.

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Figures Captions

Figure 1: Älv Textiles products by Shilo Engelbrecht, digital prints on linen, 2014.
Figure 2: 'Raimoult' Design by Robert Stewart, Classic Textiles for Living Union, digital print on linen union, 2014.
Figure 3: Dress by Iona Crawford, digital print on linen/cashmere, 2010.
Figure 4: Ribbon by Helena Britt, digital print on leather, 2006.
Figure 5: Mackintosh Reinterpreted Exhibition, Hunterian Art Gallery, University of Glasgow, 2008.